Curriculum Book

and

Assessment and Evaluation Scheme

based on

Outcome Based Education (OBE)

and

Choice-Based Credit System (CBCS)

in

Bachelor of Science

B.Sc. (Honours / By Research)
(CS/PHY/CHEM/MATHS)

4 Year Degree Program

Revised as on 01 August 2023
Applicable w.e.f. Academic Session 2023-24

AKS University

Satna 485001, Madhya Pradesh, India

Faculty of Basic Science

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

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Faculty of Basic Science

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Co-ordinator
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AKS University
Faculty of Basic Science
Curriculum of B. Sc. (Honours / By Research) Program
(Revised as on 01 August 2023)

AKS University, Satna

Faculty of Basic Science

Curriculum

of

Bachelor of Science

B.Sc. (Honours/By Research)

(CS/PHY/CHEM/MATHS)

(Revised as of 01 August 2023)
AKS University, Sherganj, Panna
Road, Satna - 485001

AKS University
Faculty of Basic Science
Curriculum of B. Sc. (Honours / By Research) Program
(Revised as on 01 August 2023)

Foreword

From the Desk of the Pro-Chancellor

As the Pro Chancellor of this esteemed institution, it is with great pleasure that I introduce the UG Program to our academic community and beyond.

UG program, often referred to as the "central science," is at the heart of countless innovations and advancements that shape our world. From the molecules that make up the air we breathe to the complex compounds powering modern technology, the study of UG is indispensable to understanding the workings of our universe.

In today's rapidly evolving landscape, the demand for skilled chemists has never been greater. The UG Program offered by our institution is designed to meet this demand by providing students with a comprehensive education that blends theoretical knowledge with practical skills.

Our dedicated faculty members, who are leading experts in their respective fields, are committed to fostering an environment of academic excellence and innovation. Through their mentor-ship, students will not only gain a deep understanding of core chemical principles but also develop the critical thinking and problem-solving abilities necessary to tackle the challenges of tomorrow.

Furthermore, our state-of-the-art laboratories and research facilities offer students the opportunity to engage in cutting-edge research across a variety of sub-disciplines, from physics, chemistry and mathematics. By actively participating in research projects, students will have the chance to contribute to the advancement of scientific knowledge while honing their own research skills.

I am confident that graduates of our UG Program will emerge as leaders in their field, equipped with the knowledge, skills, and passion to make meaningful contributions to society. Whether they choose to pursue careers in academia, industry, or government, they will be well-prepared to address the complex challenges facing our world through the trans-formative power.

I extend my heartfelt congratulations to all the students who have chosen to embark on this journey of discovery and learning. May your pursuit of knowledge in the field of Science be both rewarding and fulfilling, and may you continue to strive for excellence in all your endeavors.

Er. Anant Soni
Pro Chancellor & Chairman
AKS University, Satna

01 August 2023

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From the Desk of the Vice-Chancellor

Dear Students, Faculty, and Stakeholders,
It gives me immense pleasure to announce the launch of the UG Program at AKS University. As we embark on this new academic endeavor, I am filled with excitement and optimism for the opportunities it will provide for our students and the contributions it will make to the field of science.

At AKS University, we are committed to excellence in education and research, and the introduction of the UG Program is a testament to this commitment. This program has been meticulously designed to equip students with the knowledge, skills, and practical experience needed to excel in the dynamic and multifaceted field of science.

Our esteemed faculty members, who are renowned experts in their respective fields, will guide and inspire students throughout their academic journey. Their dedication to teaching and research will ensure that students receive a world-class education that is both rigorous and relevant to the demands of the modern world.

Furthermore, AKS University boasts state-of-the-art laboratories and research facilities that provide students with hands-on experience in conducting experiments and engaging in scientific inquiry. Through experiential learning opportunities and research projects, students will have the chance to explore their interests, deepen their understanding of chemistry, and contribute to the advancement of knowledge in the field.

As Vice Chancellor, I am confident that the UG Program at AKS University will empower students to become good academician and innovators in the field of chemistry. Whether they choose to pursue careers in academia, industry, or research, they will be well-prepared to make significant contributions to society and address the challenges of the 21st century.

I extend my best wishes to all the students who are considering joining the UG Program at AKS University. Your decision to embark on this academic journey is commendable, and I am excited to see the impact you will make in the world of chemistry and beyond.

AKS University, Satna
01 August 2023

Professor B. A. Chopade
Vice-Chancellor

AKS University
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Preface

As the coordinator, Faculty of Basic science, it is my privilege to introduce the UG curriculum, a comprehensive and dynamic program designed to cultivate the next generation of leaders and innovators in the field of science.

UG program lies at the intersection of fundamental scientific principles and real-world applications. It is a subject of immense importance, influencing everything from the development of new pharmaceuticals to the design of sustainable energy solutions. As such, our UG curriculum is built upon a strong foundation of core concepts while also incorporating the latest advancements and trends in the field.

Our curriculum is structured to provide students with a well-rounded education in all major sub-disciplines of chemistry, physics, mathematics, computer science and geology. Through a combination of lectures, laboratory work, seminars, and research projects, students will develop a deep understanding of principles on which science is based and their applications in various contexts.

One of the distinguishing features of our program is its emphasis on hands-on learning and experiential education. Our state-of-the-art laboratories provide students with the opportunity to conduct experiments, analyze data, and solve problems in a real-world setting. Additionally, our faculty members, who are leading experts in their fields, are dedicated to providing mentor ship and guidance to help students succeed both inside and outside the classroom.

Furthermore, our curriculum is designed to foster critical thinking, creativity, and communication skills, which are essential for success in today's rapidly evolving world. Whether students choose to pursue careers in academia, industry, government, or beyond, they will graduate from our program with the knowledge, skills, and confidence to excel in their chosen fields.

I am confident that the UG curriculum will provide students with a trans-formative educational experience that prepares them for a lifetime of learning, discovery, and achievement. I extend my best wishes to all the students embarking on this academic journey, and I look forward to witnessing their growth and success in the years to come.

01 August 2023

Dr. Dinesh K Mishra
Co-ordinator,
Faculty of Basic Science,
AKS University, Satna

AKS University
Faculty of Basic Science
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FACULTY OF BASIC SCIENCE

Introduction

B.Sc. (Hons) Program is a four year undergraduate program divided in eight semesters with 160 credits. This program is designed to provide in-depth knowledge and expertise in sciences. The fundamental science playing important role to improve human life by providing various needful materials and goods used in society with sustainability. There has been unprecedented development in sciences of various disciplines in the last few decades. The industrial practices which are based on sciences are also undergoing sustainable changes and are increasing by adopting recently created knowledge in science. Thus, after long duration greater specialization in undergraduate and graduate curricula interdisciplinary approach now more relevant.

Vision

To provide trained & skilled human resources in the field of physical Science, mathematical science and chemical science as researchers, educators, chemists and assist the industries as well as stakeholders in the world

Mission

M01: To develop skilled educators, researchers and scientists in field of physical science, mathematical science and chemical science.
M02: To develop skillful human resources for industries and businesses based on physical science, mathematical science and chemical science.
M03: To develop complete personality of students by providing student centric teaching and research facilities.
M04: To achieve academic excellence in chemical science through an innovative teaching-learning process.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO01: To develop skills in the students with practical knowledge work and able to solve problem in teaching, research and industrial area of science.

PEO02: To develop R&D temperament among the students for development, innovation and sustainable practices in physical science, mathematical science and chemical science

POE03: To develops ethical principles among the students and commitment of fulfilling international, national and local needs and social responsibilities with his/her professional excellence.

PEO04: Ability to understand the impact of professional chemistry base solutions in societal, economic and environmental contexts and demonstrate knowledge and need for sustainable development

Program Outcomes (PO) for UG Program (CBCS)

After completion of program student will

PO_1	**Knowledge**	demonstrate broad disciplinary knowledge acquired during study

PO_2	**Research Aptitude**	ask relevant/ appropriate questions for identification formulation and analysis the research problems and to draw conclusion from the analysis.
PO_3	**Communication**	communicate effectively on general and scientific topics with the scientific community and with society at large.
PO_4	**Problem Solving**	apply knowledge to solve scientific and other chemistry related problems.
PO_5	**Individual and Team Work**	learn and work effectively as an individual, and as a member or leader of teams in diverse, multidisciplinary settings.
PO_6	**Investigation of Problems**	critically think and apply to analytical reasoning and research based knowledge including design of experiments, analysis and interpretation of data to provide conclusions.
PO_7	**Modern Tool usage**	use and learn techniques, skills and modern tools for scientific practices.
PO_8	**Science and Society**	apply reasoning to assess the different issues related to society and the consequent responsibilities relevant to the professional scientific practices.
PO_9	**Life-Long Learning**	apply knowledge and skills that are necessary for participating in learning activities throughout life.
PO_{10}	**Ethics**	identify and apply ethical issues related to one's work; avoid unethical behaviour such as fabrication of data, committing plagiarism and unbiased truthful actions in all aspects of work.
PO_{11}	**Project Management**	demonstrate knowledge and understanding of the scientific principles and apply these to manage projects.
PO_{12}	**Environment and sustainability**	solve environmental problems related to science

Program Specific Outcomes (PSO's)

The program specific outcomes (PSO's) are the statement of competencies /abilities that describes the knowledge and capabilities of the post-graduate will have by the end of program studies.

After successful completion of UG program, the students will be able to

PSO_1	Deliver detailed functional knowledge of theoretical concepts and experimental aspects of science.

PSO_2	integrate the gained knowledge with various contemporary and evolving areas in physical science, mathematical science and chemical science.
PSO_3	understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomenon-based problems in physical science, mathematical science and chemical science. .
PSO_4	Provide opportunities to excel in academics, research or Industry by research based innovative knowledge for sustainable development in physical science, mathematical science and chemical science.

Consistency/Mapping of PEOs with Mission of the Department

PEO	M1	M2	M3	M4
PEO1	3	2	3	2
PEO2	2	2	2	3
PEO3	2	3	2	1
PEO4	2	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) "-": No correlation

GENERAL COURSE STRUCTURE & THEME

Definition of Credit

1Hours Lecture (L) per weekx15	1 Credit
1Hours Tutorial (T) per week	1 Credit
2Hours Practical (P) per week	1 Credit

Range of Credits:
In the light of the fact that a typical Model Four-year Under Graduate degree program in Basic Science has about 100 credits, the total number of credits proposed for the B.Sc. is kept as 160 considering NEP-20 and UGC guidelines.

Structure of UG Program in Bachelor of Science
The structure of B.Sc. program in science shall have essentially the following categories of courses with the breakup of credits as given:

Components of the Curriculum

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(Program curriculum grouping based on course components)

SlNo	Course Component	% of total number of credits of the Program	Total number of Credits
1	Discipline Core Course (DCC) (Major)	30%	48
2	Foundation Course (FC)/Ability Enhancement Course (AEC)	5%	08
4	Elective course (Minor+DSE)	30%	48 (32+16)
5	Open elective course	15%	24
6	Audit/Vocational Course	7.5%	12
	Field project/Internship/Research Project	12.5%	20
7	MOOC**/NTPL/SWYAM	0%	0
Total		100	160

General Course Structure and Credit Distribution (Curriculum of B.Sc.)

SEMESTER – I

Sr	Subject Code	Group	Subjects	L	T	P	Total Credit
Ability Enhancement Course –Foundation Course (compulsory paper)							
1	0FO101	Foundation	Commutations skills	2			2
	0FO102	Foundation	SDG	2			2
Major Subject- Choose anyone							
	1CS101	Major	Fundamentals of Computer	4			4
	1CS151	Major	Fundamentals of Computer Lab			4	2
	1MS101	Major	Algebra, Vector Analysis and Geometry	6			6
	1PH101	Major	Mechanics and General Properties of Matter	4			4
	1PH151	Major	Mechanics and General Properties of Matter lab			4	2
	1CH101	Major	Analytical Chemistry	4			4
	1CH151	Major	Analytical Process & Techniques lab			4	2

Minor Subjects- Choose anyone							
2	2CS101	Minor	Fundamentals of Computer	4			4
	2CS151	Minor	Fundamentals of Computer Lab			4	2
2	2MS101	Minor	Algebra, Vector Analysis and Geometry	6			6
	2PH101	Minor	Mechanics and General Properties of Matter	4			4
	2PH151	Minor	Mechanics and General Properties of Matter lab			4	2
	2CH101	Minor	Analytical Chemistry	4			4
	2CH151	Minor	Analytical Process & Techniques lab			4	2
	2GO153	Minor	Physical Geology	3			3
	2GO153	Minor	Physical Geology Lab			2	1
Generic/Open Elective Course (Choose Anyone)							
	3CS101	Open Elective	Fundamentals of Computer	4			4
	3CS151	Open Elective	Fundamentals of Computer Lab			4	2
	3MS101	Open Elective	Algebra, Vector Analysis and Geometry	6			6
	3PH101	Open Elective	Mechanics and General Properties of Matter	4			4
	3PH151	Open Elective	Mechanics and General Properties of Matter lab			4	2
	3CH101	Open Elective	Analytical Chemistry	4			4
	3CH151	Open Elective	Analytical Process & Techniques lab			4	2
	3GO153	Open Elective	Physical Geology	3			3
	3GO153	Open Elective	Physical Geology Lab			2	1

Total Credits =	**22**

SEMESTER – II

Sr	Subject Code	Group	Subjects	L	T	P	Total Credit
Ability Enhancement Course –Foundation Course (compulsory paper)							
1	0FO201	Foundation	Environmental Studies	2			2
2	0FO202	Foundation	IKS	2			2
Major Subject-Choose anyone							
1	1CS201	Major	Programming Methodologies & Data Structures	4			4
1-P	1CS251	Major	Office Tools & Programming Methodology Lab			4	2
1	1MS201	Major	Calculus and Differential Equations	6			6
1	1PH201	Major	Thermodynamics and Statistics Physics	4			4
1-P	1PH251	Major	Thermodynamics and Statistics Physics lab			4	2
1	1CH201	Major	Fundamentals of Chemistry	4			4
1-P	1CH251	Major	Qualitative and Quantitative Chemical Analysis lab			4	2
Minor Subjects- Choose any one							
2	2PH201	Minor	Thermodynamics and Statistics Physics	4			4
	2PH251	Minor	Thermodynamics and Statistics Physics lab			4	2
2	2CH201	Minor	Fundamentals of Chemistry	4			4

	2CH251	Minor	Qualitative and Quantitative Chemical Analysis lab			4	2
	2CS201	Minor	Programming Methodologies & Data Structures	4			4
	2CS252	Minor	Office Tools & Programming Methodology Lab			4	2
2	2MS201	Minor	Calculus and Differential Equations	6			6
	2GO201	Minor	Crystal and Mineral Sciences	4			4
	2GO251	Minor	Crystal and Mineral Sciences Lab			4	2
Generic/Open Elective Course (Choose Any one)				**4**			**4**
3	3PH201	Open Elective	Thermodynamics and Statistics Physics	4			4
	3PH251	Open Elective	Thermodynamics and Statistics Physics lab			4	2
	3CH201	Open Elective	Fundamentals of Chemistry	4			4
	3CH251	Open Elective	Qualitative and Quantitative Chemical Analysis lab			4	2
	3CS201	Open Elective	Programming Methodologies & Data Structures	4			4
	3CS252	Open Elective	Office Tools & Programming Methodology Lab			4	2
	3MS201	Open Elective	Calculus and Differential Equations	6			6
	3GO201	Open Elective	Crystal and Mineral Sciences	4			4
	3GO251	Open Elective	Crystal and Mineral Sciences Lab			4	2
Total Credits =							**22**

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SEMESTER – III

Sr	**Subject Code**	**Group**	**Subjects**	**L**	**T**	**P**	**Total Credit**
Skill Enhancement Course (SEC) or Vocational Course							
1	0SE301	Skill Enhancement Course (SEC) or Vocational Course	Web Designing	2		4	4
Major Subject-Choose anyone)							
1	1CS301	Major	Computer Networks and Information Security	4			4
1-P	1CS352	Major	Computer Networks lab			4	2
	1MS301	Major	Abstract Algebra and Linear Algebra	6			6
1	1PH301	Major	Waves and Optics	4			4
1-P	1PH351	Major	Waves and Opticslab			4	2
1	1CH301	Major	Reactions, Reagents and Mechanisms in Organic Chemistry	4			4
1-P	1CH351	Major	Organic, Qualitative Analysis, Reactions and Synthesis lab			4	2
Minor Subjects- Choose any one							
2	2PH301	Minor	Waves and Optics	4			4
	2PH351	Minor	Waves and Optics lab			4	2
2	2CH301	Minor	Reactions, Reagents and Mechanisms in Organic Chemistry	4			4
	2CH351	Minor	Organic, Qualitative Analysis, Reactions and Synthesis lab			4	2
	2CS301	Minor	Computer Networks and Information Security	4			4

	2CS352	Minor	Computer Networks lab			4	2
2	2MS301	Minor	Abstract Algebra and Linear Algebra	6			6
	2GO301	Open Elective	Igneous and metamorphic Petrology	4			4
	2GO353	Open Elective	Igneous and metamorphic Petrology Lab			4	2
Generic/Open Elective Course (Choose Any one)							
3	3PH301	Open Elective	Waves and Optics	4			4
	3PH351	Open Elective	Waves and Optics lab			4	2
	3CH301	Open Elective	Reactions, Reagents and Mechanisms in Organic Chemistry	4			4
	3CH351	Open Elective	Organic, Qualitative Analysis, Reactions and Synthesis lab			4	2
	3CS301	Open Elective	Computer Networks and Information Security	4			4
	3CS352	Open Elective	Computer Networks lab			4	2
	3MS301	Open Elective	Abstract Algebra and Linear Algebra	6			6
	3GO301	Open Elective	Igneous and metamorphic Petrology	4			4
	3GO353	Open Elective	Igneous and metamorphic Petrology Lab			4	2
Total Credits =							**22**

SEMESTER – IV

Sr	**Subject Code**	**Group**	**Subjects**	**L**	**T**	**P**	**Total Credit**

Skill Enhancement Course (SEC) or Vocational Course							
1	0SE401	Skill Enhancement Course (SEC) or Vocational Course	Desktop Publishing (DTP)	2		4	4
Major Subject-Choose anyone							
1	1CS401	Major	Object Oriented Programming with Java	4			4
1-P	1CS451	Major	Java Programming Lab			4	2
1	1MS401	Major	Advanced Calculus and Partial Differential Equations	6			6
1	1PH401	Major	Electricity, Magnetism and Electromagnetic Theory	4			4
1-P	1PH451	Major	Electricity, Magnetism and EMT lab			4	2
1	1CH401	Major	Transition Elements, Chemi-energetic, Phase Equilibria	4			4
1-P	1CH451	Major	Metal Complex Preparation, Thermochemistry & Phase Equalibria Experiments			4	2
Minor Subjects- Choose any one							
2	2CS401	Minor	Object Oriented Programming with Java	4			4
	2CS451	Minor	Java Programming Lab			4	2
2	2MS401	Minor	Advanced Calculus and Partial Differential Equations	6			6
	2PH401	Minor	Electricity, Magnetism and Electromagnetic Theory	4			4
	2PH451	Minor	Electricity, Magnetism and EMT lab			4	2
	2CH401	Minor	Transition Elements, Chemi-energetic, Phase Equilibria	4			4
2	2CH451	Minor	Metal Complex Preparation, Thermochemistry & Phase Equalibria Experiments			4	2

	2GO401	Minor	Sedimentary Rocks and Stratigraphy of India	4			4
	2GO451	Minor	Sedimentary Rocks and Geology of India Lab			4	2
Generic/Open Elective Course (Choose Any one)							
3	3CS401	Open Elective	Object Oriented Programming with Java	4			4
	3CS452	Open Elective	Java Programming Lab			4	2
	3CH452	Open Elective	Transition Elements, Chemi-energetic, Phase Equilibria	4			4
	3CH402	Open Elective	Metal Complex Preparation, Thermochemistry & Phase Equalibria Experiments			4	2
	3PH401	Open Elective	Electricity, Magnetism and Electromagnetic Theory	4			4
	3PH452	Open Elective	Electricity, Magnetism and EMT lab			4	2
	3GO401	Open Elective	Sedimentary Rocks and Stratigraphy of India	4			4
	3GO451	Open Elective	Sedimentary Rocks and Geology of India Lab			2	4
Total Credits =							**22**

SEMESTER –V

Sr	**Subject Code**	**Group**	**Subjects**	**L**	**T**	**P**	**Total Credit**
Skill Enhancement Course (SEC) or Vocational Course (compulsory paper)							
1	0SE501	SEC	Development of Entrepreneurship	4		0	4
Major Subject-Choose anyone							

1	1CS501	Major	Operating System	4			4
1-P	1CS551	Major	Operating System Lab			4	2
1	1MS501	Major	Numerical Methods and scientific computation	6			6
1	1PH501	Major	Quantum atomic and molecular physics	4			4
1-P	1PH551	Major	Quantum atomic and molecular physics Lab			4	2
1	1CH501	Major	Instrumental Technique in Chemistry	4			4
1-P	1CH551	Major	Instrumental Technique in Chemistry Lab			4	2
1	1GO501	Major	Mining Geology	4			4
1-P	1GO551	Major	Mining Geology Lab			4	2
Discipline Specific Elective Course (Choose Any one)							
2	2CS501	DSE	PHP & MYSQL	3			3
	2CS552	DSE	PHP & MYSQL Lab			2	1
	2PH501	DSE	Nuclear and Particle Physics	4			4
	2MH501	DSE	Elements of Discrete mathematics	4			4
	2CH501	DSE	Green Chemistry	4			4
	3GO501	DSE	Mineral Resources of India	4			4
	Field Project/Internship						
	3FP501	Project	Field Project/Internship	4			4
Total Credits =							**18**

SEMESTER –VI

Sr	Subject Code	Group	Subjects	L	T	P	Total Credit
Major Subject-Choose any one Group (compulsory paper)							
Major Group A (Computer Science)							
1	1CS601	Major	Programming With Python	4			4
1-P	1CS651	Major	Programming With Python Lab			4	2
Discipline Specific Elective Course							
2	2CS601	DSE	Data Analysis &Visualization with Python	3			3
2-P	2CS652	DSE	Data Analysis &Visualization with Python lab			2	1
3	2CS602	DSE	Cloud Computing	3			3
3-P	2CS653	DSE	Cloud Computing Lab			2	1
Major Group B (Mathematics)							
1	1MH601	Major	Integral Transform	6			6
Discipline Specific Elective Course							
2	2MH601	DSE	Fundamentals of Boolean Algebra	4			4
3	2MH602	DSE	Statistics and probability	4			4
Major Group C (Physics)							
1	1PH601	Major	Solid State Physics & Electronics	4			4

1-P	1PH651	Major	Solid state physics & Electronics Lab			4	2
Discipline Specific Elective Course							
2	2PH601	DSE	Astronomy & Space Physics	4			4
3	2PH602	DSE	Solar Energy	4			4
Major Group D (Chemistry)							
1	1CH501	Major	Pharmaceutical & Medicinal Chemistry	4			4
1-P	1CH551	Major	Pharmaceutical & Medicinal Chemistry Lab			4	2
Discipline Specific Elective Course							
2	2CH601	DSE	Polymer Chemistry	4			4
3	2CH602	DSE	Bio Physical, Bio Inorganic & Bio organic Chemistry	4			4
Major Group E(Geology)							
1	1GO501	Major	Economic Geology	4			4
1-P	1GO551	Major	Economic Geology Lab			4	2
Discipline Specific Elective Course							
2	2GO601	DSE	Fuel Geology	4			4
3	2GO602	DSE	Hydro Geology	4			4
	Field Project/Internship						
	3FP601		**Field Project/Internship**	4			4
Total Credits =							**18**

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SEMESTER –VII

Sr	Subject Code	Group	Subjects	L	T	P	Total Credit
Major Subject-Choose any one Group (compulsory paper)							
Major Group A (Computer Science)							
1	1CS701	Major	Basic Knowledge of HTML,CSS AND Javascript	4			4
1-P	1CS751	Major	Basic Knowledge of HTML,CSS AND JavaScript Lab			4	2
Discipline Specific Elective Course							
2	2CS701	DSE	Theory of Computation	4			4
2	2CS702	DSE	Research Methodology & IPR	4			4
Major Group B (Mathematics)							
1	1MH701	Major	Jacobi Polynomial and H-Function	6			6
Discipline Specific Elective Course							
2	2MH701	DSE	Real Analysis	4			4
3	2MH702	DSE	Research Methodology	4			4
Major Group C (Physics)							
1	1PH701	Major	Electronics Devices	4			4
1-P	1PH751	Major	Electronics Devices Lab			4	2
Discipline Specific Elective Course							

2	2PH701	DSE	Atomic, Molecular and Laser Physics	4			4
3	2PH702	DSE	Research Methodology	4			4
Major Group D (Chemistry)							
1	1CH701	Major	Group theory & Spectroscopy	6			6
Discipline Specific Elective Course							
2	2CH701	DSE	Industrial Chemistry	4			4
3	2CH702	DSE	Research Methodology	4			4
	Field Project/Internship						
3	3FP701		Field Project/Internship	4			4
Total Credits =							**18**

SEMESTER –VIII

Sr	**Subject Code**	**Group**	**Subjects**	**L**	**T**	**P**	**Total Credit**
Major Subject-Choose anyone Group							
Major Group A (Computer Science)							
1	1CS801	Major	Statistical Thinking for Data Science	6			6
Discipline Specific Elective Course							
2	2CS801	DSE	English For Research Paper Writing	4			4
Major Group B (Mathematics)							

1	1MH801	Major	Special Function	6			6
Discipline Specific Elective Course							
2	2MH801	DSE	Complex Analysis	4			4
Major Group C (Physics)							
1	1PH801	Major	Classical Mechanics	6			6
Discipline Specific Elective							
2	2PH801	DSE	Solid State Physics	4			4
Major Group D (Chemistry)							
1	1CH801	Major	Diffraction Methods and Spectroscopy	6			6
Discipline Specific Elective Course							
2	2CH801	DSE	Chemistry of Material	4			4
	Research Project						
3	3RP801		Research Project	8			8
Total Credits =							**18**

Note: 1= Major Subjects, 2= Discipline Specific Elective Subjects, 3=Field/Internship/Dissertation/Research Project

Note: Students can choose B.Sc. by research after 6th semester in the major course taken by them.

Course code and definition:

Induction Program

Induction program for students to be offered right at the start of the first year It is mandatory. AKS University has design an induction programfor1st year student, detailsare below:

1. Physical activity

2. Creative Arts
3. Universal Human Values
4. Literary
5. Proficiency Modules
6. Lectures by Eminent People
7. Visits to local Areas
8. Familiarization to Dept./Branch & Innovations

Mandatory Visits/ Workshop /Expert Lectures:

1. It is mandatory to arrange one industrial visit every semester for the students.
2. It is mandatory to conducta One-week workshop during the winter break after fifth semester on professional/industry/entrepreneurial orientation.
3. It is mandatory to organize at least one expert lecture persemester for each branch by inviting resource persons from industry.

<u>Semester wise Course Structure</u>

Semester wise Brief of total Cerits and Teaching Hours

Semester	L	T	P/ project	Total Hour	Total Credit
Semester-I	16	0	12	28	22
Semester-II	16	0	12	28	22
Semester-III	16	0	12	28	22
Semester-IV	16	0	12	28	22
Semester-V	12	0	12	24	18
Semester-VI	12	0	12	24	18
Semester-VII	12	0	12	24	18
Semester-VIII	10	0	16	26	18
Total				**210**	**160**

AKS University

Faculty of Basic Science

Curriculum of B. Sc.(Honours/ By Research) Program

(Revised as on 01 August 2023)

B.Sc. (1st semester)

Course Code: **0FO101**

Course Title : **Communication Skill**

Pre- requisite: Students should have basic knowledge of presenting themselves, their thoughts and ideas.

Rationale: Communication skill will make a student versatile and confident enough to portray his/her skills. Students will be able to groom their personality with multiple traits. Students will be able to crack any interview, will be able to actively participate in any group discuss.

Course Outcome

CO1: 0FO101 Building up of confidence and presentation skill.

CO2: 0FO101 Students will be able to exhibit group discussion and interview skills.

CO3: 0FO101 Students will be able to communicate effectively in Hindi and English languages without hindrances.

CO4: 0FO101 Students will be able to understand the concept of basic grammar.

CO5: 0FO101 The study of Dramas and Poems written by Indian Writers.

Scheme of Studies:

Board of Study	Course Code	Course Title			Scheme of studies (Hours/Week)			Total Credits
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	(C)
FC	0FO101	Communication Skill	2	0	1	1	4	2

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		(PRA+ ESA)
FC	0FO 101	Communication Skill	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1- To enhance the speaking skills of the students in such a way where they will be able to communicate effectively with immense self confidence in themselves.

Approximate Hours

Item	Appx Hrs.
Cl	8
LI	0
SW	0
SL	1
Total	9

	Session Outcomes **(SOs)**	**(LI)**	**Class room Instruction** **(CI)**	**(SL)**
	SO1.1 Students will be able to introduce themselves **SO1.2**Understand the concept of Oral Presentation **SO1.3**Students will be able to dress and present effectively **SO1.4** Understand the importance of Body Language **SO1.5**Students will be able to influence mass through skit and dramas		**Unit 1: Self-grooming, Basic Etiquettes and Presentation Skill** 1.1Self-introduction 1.2Oral Presentation on The importance of Education1.3 The importance of English in Today's World 1.4 Necessity of uniforms in a college 1.5Professional dressing and grooming etiquettes. 1.6Body Language tips and techniques. 1.7 Role play was conducted on following topics: Classroom interaction 1.8 Role play on Hospital Scene and Scene at Railway Station	Prepare on the given topics Prepare a play on the given topics

2 To develop the leadership skills, public speaking skills and social skills in students along with the basic knowledge of how to make an impressive resume

Approximate Hours

Item	Appx Hours
Cl	6
LI	0
SW	1
SL	1
Total	8

Session Outcomes (SOs)	**(LI)**	**Class room Instruction (CI)**	**(SL)**
SO2.1 Understand the techniques of Group Discussion SO2.2Understand the concept of Debate. SO2.3 Students present their prepared debate. SO2.4 Students will actively participate in group discussion SO2.5Students will be able to prepare themselves for interview.	.	**UNIT 2 – Confidence building skills, Interview Skills and Resume Writing** 2.1 Group Discussion on impact of covid 19 on mental health 2.2 Discussion on impact of social media on lives, pros and cons of technology 2.3 Debate 2.4 Presentation of prepared debate speeches. 2.5Interviews and their Kinds (Mock Interview Session) 2.6 Resume Writing	Prepare deabte on given topics Prepare for mock interview.

3: To improve the presentation skills of the students that plays a pivotal role in building and shaping the career of the students.

Approximate Hours

Item	Appx Hours
Cl	6
LI	0
SW	1
SL	1
Total	8

Session Outcomes (SOs)	**(LI)**	**Class room Instruction (CI)**	**(SL)**
SO3.1 Students will understand the value of speech. **SO3.2** Students will be able to host different programmes. **SO3.3** Students will be able to think and speak instantaneously. **SO3.4** To make them understand the inquiry procedure at public places **SO3.5**Students will learn effective interaction skill	.	**Unit-3 :Public Speaking Skills& Conversational Skills** 3.1Speech /Anchoring 3.2 Types of Speech 3.3 National Science Day speech , Valedictory Speech, Patriotic speech, 3.4 Extempore 3.5Pros and Cons of Online teaching, Environment Conservation and Education of a Girl Child) 3.6Conversational Topics (Inquiry at bank, Airport, Station and Hospitals)	

4: To focus on improving the fundamental grammar of the students in order to bring accuracy while speaking and writing.

Approximate Hours

Item	Appx Hours
Cl	7
LI	0
SW	1
SL	0
Total	8

Session Outcomes (SOs)	(LI)	Class room Instruction (CI)	(SL)
SO4.1 Understanding about the use of Prepositions. **SO4.2**Students will be able to understand the usage of Tenses **SO4.3**Undesrtand the concept of Active and Passive Voice **SO4.4**To understand the usage of Modals **SO4.5 Use of correct grammar in day to day conversation**	.	Unit-4**:Functional Grammar and Vocabulary Building** 4.1 Prepositions (Place, Time and Direction), 4.2 Usage of preposition. 4.3 Tenses (Present, Past and Future), 4.4 Usage of tenses in day to day life 4.5 Voice (Active and Passive) 4.6Usage of active and passive voice. 4.7 Modals.	

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5 To make them aware of the Indian Culture and English Language by imbibing the dramas and poetry of some famous Indian English Writers.

Approximate Hours

Item	Appx Hours
Cl	3
LI	0
SW	1
SL	1
Total	4

Session Outcomes (SOs)	(LI)	Class room Instruction (CI)	(SL)
SO5.1Students will be able to understand the value of Indian Literature. SO5.2 Students will be able to analyse the work of Indian Writers S05.3 Students will relate with the power of perspective and accountability. SO5.4 Students become acquainted with the **power** of unity. SO5.5 Students understand the		**Unit 5-Indian Writing in English& Hindi** 5.1 The Axe- R.K. Narayan 5.2 The Night of the Scorpion- Nissim Ezekiel 5.3 The Portrait of a Lady - Khushwant Singh	

importance of choices and its impact on life			

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+ Sl)
1: Building up of confidence and presentation skill.	8	1	1	10
2: Students will be able to exhibit group discussion and interview skills.	6	1	1	8
3: Students will be able to communicate effectively in Hindi and English languages without hindrances.	6	1	1	8
4- Students will be able to understand the concept of basic grammar.	7	1	0	8
5- The study of Dramas and Poems written by Indian Writers.	3	1	1	5
Total Hours	30	05	04	39

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

	Unit Titles	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
	Self-grooming, Basic Etiquettes and Presentation Skill.	03	01	01	05
	Confidence building skills, Interview Skills and Resume Writing.	02	06	02	10
	Public Speaking Skills& Conversational Skills.	03	07	05	15
	Functional Grammar and Vocabulary Building.	-	10	05	15
	Indian Writing in English& Hindi.	03	02	-	05
Total		11	27	15	50

Legend: **R: Remember,** **U: Understand,** **A: Apply**

The end of semester assessment for communication skillswill be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Brainstorming

Suggested Learning Resources:

(a) **Books** :

S. No.	Title	Author	Publisher	Edition & Year
1	Communication Skills	Dr. Meenu Pandey	NiraliPraksahan	2019 Edition
2	English Conversation PractiseTata	Grant Taylor	PractiseTata McGraw Hill Education Private Limited.	2022 Edition
3	प्राचीन भारत का परिचय	आर एस शर्मा	ओरिएंट ब्लैकस्वान	Revised edition 2022
4	Lecture note provided through internet			

CO-PO and PSO Mapping:

Course Code: 0FO101

Course Title : Communication Skill

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	kno wle dge	Prob lem anal ysis	Desi gn/d evelo pme nt of solut ions	Con duct inves tigati ons of com plex prob lems	Mod ern tool usag e	The engin eer and societ y	Envi ron ment and susta inabi lity:	Ethic s	Indiv idual and team work :	Com munic ation:	Proje ct mana geme nt and financ e:	Life-long learni ng	The abilit y to apply techni cal & engin eering knowl edge to mitig ate the conse quenc es of global warm	Abilit y to under stand the Differ ent SD Goals and their signifi cance	Abilit y to under stand the latest Techn ology to achie ve SD	Abili ty to use the resea rch base d inno vativ e know ledge for SDG s

												ing			
CO1:Building up of confidence and presentation skill.	**1**	**1**	**1**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**
CO2: Students will be able to exhibit group discussion and interview skills.	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
CO3: Students will be able to communicate effectively in Hindi and English languages without hindrances.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**

CO4:Students will be able to understand the concept of basic grammar	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO5: The study of Dramas and Poems written by Indian Writers.	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend:1–Low,2–Medium,3–High

POs&PSOsNo.	COsNo.&Titles	SOsNo.	LaboratoryInstruction (LI)	Classroom Instruction(CI)	SelfLearning(SL)
PO1,2,3,4,5,6 PSO1,2	CO-1**Building up of confidence and presentation skill.**	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1**:** Self-grooming, Basic Etiquettes andPresentation Skill. 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8	
PO1,2,3,4,5,6 PSO1,2	CO2:**Students will be able to exhibit group discussion and interview skills.**	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2: Confidence building skills, Interview Skills and Resume Writing. 2.1,2.2,2.3,2.4,2.5,2.6	
PO1,2,3,4,5,6 PSO1,2	CO3: **Students will be able to communicate effectively in Hindi and English languages without hindrances.**	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3 : Public Speaking Skills & Conversational Skills. 3.1,3.2,3.3,3.4,3.5,3.6	
PO1,2,3,4,5,6 PSO1,2	CO4:**Students will be able to understand the concept of basic grammar.**	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4:Functional Grammar and Vocabulary Building. 4.1,4.2,4.3,4.4,4.5,4.6,4.7	
PO1,2,3,4,5,6 PSO1,2	CO 5: **The study of Dramas and Poems written by Indian Writers.**	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit5: Indian Writing in English& Hindi. 5.1,5.2,5.3	

AKS University

Faculty of Basic Science

Curriculum of B. Sc.(Honours/ By Research) Program

(Revised as on 01 August 2023)

Curriculum Development Team

1. Professor G C Mishra, Director Cement Technology, AKS University,Satna
2. Mr.Amar Priti Saluja Head SSD,AKS University ,Satna

Course Code:	**0FO102**
Course Title :	**Sustainable Development Goals (SDGs)**
Pre-requisite:	Student should have basic knowledge of Environment, Natural resources, Climate change and sustainability.
Rationale:	To inculcate the knowledge base on sustainable development with a view to balance our economic, environmental and social needs, allowing prosperity for now and future generations. To train students to undertake major initiatives in the efficient management of natural resources and the prevention of environmental pollution with focus on Sustainable Development. To use environmental management tools that help to improve the quality of environment, to assess local vulnerabilities with respect to climate, natural disasters and to achieve sustainable developmental needs.

Course Outcomes:

0FO102.1: Examine critically the 17 newly minted UN Sustainable Development Goals and understand the historical evolution, key theories, and concepts of sustainable development.

0FO102.2: Identify and apply methods for assessing the achievement of sustainable development and discover the science, technology, economics, and politics underlying the concepts of sustainability.

0FO102.3: Understand the implications of overuse of resources, population growth and economic growth and sustainability and explore the challenges the society faces in making transition to renewable resource use.

0FO102.4: Develop skills to understand attitudes on individuals, society and their role regarding causes and solutions in the field of sustainable development and apply critical thinking skills to evaluate the quality, credibility and limitations of an argument for solution.

0FO102.5: Describe the steps of the design thinking methodology and how design thinking can accelerate effective SDG implementation. Deepen knowledge and pedagogical tools to incorporate values-based education for sustainable development in educational programmes and processes.

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Scheme of Studies:

Board of Study	Cours eCode	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Program Core VAC	**0FO102**	Sustainable Development Goal	2	0	1	1	4	2

Legend: **CI:** Class room Instruction (Includes different instructional strategies i.e.Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini projectetc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure out come of Learning.

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment	Total Marks
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	(ESA)	(PRA+ ESA)
VAC	**0FO 102**	Sustainable Development Goal	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

AKS University

Faculty of Basic Science

Curriculum of B. Sc.(Honours/ By Research) Program

(Revised as on 01 August 2023)

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

0FO102.1: Examine critically the 17 newly minted UN Sustainable Development Goals and understand the historical evolution, key theories, and concepts of sustainable development.

Approximate Hours

Item	AppX Hrs
Cl	06
LI	0
SW	1
SL	1
Total	**8**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO1.1 Understand about Sustainable Development **SO1.2** Understand the Need and Importance of SDGs **SO1.3** Understand the historical evolution of SDGs **SO1.4** Gain knowledge of SDGs Different goals and their importance **SO1.**5 Explain the Challenges & strategies of attaining SDGs in countries..		**Unit-1.0 Introduction to Sustainable Development** 1.1 eed and Importance of Sustainable Development 1.2 istorical & Policy perspectives of Sustainable Development 1.3 Sustainable Development: World and India Perspective 1.4 Introduction to 17 SDGs 1.5 Specific learning objectives for different SDGs 1.6 Challenges & strategies of attaining SDGs in developed and developing nations	Different SDG goals details and its importance

SW-1 Suggested Sessional Work (SW):

a. **Assignments:**
Overview of SDGs, Sustainable Consumption and Production, Details of 17 SDGs

b. Other Activities (Specify):
Note down the different challenges in our state and district to achieve SDG

0FO102.2: : Identify and apply methods for assessing the achievement of sustainable development and discover the science, technology, economics, and politics underlying the concepts of sustainability and measuring.

Approximate Hours

Item	AppX Hrs
Cl	06
LI	0
SW	1
SL	1
Total	8

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1 Explain Sustainable Development **SO2.2** Understand the NEP-2020 and SDG **SO2.3** Discuss higher Education role to achieve SDGs **SO2.4** Explain how education for Sustainable Development **SO2.**5 Explain the measuring techniques for Sustainability .		**Unit-2.0** Special focus on SDG 4- Quality Education and Lifelong Learning: 2.1 Focus of NEP-2020 on SDG 2.2 Education for Sustainable Development (ESD): 2.3 Berlin Declaration 2021 on ESD 2.4 Integration of ESD in curriculum and textbooks 2.5 Tools, Systems, and Innovation for Sustainability 2.6 Measuring Sustainability: How do we measure sustainability	1 NEP2020 objectives and concept for SDGs 2. Concept ,Tools and techniques for measuring sustainability

SW-1 Suggested Sessional Work (SW):

c. **Assignments:**
Education role to achieve SDGs, The role of education in Sustainable Development , Measuring techniques of sustainability, Sustainability Indicators

d. Other Activities (Specify): Seminar and group discussion on ESD and measuring sustainability Millennium Development Goals (MDGs)

0FO102.3: Understand the implications of overuse of resources, population growth and economic growth and sustainability and explore the challenges the society faces in making transition to renewable resource use.

Approximate Hours

Item	AppX Hrs
Cl	06
LI	0
SW	1
SL	1
Total	8

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 Understand current economic issues in the context of the global sustainable development debate. **SO3.2** Outline of health, hygiene and water sanitation issues. **SO3.3** Discuss the renewable energy resources and its importance in present scenario **SO3.4** Explain the importance of sustainable production and consumption **SO3.**5 Explain the problems and solution in rural and urban areas.		**Unit-3.0 Understanding the SDGs** 3.1 Circular economy (basic model of reuse, recycle, and reduce) 3.2 Rural & urban Problems & Challenges 3.3 Sustainable production and consumption 3.4 Renewable energy 3.5 Health & Hygiene, water , sanitation & water management 3.6 Waste Management	1. Water treatment and manageme nt practices. 2. Non renewable energy resources.

SW-1 Suggested Sessional Work (SW):

Smart cities

e. Assignments:

Ecofriendly energy resources importance, types of waste and its management, Urban Problems & Challenges

Other Activities (Specify):

Visit of waste water treatment plant, Visit of water treatment process.

0FO102.4: Develop skills to understand attitudes on individuals, society and their role regarding causes and solutions in the field of sustainable development and apply critical thinking skills to evaluate the quality, credibility and limitations of an argument for solution.

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Approximate Hours

Item	AppX Hrs
Cl	06
LI	0
SW	1
SL	1
Total	8

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	lf Learning (SL)
SO4.1 Understand environmental sustainability is crucial in reducing the impacts of climate change **SO4.2** Discuss causes of emission of GHGs and its consequences **SO4.3** Explain how climate change and sustainable development both play a role in shaping the human and environmental factors of the world. **SO4.4** Explain the importance of sustainable production and consumption **SO4.**5 Climate change is disrupting national economies and affecting lives and livelihoods, especially for the most vulnerable and its mitigation.		**Unit-4.0 Climate Change, Energy and Sustainable Development** 4.1 The greenhouse effect: Causes and Consequences 4.2 Climate Change: A Threat to Sustainable Development 4.3 Adaptation to Current and Future Climate Regimes 4.4 The consequences: crop failure 4.5 Solutions technology and lifestyle changes 4.6 Mitigating Climate Change	***1*** *Agreement on Climate Change, Trade, and Sustainability* Carbon Credit, carbon trading Kyoto Protocol

SW-1 Suggested Sessional Work (SW):

f. **Assignments:**
Urban Sustainability and Climate Change, Sustainable Development Policies, Agreement on Climate Change, Trade and Sustainability, Resilient cities – What makes a city sustainable, green, and resilient

Other Activities (Specify):

0FO102.5: Describe the steps of the design thinking methodology and how design thinking can accelerate effective SDG implementation. Deepen knowledge and pedagogical tools to incorporate values-based education for sustainable development in educational programmes and processes.

.

Approximate Hours

Item	AppX Hrs
Cl	06
LI	0
SW	1
SL	1
Total	8

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4.1 Understand the relevance and the concept of sustainability and the global initiatives in this direction **SO4.2** Understand role of Corporations and Ecological Sustainability**.** **SO4.3** Explain role of CSR in Sustainability. **SO4.4** Understand the SD challenge for companies, their responsibility and their potentials for action **SO4.5** Discuss the role of world government for world justice and peace		**Unit-5.0 Sustainable Business Practices:** 5.1 Corporate Social Responsibility 5.2 Sustainable products and services 5.3 Business and Environment 5.4 Corporations and Ecological Sustainability 5.5 Life Cycle Assessment: • LCA Overview and Application 5.6 World peace and justice: • United nations goals for peace and justice • World Government for peace	Local to the Global: Can Sustainable Development Work

SW-1 Suggested Sessional Work (SW):

g. **Assignments:**
Consumption Patterns and Lifestyles, Company Perspectives for Environmental Sustainability, An Introduction to Economic Growth

Other Activities (Specify): .

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
0FO102.1: Examine critically the 17 newly minted UN Sustainable Development Goals and understand the historical evolution, key theories, and concepts of sustainable development.	6	1	1	8
0FO102.2: Identify and apply methods for assessing the achievement of sustainable development and discover the science, technology, economics, and politics underlying the concepts of sustainability.	6	1	1	8
0FO102.3: Understand the implications of overuse of resources, population growth and economic growth and sustainability and explore the challenges the society faces in making transition to renewable resource use.	6	1	1	8
0FO102.4: Develop skills to understand attitudes on individuals, society and their role regarding causes and solutions in the field of sustainable development and apply critical thinking skills to evaluate the quality, credibility and limitations of an argument for solution.	6	1	1	8
0FO102.5: Describe the steps of the design thinking methodology and how design thinking can accelerate effective SDG implementation. Deepen knowledge and pedagogical tools to incorporate values-based education for sustainable development in educational programmes and processes.	6	1	1	8
Total Hours	30	5	5	40

Suggestion for End Semester Assessment

Suggested Specification Table(For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Need and Importance of Sustainable Development	03	01	01	05
CO-2	Education for Sustainable Development (ESD): Tools, Systems, and Innovation for Sustainability	02	06	02	10
CO-3	Discuss the sustainable production and consumption	03	07	05	15
CO-4	How Climate Change may be Threat to Sustainable Development	-	10	05	15
CO-5	Role of Corporations and Ecological Sustainability	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U: Understand, A: Apply A: Analyse E:Evaluate C:Create

The end of semester assessment for Sustainable Development Goals will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to industry, water treatment plant
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook, Twitter,Whatsapp,Mobile,Onlinesources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	The Economics of Sustainable Development: The Case of India (Natural Resource Management and Policy)"	Surender Kumar and Shunsuke Managi	Springer Switzerland	2009
2	*Corporate Social Responsibility in Developing and Emerging Markets*	Onyeka Osuji	Cambridge	New Edition June 2022
3	*Smart Cities for Sustainable Development*	Ram Kumar Mishra, Ch Lakshmi Kumari, Sandeep Chachra, P.S. Janaki Krishna	Springer Switzerland	March 2022
4	Sustainable Development: Linking Economy, Society, Environment	Tracey Strange and Anne Bayley		
5	Management Of Resources For Sustainable Devpt	Sushma Goyal	The Orient Blackswan	2016

6	Energy, Environment and Sustainable Development: Issues and Policies	S. Ramaswamy Sathis G. Kumar	Regal Publications	2009
7	The New Map: Energy, Climate, and the Clash of Nations	Daniel Yergin	Penguin Press	September 2015
8	Contributions of Education for Sustainable Development (ESD) to Quality Education:	Laurie, R., Nonoyama-Tarumi, Y., Mckeown, R., & Hopkins, C.	A Synthesis of Research. Jour nal of Education for Sustainable Development, 10(2), 226–242.	2016
9	Sustainable Results in Development: Using the SDGs for Shared Results and Impact	OECD	OECD Publishing, Paris	2019
10	Development Discourse and Global History from colonialism to the sustainable development goals	Ziai, Aram	Routledge, London & New York	2016
11	Sustainable Development Goals An Indian Perspective,	Hazra, Somnath., Bhukta, Anindya	Springer Switzerland	2020
12	Environmental Ecology, Biodiversity and Climate Change	HM Saxena	Rawat Publication	January 2021
13	https://www.un.org/sustainabledevelopment/			
14	https://www.aiu.ac.in/documents/AIU_Publications/UN-SDG goals			
15	https://www.unesco.org/en/education-sustainable-development			
16	https://onlinecourses.nptel.ac.in/noc23_hs57/preview			
17	ttps://www.iau-hesd.net/news/5180-berlin-declaration-education-sustainable development-adopted-unesco-esd-conference-17-19			

AKS University

Faculty of Basic Science

Curriculum of B. Sc.(Honours/ By Research) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Course Code : 0FO102
Course Title: Sustainable Development Goals (SDGs)

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability:	Ethics	Individual and team work:	Communication:	Project management and finance:	Life-long learning	The ability to apply technical & engineering knowledge to mitigate the consequences of global warming	Ability to understand the Different SD Goals and their significance	Ability to understand the latest Technology to achieve SD	Ability to use the research based innovative knowledge for SDGs

CO1: Examine critically the 17 newly minted UN Sustainable Development Goals and understand the historical evolution, key theories, and concepts of sustainable development.	**1**	**1**	**1**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**
CO2: Identify and apply methods for assessing the achievement of sustainable development and discover the science, technology, economics, and politics underlying the concepts of sustainability.	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
CO3: Understand the implications of overuse of resources, population growth and economic growth and sustainability and explore the challenges the society faces in	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**

making transition to renewable resource use																
CO4: Develop skills to understand attitudes on individuals, society and their role regarding causes and solutions in the field of sustainable development and apply critical thinking skills to evaluate the quality, credibility and limitations of an argument for solution	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO5: Describe the steps of the design thinking methodology and how design thinking can accelerate effective SDG implementation. Deepen knowledge and pedagogical tools to incorporate values-based education for sustainable development in educational	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

programmes and processes																

Legend:1–Low,2–Medium, 3–High

Course Curriculum Map:

POs &PSOsNo.	Cos No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning (SL)
PO1,2,3,4, 5,6 7,8,9,10,11 ,12 PSO 1,2, 3, 4, 5	**CO1:** Examine critically the 17 newly minted UN Sustainable Development Goals and understand the historical evolution, key theories, and concepts of sustainable development.	SO1.1SO1.2SO1.3SO1.4 SO1.5		Unit-1.0 Introduction to Sustainable Development: 1.1,1.2,1.3,1.4,1.5,1.6,1.7,	As mentioned in page number 17to 25
PO1,2,3,4, 5,6 7,8,9,10,11 ,12 PSO 1,2, 3, 4, 5	**CO2:** Identify and apply methods for assessing the achievement of sustainable development and discover the science, technology, economics, and politics underlying the concepts of sustainability.	SO2.1SO2.2SO2.3 SO2.4 SO2.5		Unit-2 Special focus on SDG 4- Quality Education and Lifelong Learning: 2.1,2.2,2.3,2.4,2.5,2.6, 2.7, 2.8,2.9	
PO1,2,3,4, 5,6 7,8,9,10,11 ,12 PSO 1,2, 3, 4, 5	**CO3:** Understand the implications of overuse of resources, population growth and economic growth and sustainability and explore the challenges the society faces in making transition to renewable resource use.	SO3.1SO3.2 SO3.3 SO3.4 SO3.5		Unit-3 : Understanding the SDGs: 3.1, 3.2,3.3,3.4, 3.5,3.6,3.7, 3.8	
PO1,2,3,4, 5,6 7,8,9,10,11 ,12 PSO 1,2, 3, 4, 5	**CO4:** Develop skills to understand attitudes on individuals, society and their role regarding causes and solutions in the field of sustainable development and apply critical thinking skills to evaluate the quality, credibility and limitations of an argument for solution.	SO4.1SO4.2SO4.3SO4.4 SO4.5		Unit-4 : Climate Change, Energy and Sustainable Development 4.1, 4.2,4.3,4.4,4.5,4.6,4.7	

PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**CO5:** Describe the steps of the design thinking methodology and how design thinking can accelerate effective SDG implementation. Deepen knowledge and pedagogical tools to incorporate values-based education for sustainable development in educational programmes and processes	SO5.1SO5.2SO5.3SO5.4SO5.5		Unit 5: Sustainable Business Practices, LCA and World peace and justice 5.1,5.2,5.3,5.4,5.5,5.6	

Curriculum Development Team

1. Professor G C Mishra, Director Cement Technology, AKS University,Satna
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Course Code: 1CS101

Course Title: Fundamentals of Computer

Pre-requisite: Basics of Computing

Rationale: Fundamentals of computer are important because it helps to understand the basic concepts of computing, its components and functionalities.

Course Outcomes:

On successful completion of this course, the students will be able to:

1CS101.1 Students should be familiar with various characteristics of the computer, and its basic functionality such as input, output, processing, memory.

1CS101.2 Learn how to use Windows Operating System including icons and menus, files and folders.

1CS101.3 Learn how to use MS-Office Package including MS-Word, MS-Excel, and MS-Power Point applications.

1CS101.4 Learn how to use Internet and Web Browsing, including Email composing, sending, and receiving.

1CS101.5 Using Google Tools such as Drive, Sheet, Doc, and Meet, including various data and transactions applications.

Scheme of Studies:

Board ofStudy	CourseCode	CourseTitle	Scheme of studies(Hours/Week)					TotalCredits (C)
			Cl	LI	SW	SL	Total StudyHours(CI+LI+SW+SL)	
DCC)	1CS101	FUNDAMENTALS OF COMPUTER	4	4	2	1	7	6

Legend: **CI:** Class room Instruction (Includes different instructional strategies i.e. Lecture(L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work(includes assignment, seminar, mini project etc.),

SL: Self Learning,

C:Credits.

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+AT)	**(ESA)**	(PRA + ESA)
DCC	1CS 101	FUNDAMENTALS OF COMPUTER	15	20	5	5	5	50	50	100

Course- Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1CS101.1 Students should be familiar with various characteristics of the computer, and its basic functionality such as input, output, processing, memory.

Approximate Hours

Item	Appx. Hrs.
Cl	07
LI	6
SW	2
SL	1
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Understandingthe characteristics of computer. **SO1.2**Understanding basic internal and external components of computer. **SO1.3** Understanding various types of software and hardware. **SO1.4**Understanding basics of operating system and utilities software. .	1.1Connecting keyboard and mouse to CPU. 1.2 Connecting monitor and printer to CPU. 1.3 Checking power supply.	**Unit-1.0 Knowing computer**. 1.1 What is Computer, Basic Applications of Computer; 1.2 Components of Computer System, Modern Central 1.3 Processing Unit (CPU), Video Display Unit. 1.4 Keyboard and Mouse, Optical Storage Devices, 1.5 Basics of Hard Drive, Concepts of Hardware and Software; 1.6 Concept of Computing, Data and Information; 1.7 Applications of Information , Electronics and Communication Technology, 1.8 Connecting keyboard, mouse, monitor and printer to CPU and checking power supply. 1.9 Computer software and its types: 1.10 System software, Application software. Types of	Learning basic features and components of computer system.

		operating systems. 1.11 Role of operating system, Utility programs, Packages, 1.12 Communication software, Commonly used application software	

SW-1 Suggested Sessional Work(SW):

h. Assignments:

i. List out and explain input devices.

ii. List out and explain output devices.

i. Mini Project:

Draw and explain block diagram of computer system.

j. Other Activities (Specify):

Connecting keyboard, mouse, monitor and printer to CPU and checking power supply.

1CS101.2 Learn how to use Windows Operating System including icons and menus, files and folders.

Approximate Hours

Item	Appx. Hrs.
Cl	12
LI	6
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**

SO2.1 Understanding graphical user interface. **SO2.2**Understandingcore components of windows operating system. **SO2.3**Understanding windows environment and appearance. **SO2.4**Understanding file and folders for data storage.	2.1 Creating copying, moving and deleting files, 2.2 Setting wall paper, changing the mouse pointer. 2.3 Setting date and time, screen saver, and appearance.	**Unit-2.0 Operating Computer** **2.1** GUI Based Operating System: What is an Operating System: Basics of Popular Operating Systems; 2.2 The User Interface, Basics of O.S Setup; Common utilities. 2.3 MS Windows Operating System: Definition and functions, 2.4 Basic Components of Windows. Icons. Desktop, Taskbar, Notification Area. 2.5 Files and folders, Start menu operations, My computer, Network Neighbourhood, Recycle-Bin, 2.6 Windows Explorer, Creating copying, Moving and Deleting files, 2.7 Setting wall paper, Changing the mouse Plotter, Paint, Notepad, 2.8 Setting Date and Time, Screen Saver, and Appearance. Using Mouse: 2.9 Using right Button of the Mouse and Moving Icons on the screen, 2.10 Use of Common Icons, Status Bar. Using Menu and Menu-selection, 2.11 Running an application, Viewing of File, Folders and Directories, Creating and Renaming of files and folders, 2.12 Opening and closing of different Windows; Using	Learning features and functionalities of windows operating system

		help; Creating Short cuts, Using Windows accessories.	

SW-2 SuggestedSessionalWork(SW):

a. **Assignments:**
   i. Create file and folder.
   ii. Apply cut, copy, paste, delete.

b. Mini Project:
   Configure your computer using control panel options.

1CS101.3 Learn how to use MS-Office Package including MS-Word, MS-Excel, and MS-Power Point applications.

Approximate Hours

Item	Appx. Hrs.
Cl	12
LI	0
SW	2
SL	2
Total	16

SessionOutcomes (SOs)	**LaboratoryInstruction (LI)**	**ClassroomInstruction (CI)**	**Self-Learning (SL)**
SO3.1 Understanding important features and functionalities of MS-Word application. **SO3.2**Understanding important features and functionalities of MS-	3.1 Customizing the word application, document views, creating & editing document. 3.2 Selecting, deleting replacing text, copying	**Unit-3.0MS Word:** 3.1 Introduction, Windows 2007 Interface, 3.2 Customizing the Word Application, Document Views, Creating & Editing	Learning various applications of MS-Office package.

Excel application. **SO3.3** Understanding important features and functionalities of MS-Power Point.	text to another file. 3.3 Using the font, dialog box, paragraph formatting.	Document. 3.3 Selecting, Deleting Replacing Text. Copying text to another fiIe. 3.4 Insert, Formatting text and paragraph 3.5 Using the Font, Dialog Box, Paragraph Formatting 3.6 Bullets and Numbering in paragraphs, Checking Spelling. 3.7 Line spacing, Margins, Space before and after paragraph. 3.8 Basic Formatting in MS Word 2007, Advanced Formatting, Navigating through a Word Document, 3.9 Performing a Mail Merge, A Quick Look at Macros 3.10 Printing Documents, Print Preview **3.11 Excel 2007:** Introduction, Workbook, Worksheet, Formatting in excel MS 3.12 PowerPoint: Creating a Presentation	

SW-3 Suggested Sessional Work(SW):

a. Assignments:

i. Create word document format and print it.
ii. Create excel sheet format and save it.

b. Mini Project:

iii. Create a power point presentation on MS-Office Package.

c. Other Activities (Specify):

i. Use mail merge tool in word document.

1CS101.4 Learn how to use Internet and Web Browsing, including Email composing, sending, and receiving.

Approximate Hours

Item	AppXHrs
Cl	12
LI	0
SW	2
SL	2
Total	16

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO4.1 Understanding internet and web browsing. **SO4.2**Understanding basic concepts of networking. **SO4.3**Understanding various elements of computer network. **SO4.4**Understanding various types of computer networks. **SO4.5**Understanding email composing, sending, and receiving.	4.1 Sending and receiving emails 4.2 Accessing sent emails, document collaboration 4.3 Connectivity and troubleshooting.	**Unit-4.0 Introduction to Internet**, 4.1 Basic of Computer networks 4.2 LAN, MAN, WAN; Concept of Internet; 4.3 Applications of Internet; Connecting to Internet 4.4 What is ISP; Knowing the Internet; 4.5 Connectivity related troubleshooting, 4.6 Search Engines; Understanding URL 4.7 Domain name; IP Address; 4.8 Using e-governance website 4.9 Basics of Electronic Mail; Getting an Email account; 4.10 Sending and receiving	Learning internet and emailing system.

		Emails 4.11 Accessing sent Emails; Document collaboration; 4.12 Instant Messaging, Netiquettes (Internet Etiquette).	

SW-4 SuggestedSessionalWork(SW):

a. Assignments:

i. Write short note on LAN, MAN, WAN.

ii. Write an electronic mail to your professor.

b. MiniProject:

i. Make report on Local Area Network.

c. Other Activities (Specify):

List out the name of any 10 domain names.

1CS101.5 Using Google Tools such as Drive, Sheet, Doc, and Meet, including various data and transactions applications.

Approximate Hours

Item	Appx. Hrs.
Cl	12
LI	0
SW	2
SL	2
Total	16

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO5.1 Understanding google tools as drive, sheet, doc, and meet. **SO5.2**Understanding various privacy and security concerns. **SO5.3**Understanding data transfer tools. **SO5.4**Understanding payment system tools. **SO5.**5 Understanding digital signature system.	5.1 Using Google Drive. 5.2 Using Google Meet. 5.3 Using Google Sheet.	**Unit-5.0Useful Google Tools** 5.1 Drive, Sheet, Doc, Meet, etc. 5.2 Firewall, 5.3 Computer Virus 5.4 Anti-Virus Software 5.5 Internet Security and Privacy 5.6 Electronic Data Interchange (EDI) 5.7 Electronic Payment System(EPS) 5.8 Types of Payment System: 5.9 Digital Cash, 5.10 Electronic Cheque, 5.11 Smart Card 5.12 Introduction to Digital Signature and Digital Certificates .	Learning google tools, data and payment transfer system, privacy and security concerns.

SW-5 SuggestedSessionalWork(SW):

a. **Assignments**
   i. Crete a google meet with your classmates.
   ii. Upload your assignment on google drive.
b. MiniProject:
   i. Make a report on use UPI outside India.
c. **OtherActivities(Specify):**
   Compare digital signature and digital certificate.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Lab Instruction (LI)	Sessional Work (SW)	Self-Learning (Sl)	Total Hour (Cl+SW+Sl)
1CS101.1Students should be familiar with various characteristics of the computer, and its basic functionality such as input, output, processing, memory.	12	12	2	1	27

1CS101.2 Learn how to use Windows Operating System including icons and menus, files and folders.	12	12	2	1	27
1CS101.3 Learn how to use MS-Office Package including MS-Word, MS-Excel, and MS-Power Point applications.	12	12	2	2	28
1CS101.4 Learn how to use Internet and Web Browsing, including Email composing, sending, and receiving.	12	12	2	2	28
1CS101.5 Using Google Tools such as Drive, Sheet, Doc, and Meet, including various data and transactions applications.	12	12	2	2	28
Total Hours	60	60	10	8	138

Suggestion for End Semester Assessment

Suggested Specification Table(For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
1CS101.1	Students should be familiar with various characteristics of the computer, and its basic functionality such as input, output, processing, memory.	02	01	01	04
1CS101.2	Learn how to use Windows Operating System including icons and menus, files and folders.	02	04	02	08
1CS101.3	Learn how to use MS-Office Package including MS-Word, MS-Excel, and MS-Power Point applications.	03	05	04	12

1CS101.4	Learn how to use Internet and Web Browsing, including Email composing, sending, and receiving.	02	08	05	15
1CS101.5	Using Google Tools such as Drive, Sheet, Doc, and Meet, including various data and transactions applications.	03	05	03	11
Total		12	23	15	50

Legend: R:Remember, U:Understand, A:Apply

The end of semester assessment for fundamentals of computer will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wiseteachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

SuggestedInstructional/ImplementationStrategies:

10. ImprovedLecture
11. Tutorial
12. CaseMethod
13. GroupDiscussion
14. RolePlay
15. Visit any software development company
16. Demonstration
17. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog ,Facebook,Twitter,WhatsApp,Mobile,Onlinesources)
18. Brainstorming

SuggestedLearningResources:

(b) Books:

S. No.	Title	Author	Publisher	Edition&Year
1	Introduction to Computers	C.Xavier	NewAgeInternational	
2	Computer Fundamentals: Concepts, Systems & Applications	PritiSinha,Pradeep K.,Sinha	BPBPublications	

3	FundamentalsofInformationtechnology	AlexisLeon&MathersLeon	VikasPublishingHouse	
4	MicrosoftOffice 2019ForDummies	WallaceWang	Wiley India Edition	

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Cos, Pos and PSO Mapping

Course Title- Fundamentals of Computer **Course Code – 1CS101**

Cos	Description	Program Outcomes												Program Specific Outcome			
		PO1 Knowledge	PO2 Research Aptitude	PO3Communication	PO4Problem Solving	PO5Individual and Team Work	PO6Investigation of Problems	PO7Modern Tool usage	PO8Science and Society	PO9Life-Long Learning	PO10Ethics	PO11Project Management	PO12 Environment and sustainability	PSO 1	PSO 2	PSO 3	PSO 4

CO1	Students should be familiar with various characteristics of the computer, and its basic functionality such as input, output, processing, memory.	3	2	3	2	1	3	3	3	3	-	3	-	3	1	3	2
CO2	**Learn how to use Windows Operating System including icons and menus, files and folders**.	3	2	3	3	2	2	2	2	2	-	3	-	3	2	3	2

CO3	**Learn how to use MS-Office Package including MS-Word, MS-Excel, and MS-Power Point applications.**	3	3	2	3	3	2	2	2	2	-	2	3	2	3	3	3
CO4	**Learn how to use Internet and Web Browsing, including Email composing, sending, and receiving.**	3	3	2	3	2	2	3	3	2	-	2	3	3	3	2	3

CO5	**Using Google Tools such as Drive, Sheet, Doc, and Meet, including various data and transactions applications.**	3	3	3	2	2	2	3	2	3	-	3	3	3	3	3	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map

Pos & PSOs No.	**Cos No.& Titles**	**SOs No.**	**Laboratory Instruction (LI)**	**Classroom Instruction(CI)**	**Self Learning(SL)**
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4	CO-1Develop simple algorithms and flow charts to solve a problem with programming using top down design principles	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1,2,3,	Unit-1 1,2,3,4,5,6,7,8,9,10, 11,12	
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4	CO2 Learn to formulate iterative solutions and array processing algorithms for problems.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	1,2,3,	Unit-2 1,2,3,4,5,6,7,8,9,10, 11,12	1
PO1,2,3,4,5,6,7,8,9, 10,11,12 PSO1,2,3,4	CO3 Will be familiar with fundamental data structures, their implementation; become accustomed to the description of algorithm in both functional and procedural styles	SO3.1 SO3.2 SO3.3 SO 3.4 SO 3.5 SO 3.6 SO 3.7	1,2,3	Unit-3 : 1,2,3,4,5,6,7,8,9,10, 11,12	1
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4	CO 4Have knowledge of complexity of basic operations like insert, delete, search on these data structures.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	1,2,3	Unit-4 1,2,3,4,5,6,7,8,9,1 0,11,12	1

		SO4.6 SO4.7			
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2,3,4	CO 5Possess ability to choose a data structure to suitably model any data used in computer applications.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	1,2,3,	Unit5: 1,2,3,4,5,6,7 ,8,9,10,11,1 2	

Curriculum Development Team:

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AKS University

Faculty of Basic Science

Curriculum of B. Sc.(Honours/ By Research) Program

(Revised as on 01 August 2023)

Course Code: **1MS101**

Course Title : **Algebra, Vector Analysis and Geometry**
Pre- requisite: Students should have basic knowledge of calculus

Rationale: The program aims to develop advanced problem-solving and analytical skills and prepares students for careers in academia, research, industry, or other sectors that require advanced mathematical expertise**.**

Course Outcome :

CO1- 1MS101.1 Student will aware of history of mathematics and hence of its Past, present and future role as part of our culture.

CO2-1MS101.2 Student will understand the mathematical structures made up of rows and columns of numbers or other elements.

CO3- 1MS101.3 Students will be able to apply the knowledge of vector quantities and their derivatives in two and three dimensions both, also use the operations like gradient, divergence and curl.

CO4-1MS101.4 Proficiency in analyzing the vector quantities to understanding vector Integration and their practical applications.

CO5-1MS101.5 Students will improve the ability to analyze and sketch various types of curves (such as conic sections, polynomial curves, trigonometric curves, etc.) using principles from algebra and geometry in real life problems.

Scheme of Studies:

Board of Study	**Course Code**	**Course Title**	**Scheme of studies (Hours/Week)**					**Total Credits (C)**
			Cl	**LI**	**SW**	**SL**	**Total Study Hours (CI+LI+SW+SL)**	
Program Core (DCC)	1MS101	Algebra, Vector Analysis and Geometry	6	0	1	1	8	6

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,

C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA + ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+AT)		
DCC	1MS101	Algebra, Vector Analysis and Geometry	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1- 1MS101.1 Student will aware of history of mathematics and hence of its Past, present and future role as part of our culture.

Approximate Hours

Item	AppX Hrs
Cl	18
LI	0
SW	1

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SL	1
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO1.1 Student will aware of history of mathematics **SO1.2** Student will aware of contribution of Indian Mathematicians in field of Mathematics **SO1.3** Understand its Past, present and future role of Mathematics as part of our culture.	-	**Unit-1.0** 1.1Historical background: 1.2Development of Indian Mathematics 1.3: Later Classical Period (500 -1250) 1.4A brief biography of Varahamihira 1.5 A brief biography of Aryabhatta, 1.6Rank of a Matrix :By Detreminant method 1.7 Elementary Row and Column operation 1.8 Echelon form of a matrix 1.9 Tutorial-I 1.10 Normal form of a matrix 1.11 Characteristic equations of a matrix of 2X2 order 1.12 Characteristic equations of a matrix of 3X3 order 1.13 Tutorial-II 1.14 Eigen-values of a matrix of 2X2 order 1.15 Eigen-values of a matrix of 3X3 order 1.16 Eigen-vectors of matrix of 2X2 order 1.17 Eigen-vectors of matrix of 3X3 order 1.18 Tutorial-III	**SL.1** Student will aware about Indian Mathematics **SL.2** Student will learn the methods to find the Rank of the matrix **SL.3** Student will learn to determine the Eigen values **SL.4** Student will learn to determine the Eigen vectors.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i.

ii. Application of Linear Algebra in real life.

iii. Derivation of Cauchy’s Theorem for finite groups.

iv. Mapping defined on groups

b. Other Activities (Specify):
Quiz, Class Test.

CO2-1MS101.2 Student will understand the mathematical structures made up of rows and columns of numbers or other elements.

Approximate Hours

Item	AppX Hrs
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO.1-		2.1 Cayley Hamilton theorem 2.2 Application of Cayley- Hamilton theorem 2.3 Methods to find the inverse of a matrix. 2.4 Tutorial-I 2.4 Application of matrix to solve a system of linear equations. 2.5 Condition for Consistency with Examples 2.6 Condition for In-consistency with Examples 2.7 Tutorial-II 2.8 Theorems on consistency and inconsistency of a system of linear equations 2.9 Solving linear equations up to three unknowns 2.10 Various Examples in linear equations 2.11 Tutorial-III	

SW-2 Suggested Sessional Work (SW):
a. Assignments:
i. Relationships between algebraic structures of ring with familiar numbers systems.
ii. Application of Ring group theory in real life.
iii. Permutation group.
iv. Mapping defined on Rings.

V. Polynomial Ring

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO3- 1MS101.3 Students will be able to apply the knowledge of vector quantities and their derivatives in two and three dimensions both, also use the operations like gradient, divergence and curl.

Approximate Hours

Item	AppX Hrs
Cl	18
LI	0
SW	1
SL	1
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO3.1 Understand the differential formulae for vectors		**Unit-3.0 Vector Differentiation** 3.1 Scalar and Vector products o three vectors 3.2 Scalar and Vector product of four vectors 3.3 Practice Questions 3.4 Reciprocal Vectors 3.5 Tutorial –I 3.6 scalar and Vector poin function 3.7 Rules of differentiation 3.8 Vector differentiation Formulae and Terminology 3.9 Derivatives of Tripl Products 3.10 Gradient: Formule an Properties 3.11 Examples on Gradient 3.12 Divergence : Formul and Properties 3.13 Examples on Curl 3.14 Tutorial-II 3.15 Directional derivatives Properties 3.16 Vector Identities 3.17 Vector Equations	

		3.18 Tutorial-III	

SW-3 Suggested Sessional Work (SW):
a. Assignments:
i. Relationships between algebraic structures of ring with familiar numbers systems.
ii. Application of Ring group theory in real life.
iii. Permutation group.
iv. Mapping defined on Rings.
V. Polynomial Ring

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO4-1MS101.4 Proficiency in analyzing the vector quantities to understanding vector Integration and their practical applications

Approximate Hours

Item	AppX Hrs
Cl	19
LI	0
SW	1
SL	1
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
S04.1 Understand the formulation of Vector Integration **S04.2** Understand the concept of Line Integral **S04.3** Understand the concept of surface Integral **S04.4** Understand the concept of Volume Integral **S04.5**		**Unit-4.0Vector Integration** 4..1 Integration: Indefinite and Definite Integral 4.2 Vector Integration 4.3 Line Integral 4.4 Circulation 4.5 Tutorial – I 4.6 Surface Integral : Basic Terminology and Formula 4.7 Surface Integral : Definition and working Terms 4.8 Flux across a surface 4.9 Tutorial – II 4.10 Volume Integral : Formulation	**SL.1** learn the formulae of Integration **SL.2** learn the difference between definite integral and Indefinite integral

Understand the relation between line and surface integral		4.11 Volume Integral : Examples 4.12 Gauss theorem (without proof} and problems based on it 4.13 Examples based Gauss theorem 4.14 Green theorem (without proof} and problems based on it 4.15 Examples based on Green theorem 4.16 Stoke's theorem (without proof) and problems based on it 4.17 Examples based on Green theorem 4.18 Tutorial – III 4.19 Tutorial – IV	

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Relationships between algebraic structures of ring with familiar numbers systems.
ii. Application of Ring group theory in real life.
iii. Permutation group.
iv. Mapping defined on Rings.
V. Polynomial Ring

b. Mini Project:

Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO5-1MS101.5

Students will improve the ability to analyze and sketch various types of curves (such as conic sections, polynomial curves, trigonometric curves, etc.) using principles from algebra and geometry in real life problems.

Approximate Hours

Item	AppX Hrs
Cl	23
LI	0
SW	1
SL	1
Total	25

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO.1- Understand the concept of Cone **SO.2-** Understand the concept of Conic **SO.3-** Understand the Difference between Conic and conic sections. **SO.4-** Understand the Concept of Generator **SO.5-** Able to trace for given any Curve		**Unit- 5.0** **General equation of second degree** 5.1 Conic Sections 5.2 General equation of second degree 5.3 Nature of Cone 5.4 Tracing of conics 5.5 Centre of conic 5.6 Working Rule to find Centre of conic 5.7 Tracing of parabola 5.8 System of conics 5.9 Conic through the point of intersection of a conic and straight line 5.10 Intersection of two conics 5.11 Tutorial-I 5.12 Cone 5.13 Equation of cone with given base and vertex 5.14 Generators of cone 5.15 Equation of cone whose vertex is as origin 5.16 Right circular cone 5.17 Tutorial-II 5.18 Cylinder 5.19 Equation of cylinder 5.20 Right Circular Cylinder 5.21 Enveloping Cylinder 5.22 Condition for three mutually perpendicular generators 5.23 Tutorial-III	SL.1- Solution the linear equations SL.2- Tracing of many curves Sl.3- Having the knowledge of Equation of circle, cone, parabola, hyperbola etc.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
CO1- 1MS101.1 Student will aware of history of mathematics and hence of its Past, present and future role as part of our culture.	18	1	1	20
CO2-1MS101.2 Student will understand the mathematical structures made up of rows and columns of numbers or other elements.	12	1	1	14

CO3- 1MS101.3 Students will be able to apply the knowledge of vector quantities and their derivatives in two and three dimensions both, also use the operations like gradient, divergence and curl.	18	1	1	20
CO4-1MS101.4 analyzing the vector quantities to understanding vector Integration and their practical applications.	19	1	1	20
CO5-1MS101.5 Students will improve the ability to analyze and sketch various types of curves (such as conic sections, polynomial curves, trigonometric curves, etc.) using principles from algebra and geometry in real life problems.	23	1	2	25
Total Hours	90	10	10	100

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Historical Background and Rank of matrix	03	02	--	05
CO-2	Caylay-Hamilton Theorem	03	05	02	10
CO-3	Vector Differentiation	03	05	02	10
CO-4	Vector Integration	02	06	05	13
CO-5	Cone	02	07	03	12
Total		13	25	12	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies

1. Improved Lecture
2. Tutorial
3. Presentation
4. Group Discussion
5. Online sources
6. Seminar
7. Workshop

Suggested Learning Resources:

a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Matrix and Linear Algebra	K. B. Datta	Prentice Hall of India Pvt. Ltd. New Delhi	2000
2	The Elements of Coordinate Geometry Part- I	S. L. Loney	New Age International (P) Ltd., Publishers, New Delhi	2016
3	A Text Book of Vector Calculus	Shanti Namyan	S. Ckaad & Co., New Delhi	1987
4	A text book of Analytical Geometry of Three Dimensions	P. K. Jain and 1haIil Ahmad	WiI1ey Eastern Ltd.	1999
5	Contributions to the History of Indian Mathematics.	S. Gerard G. Emch, R. Sridhamn, M. D. Srinivas	Hindustan Boolc Agency.	Vol. 3.2005

b) Reference Books:

S. No.	Title	Author	Publisher	Edition & Year

1	A Text Book on Algebra and Theory of Equations	Chandrika Prasad	Pothishala Pvt. Ltd.,	*Allahabad, 20l7*
2	Basic Algebra Vol. I and II	N. Jacobson	W. H. Freeman	2009
3	Algebra Vol. I and II	S. Luther and I. B. S. Passi	Narosa Publishing House	1997
4	Introduction to Vector Analysis	N. Saran and S. N. Nigam	Pothishala Pvt. Ltd. Allahabad	1990
5	Vector Analysis	Murray R. Spiegel	Schaum Publishing Company, New York	2017

Suggested Digital Platforms Web links:	https://epgp. infl ibnet.ac. in hnps://freevideolectures.com/university/i it-roorkee https://www.highereducation.mp.gov.in/?page=xhzlQmpZwkylQo2bYo2FySGTwok3DVo3D https://www.bhojvirtualuniversity.com

AKS University

Faculty of Basic Science

Curriculum of B. Sc.(Honours/ By Research) Program

(Revised as on 01 August 2023)

Cos,POs and PSOs Mapping

Course Title: B.Sc. Mathematics
Course Code : 01MS101
Course Title: Algebra, Vector Analysis and Geometry

Course Outcome																
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Knowledge	Research Aptitude	Communication	Problem Solving	Individual and Team	Investigation of Problems	Modern Tool usage	Science and Society	Life-Long Learning	Ethics	Project Management	Environment and sustainability	The detailed functional knowledge of theoretical conceptsand experimental aspects of science	To integrate the gained knowledge with various contemporary and evolving areas in chemical	To understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomenon-	Provide opportunities to excel in academics, research or Industry by research based innovative knowledge for sustainable develo

														sciences, physical science and mathematical science like analytical, synthetic, pharmaceutical etc	based problems in chemical sciences,physical science and mathematical science.	pment in chemical science, physical science and mathematical science
CO1-**1MS101**.1 Student will aware of history of mathematics and hence of its Past, present and future role as part of our culture.	2	3	1	2	1	2	2	2	1	1	1	1	2	1	1	3
CO2-**1MS101**.2 Student will understand the mathematical structures made up of rows and columns of numbers or other elements.	1	3	2	1	1	1	1	1	1	2	3	1	3	1	1	2

CO3- **1MS101**.3 Students will be able to apply the knowledge of vector quantities and their derivatives in two and three dimensions both, also use the operations like gradient, divergence and curl.	2	3	2	2	1	1	3	2	1	1	3	1	2	1	2	2
CO4-**1MS101**.4 Proficiency in analyzing the vector quantities to understanding vector Integration and their practical applications.	2	3	2	2	1	1	3	2	1	1	3	1	2	1	2	2
CO5-**1MS101**.5 Students will improve the ability to analyze and sketch various types of curves (such as conic sections, polynomial curves, trigonometric curves, etc.) using principles from algebra and geometry in real life problems.	2	3	2	2	1	1	3	2	1	1	3	1	2	1	2	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,1 1,12 PSO 1,2, 3, 4	CO1-**1MS101.1** Understand the importance of algebraic properties with regard to working within various number systems.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 Group 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8 ,1.9,1.10	SL1.1 SL1.2
PO 1,2,3,4,5,6 7,8,9,10,1 1,12 PSO 1,2, 3, 4	CO2-**1MS101**.2. Students will determine whether a given binary operation on the given set gives a group structure by applying the axioms.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-2 Ring 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	SL2.1 SL2.2
PO 1,2,3,4,5,6 7,8,9,10,1 1,12 PSO 1,2, 3, 4	CO3-**1MS101**.3. Students will be able to describe all elements in a cyclic subgroup by using generators.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-3 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	SL3.1 SL3.2
PO 1,2,3,4,5,6 7,8,9,10,1 1,12 PSO 1,2, 3, 4	CO4-**1MS101**.4 Connecting ring theory to other areas of mathematics or applications in computer science, physics, or cryptography.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-4 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	SL4.1 SL4.2
PO 1,2,3,4,5,6 7,8,9,10,1 1,12 PSO 1,2, 3, 4	CO5-**1MS101**.5 Students will create the concept of a group action to real life problems such as Counting.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-5 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	SL5.1 SL5.2

AKS University
Faculty of Basic Science
Department of Mathematics
Curriculum & Syllabus of B.Sc. Mathematics program
Semester-I

Curriculum Development Team

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AKS University

Faculty of Basic Science

Curriculum of B. Sc.(Honours/ By Research) Program

(Revised as on 01 August 2023)

Course Code: **1PH101**

Course Title: **Mechanics and General Properties of Matter**

Prerequisite: To study this course, a student must have had the subject Physics in 12th class.

Rationale: The students studying Physics should possess foundational understanding of the behavior of physical bodies, basic concepts related to the motion of all the objects around us in daily life. Basic mathematical methods to solve various problems in physics. Should possess knowledge about fluid mechanics, viscosity, gravitational potential, and central forces. They would learn Relativistic Mechanics and Astrophysics.

Course Outcomes:

1PH 101.1: The course would empower the students to develop the idea about the behavior of physical bodies.

1PH 101.2: It will provide the basic concepts related to the motion of all the objects around us in daily life.

1PH 101.3: The students would be able to build a foundation in various applied fields in science and technology, especially in the field of mechanical engineering.

1PH 101.4: The students will acquire the knowledge of basic mathematical methods to solve various problems in physics.

1PH 101.5: The students will be able to understand the relativistic effect and the relation between energy and mass.

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits(C)
			CI	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
ProgramCore (DCC)	1PH 101	Mechanics and General Properties of Matter(Paper I)	4	4	1	1	10	6

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial

(T) And others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project, etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL have to be planned and performed under the continuous guidance and feedback of the teacher to ensure the outcome of Learning.

Scheme of Assessment:

Board of Study	Course Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment**	**Total Marks**
			Class/Home Assignment 5 numbers 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT +AT)	**(ESA)**	(PRA+ ESA)
PCC	1PH101	Mechanics and General properties of Matter	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction, including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self-Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1PH 101.1: The course would empower the students to develop the idea about the behavior of physical bodies.

Approximate Hours:

Item	AppX Hrs
Cl	12
LI	12
SW	1
SL	1
Total	26

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Understand a brief historical background of mathematics in the context of India. **SO1.2** Study the history of Physics Scientists. **SO1.3** Learn about Vector and Scalar and Vector and Scalar field. **SO1.4** Learn about Vector integral, Line, surface, and Volume integral. **SO1.5** Study Divergence, curl, and Gradient and Theorems like Stokes, Green, and Gauss Divergence Theorem. .	1.1 To determine Young's Modulus by Bending of beam Method. 1.2 To determine Surface Tension of a liquid by capillary rise method.	**Unit-1.0 Historical background and Mathematical Physics** **Historical background:** 1.1 A brief historical background of mathematics and mechanics in the context of India and Indian culture. 1.2 A brief biography of Varahamihira and Vikram Sarabhai with their major contributions to science and society. **Mathematical Physics**: 1.3 Scalar fields & Vector fields 1.4 Gradient of a scalar field 1.5 Physical significance of Gradient **Vector integral:** 1.6 Line integral, surface integral, and volume integral. 1.7 Divergence of a vector field and its physical significance. 1.8 Gauss divergence theorem. 1.9 Curl of a vector field and its physical significance, 1.10 Stokes theorem 1.11 Green's theorem, 1.12 Numerical problems based on the above topics.	1. Historical background: A brief historical background of mathematics and mechanics in the context of India and Indian culture. 2. A brief biography of Varahamihira and Vikram Sarabhai with their major contributions to science and society.

SW-1 Suggested Sessional Work (SW):

a. *Assignments:*

i. Make a list of Scientists contributed in Mathematical Physics with Brief Description about them.

b. Mini Project:

i. Prepare a chart on physics scientists with Details Like (Varahamihira and Vikram Sarabhai.

c. Other Activities (Specify):

Note on the status of the Indian cement industry in the world and major cement producing companies of India.

1PH 101.2: It will provide the basic concepts related to the motion of all the objects around us in daily life.

Approximate Hours

Item	AppX Hrs
Cl	12
LI	12
SW	1
SL	1
Total	26

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self-Learning (SL)**
SO2.1 To Study about Rigid body, center of mass, and their motion. **SO2.2** Study study moment of inertia and its theorems. **SO2.3** Learn about Hook's law, Poisson's ratio, elastic moduli, torsional pendulum, and more. **SO2.4** Learn about bending of beams and the cantilever method to calculate Young's modulus. **SO2.5** To learn about Maxwell's needle, Searle's method to find Y, η and σ of the material of a wire.	2.1 To determine damping coefficient using a bar pendulum. 2.2 To determine acceleration due to gravity using compound pendulum	**Unit-2. Mechanics of rigid and deformable bodies.** **Rigid body mechanics:** 2.1 System of particles and concepts of rigid body, 2.2 Torque, center of mass (Position of the center of mass, motion of the center of mass). 2.3 Conservation of linear and angular momentum with examples. 2.4 Single-stage and multistage rockets. 2.5 Rotational motion and the concept of moment of inertia, 2.6 Theorems on moment of	i. What is a rigid body? Study about the center of mass? ii. What is Poisson's ratio and finding Ratio?

		inertia: theorem of addition, theorem of perpendicular axis, theorem of parallel axis, 2.7 Calculation of moment of inertia of rectangular lamina, disc, solid cylinder, solid sphere. **Mechanics of deformable bodies:** 2.8 Hook's law, Young's modulus, bulk modulus, modulus of rigidity, and Poisson's ratio, relationship between various elastic moduli. 2.9 Possible values of Poisson's ratio, Finding Poisson's ratio of rubber in the laboratory, 2.10 Torsion of a cylinder, Strain energy of twisted cylinder. Finding the modulus of rigidity of the material of a wire by Barton's method, 2.11 Torsional pendulum and Maxwell's needle, Searle's method to find Y, η and σ of the material of a wire, 2.12 Bending of beam, Cantilever, Beam supported at its ends and loaded in the middle.	

SW-2 Suggested Sessional Work (SW):

a. *Assignments:*

i. Describe Hook's law and write its applications in real life with some examples.
ii. Write a short note on Young's Modulus and how we can calculate it, along some applications in real life.

b. Mini Project:
Identify moment of inertia in your day-to-daylife and write it notebook.

c. Other Activities (Specify):
Types of Coal its availability in India

1PH 101.3: The students would be able to build a foundation in various applied fields in science and technology, especially in the field of mechanical engineering.

Approximate Hours

AKS University

Faculty of Basic Science

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(Revised as on 01 August 2023)

Item	AppX Hrs
Cl	12
LI	12
SW	1
SL	1
Total	26

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self-Learning (SL)**
SO3.1. Learn about surface tension, Intermolecular Inter molecular forces,force of cohesion, and adhesion. **SO3.2** Learn about surface Tension, its daily Life Applications,and effects. **SO3.3** Study the determination of surface tension of a liquid - capillary rise method, Jaeger's **SO3.4** Students will be able to understand what iscosity is, its uses, and properties. **SO3.5** Will study the derivation of Poiseuille's formula and limitations, Stock's formula, motion of a spherical body falling in a viscous fluid.	3.1 To determine Young's Modulus using Cantilever method 3.2 To determine Surface Tension by Jaegar's method	**Fluid Mechanics** **Surface Tension:** 3.1 Inter-molecular forces and potential energy curve, force of cohesion and adhesion. **Surface tension:** **3.2** Explanation of surface tension based on the basis of intermolecular forces. 3.3 Surface energy, Effect of temperature and impurities on surface tension, Daily life application of surface tension. 3.4 Angle of contact, the pressure difference between the two sides of a curved liquid surface, 3.5 Excess pressure inside a soap bubble, Capillarity, determination of surface tension of a liquid - capillary rise method, Jaeger's method. **Viscosity:** 3.6 Ideal and viscous fluid, Streamline and turbulent flow, Equation of continuity, Rotational and Irrotational flow, 3.7 Energy of a flowing fluid,	i. The applications of Bernoulli's theorem. ii. Effect of temperature and impurities on surface tension, Daily life application of surface tension.

		Euler's equation of motion of a non-viscous fluid and its physical significance. 3.8 Bernoulli's theorem and its applications 3.9 (Velocity of efflux, shapes of airplane wings, Magnus effect, filter pump, Bunsen's burner). 3.10 Viscous flow of fluids, flow of liquids through capillary tubes, 3.11 derivation of Poiseuille's formula and its limitations, Stocks formula, 3.12 Motion of a spherical body falling in a viscous fluid.	

SW-3 Suggested Sessional Work (SW):

a. Assignments:
iii. Effect of temperature and impurities on surface tension, Daily life application of surface tension.
iv. Bernoulli's theorem and its applications

b. Mini Project:
Prepare a chart on viscosity with examples.

c. Other Activities (Specify):
Identify some real-life examples of the capillary rise method and Jaeger's method.

1PH 101.4: The students will acquire the knowledge of basic mathematical methods to solve various problems in physics.

Approximate Hours

Item	AppX Hrs
Cl	12
LI	12
SW	1
SL	1
Total	26

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)

SO4.1 will understand what is Gravitational potential: Conservative and non-conservative force fields. **SO4.2** Study about Conservative force, conservation of energy, gravitational potential, and gravitational potential energy. **SO4.3** Study about Motion under central forces, Conservative characteristics of central forces. **SO4.4** Learn about the motion of a two particles system in Central force, Concept of reduced mass, Reduced mass of positronium and hydrogen. **SO4.5** Learn about Motion of particles in an inverse-square central force, Motion of celestial bodies and derivation of Kepler's laws.	4.1 To determine Viscosity of fluid using Poisellie's method. 4.2 To verify laws of parallel and perpendicular axes for moment of inertia.	**Unit-4 : Gravitational potential and Central forces** **Gravitational potential:** 4.1 Conservative and non-conservative force field, 4.2 Conservation of energy in motion under the conservative and non-conservative forces, Potential energy. 4.3 Conservative force, Conservation of energy, 4.4 Gravitational potential and gravitational potential energy, 4.5 Gravitational potential and intensity of gravitational field due to a uniform spherical shell and a uniform solid sphere. 4.6 Gravitational self-energy, Gravitational self-energy of a uniform spherical shell and a uniform solid sphere. **Central forces:** **4.7** Motion under Central forces, Conservative characteristics of central forces. 4.8 The motion of a two particles system in Central force, 4.9 Concept of reduced mass, Reduced mass of positronium and hydrogen. 4.10 Motion of particles in an inverse-square central force, 4.11 Motion of celestial bodies and derivation of Kepler's laws, 4.12 Elastic and inelastic scattering (elementary idea).	i. What is the Uniform Solid Sphere? ii. Conservative force, Conservation of energy, Gravitational potential and gravitational potential energy

SW-4 Suggested Sessional Work (SW):

a. *Assignments:*

i. Write a short note on Conservative force field, Gravitational potential, Gravitational self-energy, Central force, reduced mass, Scattering.

d. Mini Project:

i. Describe the Motion of particles in an inverse-square central force.

e. Other Activities (Specify):

Power Point Presentation of Elastic and inelastic scattering.

1PH 101.5: The students will be able to understand the relativistic effect and the relation between energy and mass.

Item	AppX Hrs
Cl	12
LI	12
SW	1
SL	1
Total	26

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**

SO5.1 Students will learn about Frame of references and Michelson Morley experiment. **SO5.2** Will know about Special theory of relativity and Lorentz transformation. **SO5.3** Study the length contraction and Time dilation. **SO5.4** Overview Students will know about Mass-energy equivalence and its experimental verification. **SO5.5** Study the Big Bang theory and learn how the stars are working in space and their life cycle.	5.1 To determine coefficient of rigidity by static method. 5.2 To determine coefficient of rigidity by dynamic method	**Unit 5 Relativistic Mechanics and Astrophysics** **Relativistic Mechanics:** 5.1 Frame of references, 5.2 Galilean transformation, 5.3 Michelson- Morley experiment. 5.4 Postulates of special theory of relativity, 5.5 Lorentz Transformation, Simultaneity and order of events, 5.6 Length contraction, Time dilation, 5.7 Relativistic transformation of velocities, Variation of mass with velocity. 5.8 Mass-energy equivalence and its experimental verification. **Astrophysics:** 5.9 Introduction to the Universe, Properties of the Sun. 5.10 Concept of Astronomical Distance. 5.11 Life cycle of a stars, Chandrasekhar Limit, H-R diagram, Red giant star, White dwarf star, Neutron star, Black hole. 5.12 Big Bang Theory (elementary idea).	1. Study about Big Bang Theory. 2. Astronomical distance, Chandrasekhar limit, Black hole. 3. H-R diagram, Red giant star, 7White dwarf star, Neutron star, Black hole.

SW-5 Suggested Sessional Work (SW):

a. *Assignments:*

1. Introduction to the Universe, Properties of the Sun, Concept of Astronomical Distance.
2. Red giant star, White dwarf star, Neutron star, Black hole.

b. Mini Project:

Write in details with diagrammatical representation of Life cycle of stars, Chandrasekhar Limit, H-R diagram.

c. *Other Activities (Specify):*

List of all Science Museum in India Related to space.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+LI+SW+Sl)
1PH 101.1: The course would empower the students to develop the idea about the behavior of physical bodies.	12	12	1	1	26
1PH 101.2: It will provide the basic concepts related to the motion of all the objects around us in daily life.	12	12	1	1	26
1PH 101.3: The students would be able to build foundation to various applied field in science and technology especially in the field of mechanical engineering.	12	12	1	1	26
1PH 101.4: The student's wi11 acquire the knowledge of basic mathematical methods to solve the various problems in physics.	12	12	1	1	26
1PH 101.5: The students will be able to understand the relativistic effect and the relation between energy and mass.	12	12	1	1	26
Total Hours	60	60	5	5	130

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Historical background and Mathematical Physics	6	2	2	10
CO-2	Mechanics of Rigid and deformable bodies	6	2	2	10
CO-3	Fluid mechanics	6	2	2	10
CO-4	Gravitational potential and Central forces	6	2	2	10
CO-5	Relativistic Mechanics and Astrophysics	6	2	2	10
Total		30	10	10	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Mechanics and General Properties of Matter will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to Science Museum
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) *Books* **:**

S. No.	Title	Author	Publisher	Edition & Year 1
1	Classical Mechanics Concrete	J C Upadhyay	Himalaya Publishing House PVT. LTD.	2014
2	Unified Physics	R. P. Goyal	Ramakrishna 11th Edition	2012 3.
3	Classical Mechanics	Addison wesley	Goldstien	1980
4	Physics Department Notes			
5	Lecture note provided by Dept. of Physics, AKS University, Satna .			

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(Revised as on 01 August 2023)

Cos, POs, and PSOs Mapping

Course Title: B. Sc. (Math/Com/Geo) Course

Code : 1PH-101

Course Title: Mechanics and General Properties of Matter

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO 10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Science knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The Science and Society	Environment and sustainability:	Ethics	Individual and teamwork: Communication:	Comm	Project management and finance:	Life-long learning	The ability to apply basic knowledge of science in real life.	Ability to understand the day-to-day problems of Science	Ability to understand the basic fundamental of science.	Ability to use the basic knowledge for SDGs
CO 1: The course would empower the students to develop the idea about the behavior of physical bodies.	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1
CO 2: It will provide the basic concepts related to the motion of all the objects around	1	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1

us in daily life.																
CO 3: The students will be able to build a foundation in various applied fields in science and technology, especially in the field of mechanical engineering.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO 4: The students will acquire the knowledge of basic mathematical methods to solve various problems in physics.	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO 5: The students will be able to understand the relativistic effect and the relation between energy and mass.	**-**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: 1 - Low, 2 - Medium, 3 - High

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Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	CO-1:The course would empower the students to develop an idea about the behavior of physical bodies.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1,1.2	Unit-1.0 Historical background and Mathematical Physics 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10, 1.11,1.12	As mentionedin page number 2 to 6
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 2:It will provide the basic concepts related to the motion of all the objects around us in daily life.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1,2.2	Unit-2 Mechanics of Rigid and deformable bodies 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10,2.11,2.12	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	CO3 : The students would be able to build a foundation in various applied fields in science and technology, especially in the field of mechanical engineering.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1,3.2	Unit-3 : Fluid mechanics 3.1, 3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9, 3.10,3.11,3.12	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 4: The students will acquire the knowledge of basic mathematical methods to solve various	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1,4.2	Unit-4:Gravitational potential and Central forces4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10, 4.11,4.12	

	problems in physics.				
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 5: The students will be able to understand the relativistic effect and the relation between energy and mass.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1,5.2	Unit 5: Relativistic Mechanics and Astrophysics 5.1,5.2,5.3,5.4,5.5,5.6 ,5.7,5.8,5.9,5.10, 5.11,5.12	

Curriculum Development Team

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6. Ms. Swati Kushwaha, Lab Assistant, Department of Physics, AKS University Satna (M.P.)

Course Code : 1CH501
Course Title : Analytical Chemistry

Pre-requisite: Students must have fundamental knowledge of mathematics, valence shell electron pair repulsion theory, and different concentration terms to understand the concept of analytical chemistry.

Rationale: The students studying analytical chemistry should possess foundational understanding about basic mathematics, valence shell electron pair repulsion theory, and different concentration terms to understand the basic principle of chromatography and spectroscopic analysis.

Course Outcomes:
After the completion of this course, the learner will able to

1CH501.1: explain basic concept of straight line equation, logarithmic relation, differentiation and integration and run the software's to plot the graphs and draw the structure of different molecules.

1CH501.2: describe the presentation of experimental data and analyze the results in terms of significant figure by applying the concept of concentration terms, error, sampling, precision, accuracy

1CH501.3: explain thermodynamic derivation of law of chemical equilibrium by applying the concept of Gibbs free energy and chemical potential

1CH501.4: **d**iscuss principle of chromatography and analyze different components of a mixture quantitatively by applying chromatographic principle.

1CH501.5: discuss basic concept of spectroscopy and analyze unknown component qualitatively & quantitatively and also identify the functional groups of a molecule on the basis of their stretching and bending vibrations.

SUGGESTED WEB SOURCES:

1. https://nptel.ac.in/course.html
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5
3. https://swayam.gov.in/explorer?category=Chemistry

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies (Hours/Week)					Total CreditsI
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Program Core (PCC)	**1CH501**	**Analytical Chemistry**	4	4	1	1	8	6

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment: Theory

Board of Study	Course Code	Course Title	Scheme of Assessment (Marks)						
			Progressive Assessment (RA)					End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each	Seminar one + Class activity	Class Attendance (AT)	Total Marks (CA+CT+SA +AT)		
DCC	1CH501	Analytical Chemistry	15	20	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (Sos), culminating in the overall achievement of Course Outcomes (Cos) upon the course's conclusion.

Unit-1 (1CH501.1): Basics of mathematics and computer for Chemists

Straight line equation, Logarithmic relations, relations, curve sketching, linear graphs & calculation of slopes. Differentiation of functions like kx, e^x, x^n, sinx, Logx, maxima & minima, Integration of some useful relevant functions Introduction to computer, Execution of linear regression x-y Plot Use of software's for drawing structures and molecular formulae.

Activity	Appx Hrs
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes (SOs)	LI	CI	SL
After the completion of topics students will be able to SO1.1 understand the concept of Straight line equation and calculation of slopes SO1.2 explain logarithmic relations, relations of different functions SO1.3 discuss differentiation of important functions and calculate of maxima & minima SO1.4 discuss integration of some useful relevant functions SO1.5 discusses software's for drawing structures and molecular formulae.	Basic exercises • To introduce software's to draw structure of different compounds • Calibration of different weights and glass apparatus • To prepare solutions of different molarity/normality by weighing and dilution.	**Unit-1 (2CH101.1): Basics of mathematics and computer for Chemists** 1.1 Significance of straight line equation and its applications 1.2 Logarithmic relations 1.3 Curve sketching 1.4 linear graphs & calculation of slopes 1.5 Differentiation of functions like kx, e^x, x^n, sinx, Logx, 1.6 Differentiation of functions like sinx, Logx, 1.7 calculations of maxima & minima 1.8 Integration of some useful relevant functions 1.9 Introduction to computer and execution of linear regression x-y Plot. 1.10 Introduction to software's 1.11 Applications of software for drawing structures and molecular formulae 1.12 Introduction to ChemDraw and Origin	• Significance of differentiation and integration • Introduction to window

SW-1 Suggested Sessional Work (SW):
Assignments: curve sketching
Mini Project: Software's for drawing structures and molecular formulae.
Other Activities (Specify): Introduction to graph and its types in different ways to represent data

Unit-2 (1CH501.2): Basic Analytical Chemistry
Introduction to Analytical Chemistry and its interdisciplinary nature, Concept of sampling, Importance of accuracy, precision and source of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures, statistical terms: mean, mean deviation, median standard deviation, Numerical Problems.
Calculations used in Analytical Chemistry
Some Important units of measurements: SI Unit, distinction between mass and weight, mole, mill mole and numerical problems.
Solution and their concentrations: Concept of Molarity, molality, and normality. Expressing the concentration in parts per million (ppm), parts per billion (ppb), Numerical Problems.
Chemical Stoichimetry: Empirical and Molecular Formulas, Stoichemetric Calculations, Numerical Problems.

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Activity	AppX Hrs
Cl	13
LI	12
SW	2
SL	1
Total	28

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
After the completion of topics students will be able to **SO2.1** restate concept of sampling, Importance of accuracy, precision and source of error in analytical measurements. **SO2.2** explain experimental data in terms of significant figure **SO2.3** discuss mathematical terms such as mean, mean deviation, median standard deviation etc **SO2.4** discuss different concentration terms and apply the same concept of to prepare solutions **SO2.5 estimate e**mpirical and molecular formulae	Quantitative analysis through Titrimetric method • Standardization of NaOH with Oxalic acid. • Determination of carbonate and hydroxide present in mixture • Determination of carbonate and bicarbonate present in a mixture.	**Unit-2 (2CH101.2): Basic Analytical Chemistry** 2.1 Introduction to Analytical Chemistry and its interdisciplinary nature 2.2 Concept of sampling 2.3 Importance of accuracy, precision 2.4 Source of error in analytical measurements. 2.5 Statistical terms: mean, mean deviation, median standard deviation 2.6 Solution and their concentrations 2.7 Concept of Molarity, molality, and normality. 2.8 Expressing the concentration in parts per million (ppm), parts per billion (ppb), 2.9 Numerical Problems. 2.10 Chemical Stoichimetry 2.11 Empirical and Molecular Formulae 2.12 Stoichemetric Calculations 2.13 Numerical Problems	• Some Important units of measurements: SI Unit • distinction between mass and weight • mole, mill mole and numerical problems

SW-2 Suggested Sessional Work (SW):

Assignments: Presentation of experimental data and results, from the point of view of significant figures

Mini Project:

Other Activities (Specify): Numerical Problems.

Unit-3 (1CH501.3): Chemical Equilibrium

Equilibrium constant and free energy, concept of chemical potential, Thermodynamic derivation of law of chemical equilibrium Temperature dependence of equilibrium constant: Van't Hoff reaction isochors, Van't Hoff reaction isotherm, Le-Chatelier's Principle and its applications.

Activity	AppX Hrs
Cl	11
LI	12
SW	2
SL	1
Total	26

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
After the completion of topics students will be able to **SO3.1** explain equilibrium constant and free energy **SO3.2** discuss concept of chemical potential **SO3.3** describe thermodynamic derivation of law of chemical equilibrium **SO3.4** explain conceptually Van't Hoff reaction isochors, Van't Hoff reaction isotherm **SO3.5** describe Le-Chatelier's Principle and its applications	• To study the shift of equilibrium between ferric ions and thiocyanate ions by increasing the concentration of either of them. • Determination of free alkali present in different soaps/detergents.	**Unit-3 (2CH101.3): Chemical Equilibrium** 3.1 Introduction to equilibrium constant 3.2 Introduction to free energy 3.3 concept of chemical potential 3.4 Thermodynamic derivation of law of chemical equilibrium 3.5 Discussion of temperature dependence of equilibrium constant 3.6 Van't Hoff reaction isochors, 3.7 Van't Hoff reaction isotherm 3.8 Introduction to Le-Chatelier's Principle 3.9 Applications of Le-Chatelier's Principle 3.10 Solving numerical problems 3.11 Solving numerical problems	• Gibbs free energy • Van't Hoff factors

SW-3 Suggested Sessional Work (SW):

Assignments: Concept of chemical potential

Mini Project:

Other Activities (Specify):

Unit-4 (1CH501.4): Chromatography

Introduction, Principle and Classification Mechanism of separation: adsorption, partition and ion-exchange.
Development of Chromatograms: frontal elution and displacement methods.
Paper Chromatography (ascending, descending and circular), Thin Layer Chromatography (TLC) and Column Chromatography (CC). Gas Chromatography (GC) and High Pressure Liquid Chromatography (HPLC) types of column and column selection, applications, Limitations
Principle and Applications of:

- Flash chromatography,
- Ion-exchange chromatography and
- Chiral chromatography.
-

Activity	AppX Hrs
Cl	13
LI	12
SW	2
SL	1
Total	28

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)

After the completion of topics students will be able to **SO4.1** understand basics of separation of components of a mixture **SO4.2** to discuss development of chromatograms **SO4.3** discusses principles of paper chromatography and thin layer chromatography (TLC) **SO4.4** explain column chromatography (CC) and gas chromatography (GC) **SO4.5** discuss the concept of chiral chromatography	Qualitative Analysis • Identification by determination of the Rf values of the given organic / inorganic compounds by paper/ thin layer chromatography. • Systematic identification of organic compound by qualitative analysis	**Unit-4 (2CH101.4): Chromatography** 4.1 Introduction to chromatography 4.2 Discussion of principle involved 4.3 Classification of chromatography 4.4 Mechanism of separation of components in a mixture 4.5 Development of Chromatograms: frontal elution and displacement methods 4.6 Principle of Paper Chromatography (ascending, descending and circular) and Thin Layer Chromatography (TLC) 4.7 Column Chromatography (CC) 4.8 Gas Chromatography (GC) 4.9 High Pressure Liquid Chromatography (HPLC) 4.10 Types of column involved and selection of column 4.11 Principle of Chiral chromatography 4.12 Applications of Chiral chromatography 4.13 Principle and applications of flash chromatography	To understand the chromatographic principle students must read about • Nature of compound (polar/non-polar)

SW-4 Suggested Sessional Work (SW)
Assignment: Chromatography (HPLC) types of column and column selection
Mini Project:
Other Activities (Specify): Mechanism of separation of components in a mixture: adsorption, partition and ion-exchange

Unit-5 (1CH501.5): Spectral techniques of analysis
Basics of absorption spectroscopy: Electromagnetic radiation, Spectral; range. Absorbance Absorptivity, Molar Absorptivity, Fundamental Laws of Absorption, Lambert-Beer Law and its limitations Constitution & working of photometer spectrometer, colorimeter.
Ultraviolet (UV) absorption spectroscopy: Presentation and analysis of UV spectra, Types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, Hyper-chromic and hypo-chromic shifts. UV spectra of conjugated polyenes and enones.
Infra-red (IR) absorption spectroscopy: Molecular vibrations Hooke’s law, selection rules, intensity and position of IR bands. Measurement of IR spectrum, finger print region, characteristic absorption of various functional groups and interpretation of IR spectra of simple organic compounds

Activity	AppX Hrs
Cl	11
LI	12
SW	2
SL	1

Total	26

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
After the completion of topics students will be able to **SO5.**1 understand Basics of absorption spectroscopy **SO5.2** discuss the principle of UV-visible spectroscopy or Lambert-Beer Law and its limitations **SO5.3** apply the concept of UV-visible spectra to calculate the λ_{max} of conjugated polyenes and enones **SO5.**4 describes Hook's law and correlates it with spectral frequency of functional groups. **SO5.5 explain principle of IR** absorption spectroscopy and measure the characteristic absorption band of various functional groups	.Quantitative Analysis by Colorimeter: • Verification of Lambert-Beer Law • Determination of concentration of colored compounds (e.g. CuSO4, KMnO4) • Verification of Lambert-Beer Law	**Unit-5 (2CH101.5): Spectral techniques of analysis** 4.1 Fundamental Laws of Absorption 4.2 Lambert-Beer Law and its limitations Constitution & working of photometer spectrometer, colorimeter. 4.3 Presentation and analysis of UV spectra 4.4 Types of electronic transitions, effect of conjugation. 4.5 Concept of chromophore and auxochrome. Bathochromic, hypsochromic, Hyper-chromic and hypo-chromic shifts. 4.6 UV spectra of conjugated polyenes and enones. 4.7 Infra-red (IR) absorption spectroscopy 4.8 Molecular vibrations 4.9 Hooke's law, selection rules, intensity and position of IR bands 4.10 Measurement of IR spectrum, finger print region, 4.11 characteristic absorption of various functional groups	Basics of absorption spectroscopy: • Electromagnetic radiation, • Spectral range • Absorbance Absorptivity, Molar Absorptivity

SW-5 Suggested Sessional Work (SW):
Assignments: UV spectra of conjugated polyenes and enones.

Mini Project:
Other Activities (Specify): Interpretation of IR spectra of simple organic compounds

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
1CH501.1: explain basic concept of straight line equation, logarithmic relation, differentiation and integration and run the software's to plot the graphs and draw the structure of different molecules.	12	12	02	01	27
1CH501.2: describe the presentation of experimental data and analyze the results in terms of significant figure by applying the concept of concentration terms, error, sampling, precision, accuracy	13	12	02	01	28
1CH501.3: explain thermodynamic derivation of law of chemical equilibrium by applying the concept of Gibbs free energy and chemical potential	11	12	02	01	26
1CH501.4: **d**iscuss principle of chromatography and analyze different components of a mixture quantitatively by applying chromatographic principle.	13	12	02	01	28
1CH501.5: discuss basic concept of spectroscopy and analyze unknown component qualitatively & quantitatively and also identify the functional groups of a molecule on the basis of their stretching and bending vibrations.	11	12	02	01	26
Total Hours	60	60	10	05	135

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	**Basics of mathematics and computer for**	03	01	01	05

	Chemists				
CO-2	**Basic Analytical Chemistry**	02	06	02	10
CO-3	Chemical Equilibrium	03	04	03	10
CO-4	Chromatography	-02	08	05	15
CO-5	**Spectral techniques of analysis**	03	02	05	10
Total		13	21	16	50

Legend: R: Remember, U: Understand, A: Apply

The written examination of 50 marks will be held at the end of semester for Inorganic Chemistry

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to NCL, CSIR laboratories
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT,Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher
1	Organic Chemistry, Sultan Chand and Sons. Delhi.	Soni PL,	Sultan Chand and Sons, . Delhi
2	Chemistry	Srivastava, S. S. Gehlot. A.S.	Ratan Prakashan Temple. Indore.
3	Inorganic Chemicals	Sing, DR, Saxena, G, Singh, B.	Shivlal Aggarwal & Company, Agra
4	Bioinorganic Chemistry	AK Das	Prentice -Hall
5	Inorganic chemistry	Gary L. Miessler	Pearson
6	Inorganic chemistry	VK Jaiswal	Shri Balaji
7	Elementary Organic Spectroscopy	Sharma Y.R.	S Chand, 2013
8	Analytical Chemistr	Gupta Alka L	Pragiti Prakashan 2020
9	Analytical Chemistry	Kaur H,	Pragatic Prakashan 2008
10	Advanced Organic Chemistry	Bahl. A. & Bahal. B.S.	S. Chand. 2010
11	Chromatography	Sharma B.K.	Krishna Prakashan, 2019

Suggested Web Sources:

1. https://celqusb.files.wordpress.com/2017/12/inorganic-chemistry-g-l-miessler-2014.pdf
2. https://www.slideshare.net/MANISHSAHU106/inert-and-labile-complexes
3. https://swayam.gov.in/explorer?category=Chemistry

Mode of Delivery: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point;

LMS/ICT Tools: Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

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Course Title: Analytical Chemistry **Course Code: 1CH501**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO 2	PO3	PO4	PO5	PO 6	PO7	PO8	PO9	PO1 0	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Knowledge	Research	Communic ation	Problem Solving	Individual and Team	Investigatio	Modern Tool usage	Science and Society	Life-Long Learning	Ethics	Project Manageme	Environme nt and	The detailed functional	To integrate the gained knowledge	understand, analyze, plan and implement	Provide opportunitie s to excel in academics,
CO1: explain basic concept of straight line equation, logarithmic relation, differentiation and integration and run the software's to plot the graphs and draw the structure of different molecules.	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**
CO2: describe the presentation of experimental data and analyze the results in terms of significant figure by applying the concept of concentration terms,	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**

error, sampling, precision, accuracy																
CO3: explain thermodynamic derivation of law of chemical equilibrium by applying the concept of Gibbs free energy and chemical potential	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO4: discuss principle of chromatography and analyze different components of a mixture quantitatively by applying chromatographic principle.	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO5: discuss basic concept of spectroscopy and analyze unknown component	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

qualitatively & quantitatively and also identify the functional groups of a molecule on the basis of their stretching and bending vibrations.																

Legend: **1–Low,** **2–Medium,** **3–High**

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Course Curriculum Map:

POs &PSOsNo.	**COs No. & Titles**	**SOs No.**	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
PO1,2,3,4, 5,6 7,8,9,10,11 ,12 PSO 1,2, 3, 4	CO-1: explain basic concept of straight line equation, logarithmic relation, differentiation and integration and run the software's to plot the graphs and draw the structure of different molecules.	SO 1.1 SO 1.2 SO 1.3 SO 1.4 SO 1.5		Unit-1. **Basics of mathematics and computer for Chemists** 1.1,1.2,1.3, 1.4,1.5,1.6,1.7	• Significance of differentiation and integration • Introduction to window
PO1,2,3,4, 5,6 7,8,9,10,11 ,12 PSO 1,2, 3, 4	CO2: describe the presentation of experimental data and analyze the results in terms of significant figure by applying the concept of concentration terms, error, sampling, precision, accuracy	SO 2.1 SO 2.2 SO 2.3 SO 2.4 SO 2.5		Unit-2 **Basic Analytical Chemistry** 2.1,2.2,2.3,2.4,2.5, 2.6, 2.7, 2.8,2.9	• Some Important units of measurements: SI Unit • distinction between mass and weight • mole, mill mole and numerical problems
PO1,2,3,4, 5,6 7,8,9,10,11 ,12 PSO 1,2, 3, 4	CO3: explain thermodynamic derivation of law of chemical equilibrium by applying the concept of Gibbs free energy and chemical potential	SO 3.1 SO 3.2 SO 3.3 SO 3.4 SO 3.5		Unit-3 : Chemical Equilibrium 3.1, 3.2,3.3,3.4,3.5,3.6,3.7	• Gibbs free energy • Van't Hoff factors
PO1,2,3,4, 5,6 7,8,9,10,11 ,12 PSO 1,2, 3, 4	CO4: **d**iscuss principle of chromatography and analyze different components of a mixture quantitatively by applying chromatographic principle.	SO 4.1 SO 4.2 SO 4.3 SO 4.4 SO 4.5		Unit-4 Chromatography 4.1,4.2,4.3,4.4,4.5,4.6, 4.7	To understand the chromatographic principle students must read about • Nature of compound (polar/non-polar)

PO1,2,3,4, 5,6 7,8,9,10,11 ,12 PSO 1,2, 3, 4	CO5: discuss basic concept of spectroscopy and analyze unknown component qualitatively & quantitatively and also identify the functional groups of a molecule on the basis of their stretching and bending vibrations	SO 5.1 SO 5.2 SO 5.3 SO 5.4 SO 5.5		Unit 5: **Spectral techniques of analysis** 5.1,5.2,5.3,5.4,5.5,5.6,5.7	Basics of absorption spectroscopy: • Electromagnetic radiation, • Spectral range • AbsorbanceAbsorptivity, Molar Absorptivity

Curriculum Development Team:

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Course Code	Course Title	L	T	P	Total Credits
2GO101	**Physical Geology**	**4**	**0**	**4**	**6**

Course Code: 2GO101

Course Title: Physical Geology

Pre-requisite: To study this course a student must have had the subject Mathematics group or Biology group in the 12 class Student should have basic knowledge of scope and purpose of geology .

Rationale: The course will formulate an understanding and working knowledge of the composition, structure and processes active inside and outside the Earth. The course will demonstrate that the planet is a completely integrated, continually evolving and dynamic system. The study of geology is not just a question of understanding the Earth processes it is also aimed at creating an awareness of how it affects our life and our responsibility to the planet and its future.

Course Outcomes:

2GO101.1: Basic concept of geology and its branches and general introduction about Earth and solar system.
2GO101.2: Explain the theory of plate tectonics and its relationship to earth processes, features, and landforms.
2GO101.3: Describe and explain processes operating on the surface of the Earth and the resulting landforms and features.
2GO101.4: Explain geological work of natural agency work on the surface of the Earth and the resulting landforms and features.
2G0101.5: Explain the Ocean morphology and glacial morphology.

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies(Hours/Week)						Total Credits (C)
			CI	T	LI	SW	SL	Total Study Hours(CI+LI+T+SW+SL)	
Minor (DSE)	2GO101	Physical Geology	4	0	4	1	1	8	6

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory, workshop, field or other locations using different instructional strategies)

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SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Board of Study	Course Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	**(ESA)**	(PRA + ESA)
PCC		Physical Geology	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

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Curriculum of B. Sc.(Honours/ By Research) Program

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2GO101.1: Basic concept of geology and its branches and general introduction about Earth and solar system.

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	12
SW	1
SL	1
Total	26

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 Introduction to geology, its branches and importance. **SO1.2** Introduction to solar system; Star, Planet, Satellite, asteroid and meteorite. **SO1.3** Origin of the Earth – Planetesimal hypothesis. **SO1.4.** Interior of the Earth Crust , Mantle ,Core. **SO1.5** Age of The Earth, radioactivity methods, Geological time scale.	1.1 Numbering and reading of topographical maps of the Survey of India. 1.2 Identification of geomorphic landforms, drainage patterns on topographic map.	**Unit-Introduction to geology** 1.7 ranches of geology. 1.8 olar system and its member. 1.9 rigin of the Earth. 1.10 lanetesimal hypothesis. 1.11 idal hypothesis. 1.12 Introduction to Interior of the Earth. 1.13 ore, Mantle and Core properties. 1.14 Introduction of Age of the Earth. 1.15 adioactive method of age determination. 1.1 6 Core, Mantle and Core properties. 1.17Introduction of Age of the Earth. 1.2 adioactive method of age determination.	1. Overview of Earth and its features through Atlas.

SW-1 Suggested Sessional Work (SW):

A. **Assignments:**
   1. Age of the earth.
   2. Origin of the earth.
B. **Mini Project:**
   1. Flow diagram of geological time scale.
C. **Other activites:**
   1. Interior of the Earth.

2GO101.2: Explain the theory of plate tectonics and its relationship to earth processes, features, and landforms.

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 Concept and theory of Isostasy **SO2.2** Continental drift and Sea floor spreading and evidences. **SO2.3** Concept of Plate tectonics. **SO2.4** tectonic plates and	2.1 Plotting of continents and ocean in the world map to understand configuration of Earth surface. 2.2 Mark plate boundaries in world map.	**Unit-2:** Dynamic Earth 2.1 Concept of Isostasy. 2.2 Airys and Pratt hypothesis. 2.3 Continental drift Theory. 2.4 Sea floor spreading theory. 2.5 Concept of Plate tectonics. 2.6 Types of plate boundaries.	1. Overview of Earth and its features through Atlas.

types, and plate boundaries. **SO2.5** Mid-oceanic Ridges, Trenches and Island arcs.		2.7 Mid Oceanic Ridge. 2.8 Trenches 2.9 Island arcs **Tutorial** 2.1 Continental drift Theory. 2.2 Sea floor spreading theory. 2.3 Concept of Plate tectonics.	

SW-2 Suggested Sessional Work (SW):

c. **Assignments:**
iv. Plate tectonic theory.
v. Continental drift theory.

d. **Mini Project:**
1. Representation of plate boundary and type of plate movement in world map.

e. **Other Activities (Specify):**
1. Make a poster on continental drift.

2GO101.3: Describe and explain processes operating on the surface of the Earth and the resulting landforms and features.

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	12
SW	2
SL	1
Total	33

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 Earthquake-causes, effects and distribution. Seismic zones of India **SO3.2** Volcanoes; types and landforms. Volcanic zones of world. **SO3.3** Fundamental Concepts of geomorphology. **SO3.4** Rock weathering and its type. **SO3.5** Soil formation, soil profile and types of soil.	3.1 Plotting of seismic zones map of India. 3.2 Mark physiographic division of India. .	**Unit-3** Geomorphic processes 3.1 Earthquake and seismic waves. 3.2 Earthquake causes and its effect. 3.3 Volcano and its causes and effect. 3.4 Ring of Fire. 3.5 Concepts of Geomorphology. 3.6 Weathering and Erosion. 3.7 types of weathering. 3.8 Soil/Soil Profile. 3.9 distribution of soil in India. **Tutorial** 3.1 Earthquake and seismic waves. 3.2 Concepts of Geomorphology. 3.3 Soil/Soil Profile.	(1) Read some important earthquakes of India and reason of that earthquake.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

1. Earthquake-cause and its distribution in India.
2. Write weathering and types of weathering.

b. **Mini Project:**

1. Prepare a soil map of India.
2. Prepare a map Seismic Zone of India

c. Other Activities (Specify):

1. Write significance of Ring of Fire.

2GO101.4: Explain geological work of natural agency work on the surface of the Earth and the resulting landforms and features.

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	12
SW	2

SL	1
Total	33

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO4.1 Geomorphic processes and agents. River, wind glacier, ocean. **SO4.2** Geological works of River and its landforms **SO4.3** Drainage system and introduction of Wetlands. . **SO4.4** Geological works of Groundwater and karst topography **SO4.5** Geological works of Wind and its landforms , Introduction of desert.	4.1 plotting of major mountain ranges, lakes and rivers on map of India. 4.2 Study of important geomorphological models.	**Unit-4: Geological works:** 4.1 Geomorphic processes. 4.2 Natural agencies wind, river, groundwater, glacier. 4.3 Geological work of River. 4.4 Fluvial landform. 4.5 Drainage system. 4.6 Work of groundwater. 4.7 Karst topography. 4.8 Desert and work of wind. 4.9 Aeolian landform. **Tutorial** 4.1 Natural agencies wind, river, groundwater, glacier. 4.2 Work of groundwater. 4.3 Desert and work of wind.	1. ind out world major deserts 2. verview of glacial area in world.

SW-4 Suggested Sessional Work (SW):

b. Assignments:

1. Write significance of normal cycle of Erosion.
2. Write down wind cycle of erosion and landform produced by wind.

c. **Mini Project:**

1. Prepare a geomorphologic model of fluvial landforms.

2. Prepare poster of Karst topography.

d. Other Activities (Specify):

1. Presentation on geomorphic processes and natural agencies.

2GO101.5: Explain the Ocean morphology and Glacial morphology.

Approximate Hours

Item	Approx. Hrs
Cl	12
T	12
LI	12
SW	2
SL	1
Total	21

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO5.1 Geological works of Glacier and glacial topography. **SO5.2** Fluvio glaciated and glaciated Landform. **SO5.3** Ocean Morphology. . **SO5.4** Features of Ocean, landform produced by ocean **SO5.5** Significance of Geomorphology.	5.1 Study of important geomorphologic models.. 5.2 Study of important geomorphologic models.	**Unit 5:** Glacier and Ocean. 5.1 Glacier in World and its Significance. 5.2 Glacial Landforms 5.3 ocean currents and Waves. 5.4 Ocean Features and hypsometric curve. 5.5 Ocean Landforms. 5.6 Role of Geomorphology. 5.7 Toposheet map study 5.8 Toposheet map utilization in Field 5.9 Role of field in geology. **Tutorial** 5.1 Ocean Features and hypsometric curve. 5.2 Toposheet map utilization in Field. 5.3 Role of field in geology.	1. Glacier of world. 2. Glacier in India.

SW-5 Suggested Sessional Work (SW):

d. Assignments:
1. Make assignment in features of ocean and function of oceanic waves and currents.

e. **Mini Project:**
1. Prepare power point presentation for application of Geomorphology.

f. Other activities.
1. Make a power point presentation on use of geomorphology in hydrogeology.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)

1GE101.1: Basic concept of geology and its branches and general introduction about Earth and solar system.	12	12	2	1	27
1GE101.2: Explain the theory of plate tectonics and its relationship to earth processes, features, and landforms.	12	12	2	1	27
1GE101.3: Describe and explain processes operating on the surface of the Earth and the resulting landforms and features.	12	12	2	1	27
1GE101.4: Explain geological work of natural agency work on the surface of the Earth and the resulting landforms and features.	12	12	2	1	27
1GE101.5: Explain the Ocean morphology and Glacial morphology.	12	12	2	1	27
Total Hours	60	60	10	5	135

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Introduction to geology	03	01	01	05
CO-2	Dynamic Earth	02	06	02	10
CO-3	Geomorphic processes	03	07	05	15
CO-4	Geological works of River, wind,	-	10	05	15

	groundwater.				
CO-5	Ocean and glacier morphology.	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Physical Geology will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

19. Improved Lecture
20. Tutorial
21. Case Method
22. Group Discussion
23. Role Play
24. Visit to cement plant
25. Demonstration
26. ICT Based Teaching Learning (VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
27. Brainstorming

Suggested Learning Resources:

(c) **Books**:

S. No.	Title	Author	Publisher	Edition Year
1	Introduction to Geology	G.B.Mahapatra	CBS publication	January 2019
2	A Text Book of Geology	P.K. Mukherjee	ISBN-10	January 2010
3	Engineering And General Geology	Parbin Singh	ISBN-10	January 2010

4	Principles of Engineering Geology.	K.M. Banger	CBS publication	1995
5	Principles of Geomorphology	W.D. Thournbury	Wiley publication	1954

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(Revised as on 01 August 2023)

Cos, Pos and PSOs Mapping

Program Title: B.Sc Physical geology
Course Code: 1GE101:
Course Title: B. Sc (Geology Hons)

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Knowledge.	Research aptitude.	Communication.	Problem solving.	Individual and team work.	Investigation of Problem.	Modern tool usage	Science and Society.	Life-long learning	Ethics	Project management and finance:	Environment and sustainability.	The detailed functional knowledge of Theoretical concepts and experimental concepts of geology.	Ability Word skills and advanced GIS, statistics, databases, spreadsheets, digital drawing through online workbooks and workshops	Develop a research design, which has an appropriate problem related to earth	Provide an excellent preparation for a career in professional practice in
CO-1 Basic concept of geology and its branches and general introduction about Earth and	3	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1
CO-2 Explain the theory of plate tectonics and its relationship to earth processes, features,	2	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1

CO-3 Describe and explain processes operating on the surface of the Earth and the resulting landforms and	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO-4 Explain geological work of natural agency work on the surface of the Earth and the resulting	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO-5 Explain the Ocean morphology and Glacial morphology.	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,67,8,9,10,11,12 PSO1,2,3,4	CO-1 Basic concept of geology and its branches and general introduction about Earth and solar system.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1 1.2	Unit-1.0 Dynamic Earth 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9 Tutorial 1.1, 1.2, 1.3	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-2 Explain the theory of plate tectonics and its relationship to earth processes, features, and landforms.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1 2.2	Unit-2 Dynamic Earth 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9 Tutorial 2.1, 2.2, 2.3	As mention in page number 2 to 6
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-3 Describe and explain processes operating on the surface of the Earth and the resulting landforms and features.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1 3.2	Unit-3 : Geomorphic processes 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9 Tutorial 3.1, 3.2, 3.3	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-4 Explain geological work of natural agency work on the surface of the Earth and the resulting landforms and features.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1 4.2	Unit-4: Geological works 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9 Tutorial 4.1, 4.2, 4.3	

PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-5 Explain the Ocean morphology and Glacial morphology.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1 5.2	Unit5: 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9 Tutorial 5.1, 5.2, 5.3	

Curriculum Development Team:

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(Revised as on 01 August 2023)

B.Sc. (IInd semester)

Course Code: **0FO201**

Course Title: **Environmental studies**

Pre-requisite: To study this course, the student must have a knowledge about the environmental components, pollution, biodiversity, and ecosystem at senior secondary,

Rationale: The students studying Environmental Science should possess foundational understanding about environment and its components. They should also know the importance of ecosystems in our surroundings.

Course Outcomes:

0FO201.1: To understand various aspects of life forms, ecological processes, and the impacts on them by the human during Anthropocene era.

0FO201.2: To build capabilities to identify relevant environmental issues, analyze the various underlying causes, evaluate the practices and policies, and develop framework to make inform decisions.

0FO201.3: To develop empathy for all life forms, awareness, and responsibility towards environmental protection and nature preservation.

0FO201.4: To develop the critical thinking for shaping strategies such as; scientific, social economic. administrative & legal. environmental protection, conservation of biodiversity environmental equity and sustainable development.

0FO201.5: To prepare for the competitiveexams.

SchemeofStudies:

Board ofStudy	**CourseCode**	**CourseTitle**			**Scheme of studies(Hours/Week)**			**TotalCredits (C)**
			Cl	**LI**	**SW**	**SL**	**Total StudyHours(CI+LI+SW+SL)**	
Program Core (FC)	0FO201	Environmental studies	2	0	1	1	5	2

Legend:

CI: ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.,Lecture(L)andTutorial (T)andothers),
LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworkshop, field or other locations using different instructional strategies)
SW: Sessional Work(includesassignment, seminar, miniprojectetc.),

SL: SelfLearning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacherto ensureoutcomeofLearning.

SchemeofAssessment:

Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment	Total Marks
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	(ESA)	(PRA + ESA)
PCC	0FO 201	Environmental Science	15	20	5	5	5	50	50	100

Course-CurriculumDetailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

0FO201.1: To understand various aspects of life forms, ecological

processes, and the impacts on them by the human during Anthropocene era.

Approximate Hours

Item	AppX Hrs.
Cl	08
LI	0
SW	1
SL	2
Total	11

SessionOutcomes (SOs)	Laboratory Instruction (LI)	ClassroomInstruction (CI)	Self-Learning (SL)
SO1.1Know multidisciplinary nature of environmental science. SO1.2 Learn about the natural resources. SO1.3Know the problems associated with land resource. SO1.4Learn the conservation of resources. SO1.5 Know alternative energy resources.	.	**Unit-1 Environment and Natural Resources:** 1.1 The Multidisciplinary nature of environmental studies. 1.2 Scope and Importance of Environmental studies 1.3 Components of Environment: Atmosphere, Hydrosphere, Lithosphere, and Biosphere. 1.4 Brief account of Natural Resources and associated problems 1.5 Land Resource 1.6 Water Resource 1.7 Energy Resource 1.8 Concept of Sustainability and Sustainable Development	i. What is environmental Science? ii. What are resources?

SW-1 SuggestedSessionalWork(SW):

a. **Assignments:**
   i. Write thedefinition and causes of soil erosion.
   ii. Define desertification and write its causes.
   iii. Describe structure of atmosphere.
   iv. Explain lithosphere.

0FO201.2: To build capabilities to identify relevant environmental issues, analyze the various underlying causes, evaluate the practices and policies, and develop framework to make inform decisions.

Approximate Hours

Item	AppXHrs
Cl	05
LI	0
SW	2
SL	2
Total	09

SessionOutcomes (SOs)	LaboratoryInstruction (LI)	ClassroomInstruction (CI)	Self-Learning (SL)
SO2.1 Understand the concept of ecosystem. **SO2.2**Learn the structure of ecosystem. **SO2.3**Know the function of ecosystem. **SO2.4**Describe the structure of forest ecosystem. **SO2.**5 Learn about biodiversity and its conservation.		Unit-2 Biomes, **Ecosystem and Biodiversity** 2.1 Major Biomes: Tropical, Temperate, Forest, Grassland, Desert, Tundra, Wetland, Estuarine and Marine 2.2 Ecosystem: Structure 2.3 Function and types 2.4 their Preservation & Restoration 2.5 Biodiversity and its conservation practices.	i.What is biotic and abiotic components of environment ? ii. What are interactions?

SW-2 SuggestedSessionalWork(SW):

a. Assignments:

i. What do you mean by ecosystem? Describe the structure of ecosystem.
ii. Give a brief classification of ecosystem.
iii. Write the function of an ecosystem.
iv. Define biodiversity write strategies of biodiversity conservation.

b. MiniProject:

Visit to various ecosystem and study biotic and abiotic ecosystem.

0FO201.3: To develop empathy for all life forms, awareness, and responsibility towards environmental protection and nature preservation.

Approximate Hours

Item	AppXHrs
Cl	07
LI	0
SW	02
SL	2
Total	11

SessionOutcomes (SOs)	**LaboratoryInstruction (LI)**	**ClassroomInstruction (CI)**	**Self-Learning (SL)**
SO3.1. Learn about pollution and its sources. **SO3.2**Know the sources of different pollutant. **SO3.3**Understand the law & legislation related to environment. **SO3.4**Learn the control of pollution. 3.1 **SO3.**5 Describe the role of information technology in environment and human health.		**Unit-3:Environmental Pollution, Management and** Social **Issues:** 3.2 Pollution: Types, Control measures, Management and associated problems. 3.3 Environmental Law and Legislation: Protection and conservation Acts. 3.4 International Agreement &**Program** 3.5 Environmental Movements, communication and public awareness Program. 3.6 National and International organizations related to environment conservation and monitoring. 3.7 Role of information technology in environment	i. What is pollution basic introduction? ii. What is pollutant?

		and human health.	

SW-3 SuggestedSessionalWork(SW):

a. Assignments:

i. Write an essay on air pollution.
ii. What do you mean by acid rain write its causes and effects.
iii. Describe the effects of water pollution.
iv. How soil pollution can be control?
v. Describe the role of information technology in environment and human health.
vi. Mention some national and international organizations related to environment conservation and monitoring.

b. OtherActivities(Specify):

Visit to different polluted sites and study the source of pollution and their effects.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
0FO201.1: To understand various aspects of life forms, ecological processes, and the impacts on them by the human during Anthropogenic era.	08	1	2	11
0FO201.2: To build capabilities to identify relevant environmental issues, analyze the various underlying causes, evaluate the practices and policies, and develop framework to make inform decisions.	05	2	2	09
0FO201.3: To develop empathy for all life forms, awareness, and responsibility towards environmental protection and nature preservation.	07	2	2	11
Total Hours	20	05	06	31

Suggestion for End Semester Assessment

SuggestedSpecificationTable(ForESA)

CO	UnitTitles	MarksDistribution			Total Marks
		R	U	A	
CO-1	**Environment and Natural Resources:**	03	01	01	05
CO-2	Biomes, **Ecosystem and Biodiversity**	02	06	02	10
CO-3	**Environmental Pollution, Management and** Social **Issues**	03	07	05	15
Total		11	26	13	50

Legend: R:Remember, U:Understand, A:Apply

Theendofsemesterassessmentfor Fundamental of Environmental Sciencewillbeheldwith written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wiseteachers for above tasks. Teachers can also design different tasks as per requirement, for endsemesterassessment.

SuggestedInstructional/ImplementationStrategies:

1. ImprovedLecture
2. Tutorial
3. CaseMethod
4. GroupDiscussion
5. RolePlay
6. Visit to cement plant
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog ,Facebook,Twitter,WhatsApp,Mobile,Onlinesources)
9. Brainstorming

Suggested Learning Resources:

(a) **Books:**

S. No.	Title	Author	Publisher	Edition&Year

1	Ecology; Environment Science and Conservation	Singh; J.S., Singh S.P. and Gupta, S. R	S. Chand publishing, New Delhi.	2018
2	Perspectives in Environmental Studies	Kaushik, Anubha, Kaushik, C.P.	New age International Publishers	2018
3	A Textbook of Environmental Studies	Asthana, D. K Asthana Meera	S. C1iand.Publishing, New Delhi	2007
4	Environmental Law and Policy in India: Cases, Material & Status	Divan, S. and Rosenkranz, A	Oxford University Press, India	2002

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Cos, POs and PSOs Mapping

Course Code: 0FO201 **Course Title: Environmental studies**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
	Knowledge	Research Aptitude	Communication	Problem Solving	Individual and Team Work	Investigation of Problems	Modern Tool usage	Science and Society	Life-Long Learning	Ethics	Project Management	Environment and sustainability	The detailed functional knowledge of theoretical concepts and experimental aspects of chemistry	To integrate the gained knowledge with various contemporary and evolving areas in chemical sciences like analytical,	understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomenon-based probl	Provide opportunities to excel in academics, research or Industry by research based innovative kno

														synthetic, pharmaceutical etc.	**ems in chemical sciences.**	**wledge for sustainable development in chemical science**
0FO201.1: To understand various aspects of life forms, ecological processes, and the impacts on them by the human during Anthropogenic era.	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**

0FO201.2: To build capabilities to identify relevant environmental issues, analyze the various underlying causes, evaluate the practices and policies, and develop framework to make inform decisions.	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
0FO201.3: To develop empathy for all life forms, awareness, and responsibility towards environmental protection and nature preservation.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

POs &PSOsNo.	Cos No. &Titles	SOsNo.	Laboratory instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	1CH201 **1:** Various theories and principles applied to reveal atomic structure, Significance of quantum numbers .	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 Symmetry and Group Theory 1.1,1.2,1.3, 1.4,1.5,1.6, 1.7	Character tables and their use in spectroscopy.
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	1CH201 Concept of Periodic table & periodic properties of elements of elements..	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2 **Vibrational Spectroscopy** 2.1,2.2,2.3, 2.4,2.5,2.6, 2.7, 2.8,2.9	Resonance Raman Spectroscopy, coherent anti-stokes Raman Spectroscopy (CARS).
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	1CH201 Theories related to chemical bonding	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3 : **Mössbauer Spectroscopy** 3.1, 3.2,3.3,3.4,3.5,3.6,3.7	Nature of M-L bond, coordination number, structure and detection of oxidation state.
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	1CH201 Factors responsible for reactivity of organic molecules	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4 : : **Magnetic Resonance Spectroscopy** 4.1, 4.2,4.3 ,4.4,4.5,4.6,4.7	Quadrupole nuclei, quadrupole moments, electric field gradient, coupling constant splitting. Applications

PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	1CH201 Related the structure and physical properties of drugs to their pharmacological activity. Explain physio-chemical properties related	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit 5: X-ray Diffraction , Electron Diffraction** **Neutron Diffraction** 5.1,5.2,5.3, 5.4,5.5,5. 6,5.7	Low energy electron diffraction and structure of surfaces. ,

Curriculum Development Team

Dr.Mahendra Tiwari Head, Department of Environmental science, AKS University ,Satna

Course Code: **0FO202**

Course Title: **Fundamentals of Indian Knowledge System**

Pre- requisite: Creating awareness among the youths about the true history and past rich culture of India.

Rationale: India has very rich and versatile knowledge system and cultural heritage since antiquity. The Indian Knowledge systems was developed on life science, medical science, literature, drama, art, music, dance, astronomy, mathematics, architecture (Sthapatyaveda), chemistry, aeronautics etc, during ancient period. In this basic course, a special attention is given to the ancient and historical perspective of ideas occurrence in the ancient society, and implication to the concept of material world and religious, social and cultural beliefs. On the closer examination, religion, culture and science have appeared epistemological very rigidly connected in the Indian Knowledge System. This land of Bharat Bhumi has provided invaluable knowledge stuff to the society and the world in all sphere of life.

Course Outcomes:

CO- 0FO202. 1: To understand the ancient civilization, Indian Knowledge Systems, Concept of Panch Mahabhuta, Origin of name Bharat Varsha, Ancient Rivers, Ancient Universities and ancient agriculture.

CO- 0FO202.II: Students will have the ability to learn about ancient books, Religious places, basic concept of Indian dance, music and arts, and fundamental aspects of Sangeeta and Natyashashtra etc.

CO- 0FO202.III: Student will be able to gain knowledge on Vedic Science, Astronomy, Astrovastu, Vedic Mathematics, Aeronautics, Metallurgy, Nakhatras, Panchang, Concept of Zero, Pi and point etc.

CO- 0FO202. IV: Understanding on ancient Engineering, Science and Technology, Town Planning, Temple architecture, Chemistry and Metallurgy, Metal manufacturing etc.

CO- 0FO202. V: Student will able to understand about the Life, Nature and Health through basic concept of Ayurveda andYoga, Traditional Medicinal Systems, Ethnomedicine, Nature conservation, World Heritage Sites etc.

Scheme of Studies:

Category of Course	Cours e Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours CI+LI+SW+SL	
VAC	0FO20 2	Indian Knowledge System	2		1	1	4	2

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Session Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Proposed examination scheme (Marking) as per the recommendation of University Grant Commission (UGC) for Under Graduate Courses in Fundamentals of Indian Knowledge Systems 2022-23 onwards

S. No.	Category of Course/Subject	Components of Marks				Total
		Semester End Examination (External	Mid Term exam (Internal)	Assignment (Internal)	Practical Exam (Internal)	
1	Only Theory Subject Course	03	01	01	05	03
2	Subject/ Course with theory and Practical	02	06	02	10	02
3	Subject/ Course only Practical	03	07	05	15	03

Course-Curriculum Detailing:
This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

0FO202. 1. To understand Indian Civilization and Indian Knowledge Systems

Approximate Hours

Item	Approximate Hours
CI	6
LI	
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 1.1. Understand Overview of Indian Knowledge Systems (IKS) SO 1.2. Understand Classification of Ancient IKS texts SO 1.3. Understand Introduction to Panch Mahabhutas (Earth, Water, Fire, Sky and Air) SO 1.4. Understand Origin of the name Bharatvarsha: the Land of Natural Endowments SO 1.5. Understand Rivers of ancient India (The Ganga, Yamuna, Godawari, Saraswati, Narmada, Sindhu and Kaveri) SO 1.6. Understand Ancient Agriculture and ancient Universities: Takshashila and Nalanda, Gurukul system		**Unit-1. Indian Civilization and Indian Knowledge Systems** 1.1. Overview of Indian Knowledge Systems (IKS) 1.2 Classification of Ancient IKS texts 1.3 Introduction to Panch Mahabhutas (Earth, Water, Fire, Sky and Air) 1.4 Origin of the name Bharatvarsha: the Land of Natural Endowments 1.5 Rivers of ancient India (The Ganga, Yamuna, Godawari, Saraswati, Narmada, Sindhu and Kaveri) 1.6 Agriculture system in ancient India, Ancient Universities: Takshashila and Nalanda, Gurukul system	Golden era of ancient India

SW-1 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Concepts of Panch Mahabhuta, Classification of ancient texts, origin of ancient rivers

b. **Mini Project:**
   i. Ancient Universities: Takshashila and Nalanda,

c. **Other Activities (Specify):**

0FO202. 2: Students will have the ability to apply the knowledge gained about Indian Art, Literature and Religious Places

Approximate Hours

Item	Approximate Hours
CI	6
LI	
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 2.1. Understand the Ancient Indian Books: Vedas, Puranas, Shastras, Upanishads, Mahakavyas (Ramayana & Mahabharata), Smrities, Samhitas SO 2.2. Understand the Religious places: Puries, Dhams, Jyotiralinga, Shaktipeeths, Kumbha Mela SO 2.3. Understand the Legendary places of Madhya Pradesh: Ujjain, Chitrakoot, Omkareshwar, Bharhut, Maihar SO 2.4. Understand the Basic concept of Indian Art, Music and Dance, Indian Musical Instruments SO 2.5. Understand the Fundamental aspects of Sangeeta and Natya shastra SO 2.6. Understand the different schools of music, dance and painting in different regions of India		**Unit-2. Indian Art, Literature and Religious Places** 2.1. Ancient Indian Books: Vedas, Puranas, Shastras, Upanishads, Mahakavyas (Ramayana & Mahabharata), Smrities, Samhitas 2.2. Religious places: Puries, Dhams, Jyotiralinga, Shaktipeeths, Kumbha Mela 2.3. Legendary places of Madhya Pradesh: Ujjain, Chitrakoot, Omkareshwar, Bharhut, Maihar 2.4. Basic concept of Indian Art, Music and Dance, Indian Musical Instruments 2.5. Fundamental aspects of Sangeeta and Natya shastra 2.6. Different schools of music, dance and painting in different regions of India	**1.** Indian Art, Music and Dance

SW-2 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Visit of Chitrakoot, Maihar and Bharhuta

b. **Mini Project:**
   ii. Kumbhmela, Story of Ramayana and Mahabharata

c. **Other Activities (Specify):**

0FO202. 3: Student will be able to understand Ancient Science, Astronomy and Vedic Mathematics

Approximate Hours

Item	Approximate Hours
CI	**6**
LI	
SW	**2**
SL	**1**
Total	**9**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 3.1. Understand Vedic Cosmology SO 3.2. Understand the Astronomy, Astrovastu, Vedang Jyotish, Nakshatras, Navagraha, Rashis, Vastushastra and their related plants SO 3.3. Understand the Time and Calendar, Panchang SO 3.4. Understand the Concept of Zero, Point, Pi -number system, Pythagoras SO 3.5. Understand the Vedic Mathematics, Vimana-Aeronautics, Basic idea of planetary model of Aryabhatta SO 3.6. Understand the Varanamala of Hindi language based on classification of sounds on the basis of their origin, Basic purpose of science of		**Unit-3. Ancient Science, Astronomy, Mathematics** 3.1. Vedic Cosmology 3.2. Astronomy, Astrovastu, Vedang Jyotish, Nakshatras, Navagraha, Rashis, Vastushastra and their related plants 3.3. Time and Calendar, Panchang 3.4. Concept of Zero, Point, Pi -number system, Pythagoras 3.5. Vedic Mathematics, Vimana-Aeronautics, Basic idea of planetary model of Aryabhatta 3.6. Varanamala of Hindi language based on classification of sounds on the basis of their origin, Basic purpose of science of Vyakarana.	1. Ancient Science, Astronomy and Vedic Mathematics

Vyakarana			

SW-2 Suggested Sessional Work (SW):

a. **Assignments:**
   1. Varanamala of Hindi language based on classification of sounds on the basis of their origin

b. **Mini Project:**
   1. Nakshatras, Navagraha and their related plants

c. **Other Activities (Specify):**

0FO202. 4: Understand the Engineering, Technology and Architecture

Approximate Hours

Item	Approximate Hours
CI	**6**
LI	
SW	**2**
SL	**1**
Total	**9**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 4.1. Understand the Engineering Science and Technology in Vedic and Post Vedic Era SO 4.2. Understand the Town and Home planning, Sthapatyaveda SO 4.3. Understand the Chemistry and Metallurgy as gleaned from archeological artifacts SO 4.4. Understand the Chemistry of Dyes, Pigments used in Paintings, Fabrics, Potteries and Glass SO 4.5. Understand the Temple Architecture: Khajuraho, Sanchi Stupa, Chonsath Yogini temple SO 4.6. Understand the Mining and manufacture in India of Iron,		**Unit-4. Engineering, Technology and Architecture** 4.1. Engineering Science and Technology in Vedic and Post Vedic Era 4.2. Town and Home planning, Sthapatyaveda 4.3. Chemistry and Metallurgy as gleaned from archeological artifacts 4.4 Chemistry of Dyes, Pigments used in Paintings, Fabrics, Potteries and Glass 4.5. Temple Architecture: Khajuraho, Sanchi Stupa, Chonsath Yogini temple 4.6. Mining and manufacture in India of Iron, Copper, Gold from ancient times	2. Ancient Science, Astronomy and Vedic Mathematics

Copper, Gold from ancient times			

SW-2 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Varanamala of Hindi language based on classification of sounds on the basis of their origin

b. **Mini Project:**
   i. Nakshatras, Navagraha and their related plants

c. **Other Activities (Specify):**

0FO202. 5: Understand about the Life, Nature and Health

Approximate Hours

Item	Approximate Hours
CI	6
LI	
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 5.1. Understand the Fundamentals of Ayurveda (Charaka & Shushruta) and Yogic Science (Patanjali),Ritucharya and Dinacharya SO 5.2. Understand the Traditional system of Indian medicines (Ayurveda, Siddha, Unani and Homoeopathy) SO 5.3. Understand Fundamentals of Ethnobotany and Ethnomedicines of India SO 5.4. Understand the Nature Conservation in Indian ancient texts SO 5.5. Understand the Introduction to Plant Science in Vrikshayurveda SO 5.6. Understand the World Heritage Sites of Madhya Pradesh: Bhimbetka, Sanchi, Khajuraho		**Unit-5. Life, Nature and Health** 5.1. Fundamentals of Ayurveda (Charaka & Shushruta) and Yogic Science (Patanjali), Ritucharya and Dinacharya 5.2. Traditional system of Indian medicines (Ayurveda, Siddha, Unani and Homoeopathy) 5.3. Fundamentals of Ethnobotany and Ethnomedicines of India 5.4. Nature Conservation in Indian ancient texts 5.5 Introduction to Plant Science in Vrikshayurveda 5.6. World Heritage Sites of Madhya Pradesh: Bhimbetka, Sanchi, Khajuraho	1. Concept of Ayurveda and Yoga 2. Traditional system of Indian medicines 3. Ethnobotany and Ethnomedicines of India 4. World Heritage Sites

SW-2 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Visit to world Heritage Site Khajuraho
b. **Mini Project:**
   i. Ritucharya and Dincharya, Ethnomedicinal plants
c. **Other Activities (Specify):**

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
0FO202. 1: To understand Indian Civilization and Indian Knowledge Systems	**6**	**2**	**1**	**9**
0FO202. 2: Students will have the ability to apply the knowledge gained about Indian Art, Literature and Religious Places	**6**	**2**	**1**	**9**
0FO202. 3: Student will be able to understand the Ancient Science, Astronomy and Vedic Mathematics	**6**	**2**	**1**	**9**
0FO202. 4: Understand the Engineering, Technology and Architecture	**6**	**2**	**1**	**9**
0FO202. 5: Understand about the Life, Nature and Health	**6**	**2**	**1**	**9**
Total	**30**	**10**	**5**	**45**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO 1	Indian Civilization and Indian Knowledge Systems	**2**	**5**	**1**	**8**
CO 2	Indian Art, Literature and Religious Places	**2**	**6**	**2**	**8**
CO 3	Ancient Science, Astronomy and Vedic Mathematics	**2**	**6**	**5**	**13**
CO 4	Engineering, Technology and Architecture	**2**	**4**	**4**	**10**
CO 5	Life, Nature and Health	**2**	**5**	**2**	**9**
Total		**10**	**26**	**14**	**50**

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Indian Knowledge Systems** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course teacher for above tasks. Teacher can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to Religious places, World Heritage Sites
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	An Introduction of Indian Knowledge Systems: Concept and Applications	Mahadevan, B.; Bhat V. R. and Pavana, Nagendra R. N.	Prentice Hall of India.	2022
2	Indian Knowledge Systems: Vol. I and II.	Kapoor, Kapil and Singh, A. K.	D.K. Print World Ltd	2005
3	Science of Ancient Hindus: Unlocking Nature in Pursuit of Salvation	Kumar, Alok	Create pace Independent Publishing	2014
4	A History of Agriculture in India	Randhava, M.S.	ICAR, New Delhi	1980
5	Panch Mahabhuta,	Yogcharya, Jnan Dev	Yog Satsang Ashram	2021
6	The Indian Rivers	Singh, Dhruv Sen	Springer	2018
7	The Wonder That Was India	Basam, Arthue Llewllyn	Sidgwick & Jackson	1954
8	Ancient Cities, Sacred Skies: Cosmic Geometries and City Planning in Ancient India	Malville, J. MacKim & Gujaral, Lalit M.	IGNCA & Aryan Books International, New Delhi	2000
9	The Natya Shastra of Bharat Muni	Jha, Narendra	Innovative Imprint, Delhi	2023
10	Astronomy in India: A Historical Perspective	Padmanabhan, Thanu	Indian National Science Academy, New Delhi &	2010

			Springer (India).	
11	History of Astronomy in India 2nd Ed.	Sen, S.N. and Shukla, K.S.	INSA New Delhi	2001
12	History of Indian Astronomy A Handbook	Ramasubramanian, K.; Sule, Aniket and Vahia, Mayank	Science and Heritage Initiative, I.I.T. Mumbai and Tata Institute of Fundamental Research, Mumbai	2016
13	Indian Mathematics and Astronomy: Some Landmarks	Rao, Balachandra S.	Jnana Deep Publications, Bangalore, 3rd Edition	. 2004
14	Vedic Mathematics and Science in Vedas	Rao, Balachandra S.	Navakarnataka Publications, Bengaluru	2019
15	A History of Hindu Chemistry	Ray, Acharya Prafulla Chandra	Repbl Shaibya Prakashan Bibhag, Centenary Edition, Kolkata	1902
16	Early Indian Architecture: Cities and City Gates	Coomeraswamy, Anand	Munciram Manoharlal Publishers	2002
17	Theory and Practices of Temple Architecture in Medieval India: Bhojas samrangasutradhar and the Bhojpur Line Drawings	Hardy, Adams	Dev Publishers & Distributors.	2015
18	Indian Science and Technology in Eighteenth Century	Dharmpal	Academy of Gandhian Studies, Hyderabad.	1971
19	Science in India: A Historical Perspective	Subbarayappa, B.V.	Rupa New Delhi	2013
20	Fine Arts & Technical Sciences in Ancient India with special reference to Someswvara's Manasollasa	Mishra, Shiv Shankar	Krishnadas Academy, Varanasi	1982
21	Fundamental Principles of Ayurveda, Volume One	Lad, Vasant D.	The Ayurvedic Press, Alboquerque, New Mexico.	2002
22	Charak Samhita, Chaukhamba	Pandey, Kashinath and Chaturvedi Gorakhnath	Vidya Bhawan, Varanasi	
23	Ayurveda: The Science of Self-Healing	Lad, Vasant D.	Lotus Press: Santa Fe	1984
24	Ayurveda: Life, Health and Longevit	Svoboda, Robert E	Penguin: London	1992
25	Plants in the Indian Puranas	Sensarma, P.	Naya Prokash, Calcutta	1989
26	Indian Cultural Heritage Perspective for Tourism	Singh, L. K.	Gyan Publishing House, Delhi	2008
27	Glimpses of Indian Ethnobotany	Jain, S.K.	Oxford & IBH Publishing Company Private	1981

			Limited, New Delhi	
28	Manual of Ethnobotany	Jain, S.K.	Scientific Publishers, Jodhpur	2010

Cos, POs and PSOs Mapping

Course Code: 0FO202
Course Title: Fundamentals of Indian Knowledge System

Coursze Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Knowledge	Research Aptitude	Communication	Problem Solving	Individual and Team Work	Investigation of Problems	Modern Tool usage	Science and Society	Life-Long Learning	Ethics	Project Management	Environment and sustainability	The detailed functional knowledge of theoretical concepts and experimental aspects of chemistry	To integrate the gained knowledge with various contemporary and evolving areas in chemical sciences like analytical, synthe	understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomeno	Provide opportunities to excel in academics, research or Industry by research based inno

														tic, pharmaceutical etc.	**n-based problems in chemical sciences.**	**vative knowledge for sustainable development in chemical science**
CO-1: To understand the ancient civilization, Indian Knowledge Systems, Concept of Panch Mahabhuta, Origin of name Bharat Varsha, Ancient Rivers, Ancient Universities and ancient agriculture.	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**

CO-2: Students will have the ability to learn about ancient books, Religious places, basic concept of Indian dance, music and arts, and fundamental aspects of Sangeeta and Natyashashtra etc.	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
CO-.3: Student will be able to gain knowledge on Vedic Science, Astronomy, Astrovastu, Vedic Mathematics, Aeronautics, Metallurgy, Nakhatras, Panchang, Concept of Zero, Pi and point etc.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO- 4: Understanding on ancient Engineering,	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**

Science and Technology, Town Planning, Temple architecture, Chemistry and Metallurgy, Metal manufacturing etc.																
2		**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**

Legend:1–Low,2–Medium, 3–High

Course Curriculum Map:

POs & PSOs No.	Cos No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning (SL)
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**CO-1:** To understand the ancient civilization, Indian Knowledge Systems, Concept of Panch Mahabhuta, Origin of name Bharat Varsha, Ancient Rivers, Ancient Universities and ancient agriculture.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1**: Indian Civilization and Indian Knowledge Systems 1.1,1.2,1.3,1.4,1.5,1.6	As mentioned
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**CO-2:** Students will have the ability to learn about ancient books, Religious places, basic concept of Indian dance, music and arts, and fundamental aspects of Sangeeta and Natyashashtra etc.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**Unit-2:** Indian Art, Literature and Religious Places 2.1,2.2,2.3,2.4,2.5,2.6	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**CO-.3:** Student will be able to gain knowledge on Vedic Science, Astronomy, Astrovastu, Vedic Mathematics, Aeronautics, Metallurgy, Nakhatras, Panchang, Concept of Zero, Pi and point etc.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3**: Ancient Science, Astronomy and Vedic Mathematics 3.1, 3.2,3.3,3.4,3.5,3.6	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**CO- 4:** Understanding on ancient Engineering, Science and Technology, Town Planning, Temple architecture, Chemistry and Metallurgy, Metal manufacturing etc.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4:** Engineering, Technology and Architecture 4.1, 4.2,4.3,4.4,4.5,4.6	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**CO- 5:** Student will able to understand about the Life, Nature and Health through basic concept of Ayurveda andYoga, Traditional Medicinal Systems, Ethnomedicine, Nature conservation, World	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit 5: **Life, Nature and Health** 5.1,5.2,5.3,5.4,5.5,5.6	

	Heritage Sites etc.				

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Course Code	Course Title	L	T	P	Total Credits
1CS201	**Programming methodology & data structures**	3	1	1	5

Course Code: **1CS201**

Course Title : **Programming Methodology & Data Structures**

Pre-requisite: Students should have a basic understanding of computers, including hardware, software, and operating systems, as well as fundamental mathematical concepts. They should be familiar with programming basics such as variables, data types, control structures, and functions in C. Problem-solving skills and logical thinking are essential for algorithmic understanding.

Rationale: This syllabus aims to provide students with a comprehensive foundation in programming and data structures using C++. It emphasizes fundamental concepts such as program development stages, variable manipulation, control structures, and functions. Through practical exercises and examples, students develop problem-solving skills and logical thinking abilities crucial for software development. The syllabus is designed to equip students with the necessary knowledge and skills to understand and implement algorithms efficiently. By covering essential data structures like arrays, linked lists, queues, trees, and graphs, it prepares students for real-world programming challenges and fosters their ability to design and analyze algorithms effectively in various computing applications.

Course Outcomes:

1CS201.1: Develop simple algorithms and flow charts to solve a problem with programming using top down design principles.

1CS201.2 Learn to formulate iterative solutions and array processing algorithms for problems.

1CS201.3: Will be familiar with fundamental data structures, their implementation; become accustomed to the description of algorithm in both functional and procedural styles

1CS201.4: Have knowledge of complexity of basic operations like insert, delete, and search on these data structures.

1CS201.5: Possess ability to choose a data structure to suitably model any data used in computer applications.

Scheme of Studies:

Board of Study	**Cours eCode**	**CourseTitle**	Scheme of studies(Hours/Week)					**TotalCredits (C)**
			Cl	**LI**	**SW**	**SL**	**Total StudyHours(CI+LI+SW+SL)**	

Program Core (PCC)	**1CS201**	Programming methodology & data structures	4	1	1	1	7	5

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T)and others).
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sectional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacherto ensureoutcomeofLearning.

Scheme of Assessment:

Theory

Board of Study	Course Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	**(ESA)**	(PRA+ ESA)
Program Core (DCC)	**1CS 201**	Programming methodology & data structures	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1CS201.1: Develop simple algorithms and flow charts to solve a problem with programming using top down design principles.

Approximate Hours

Item	Appx Hrs.
Cl	10
LI	4
SW	1
SL	1
Total	15

Session Outcomes (SOs)	(LI)	Classroom Instruction (CI)	(SL)
SO1.1 Understand the fundamental concepts of programming, including program structure, characteristics, and development stages, enabling students to comprehend the principles underlying software development processes. **SO1.2**Master the manipulation of variables in C++, covering declaration, definition, initialization, and scope, as well as the utilization of named constants, keywords, and data type casting, facilitating proficient variable management within programs. **SO1.3**Gain proficiency in utilizing operators, including arithmetic, logical, and bitwise operators, and comprehend their precedence in expressions, empowering students to construct and evaluate complex expressions accurately in C++. **SO1.4**Develop the ability to design and represent algorithms using appropriate notations and flowcharts, enabling students to translate problem-solving strategies into algorithmic	**LI1.1**Problem analysis, algorithm design, coding, testing, maintenance. **LI1.2**. Declare, scope, and use named constants **LI1.3.** Explain arithmetic, logical, bitwise operators and their precedence with the help of program. Introduce the concept of programming and its characteristics.	**Unit-1** 1.1. Introduce the concept of programming and its characteristics. 1.2. Discuss the stages involved in program development, including analysis, design, coding, testing, and maintenance. 1.3.Explain algorithms and their importance in problem-solving, illustrating with examples. 1.4.Introduce different notations used in programming, such as pseudocode and flowcharts, and demonstrate how to use them for algorithmic representation. 1.5.Teach the process of declaring, defining, and initializing variables in C++, including variable scope and the use of named constants. 1.6.Cover keywords and their significance in C++ programming. 1.7.Explain data type casting and its role in type conversion. 1.8. Discuss arithmetic, logical, and bitwise operators in C++, including their usage and precedence in expressions. 1.9. Demonstrate how to write comments effectively in programs to enhance code readability and documentation. 1.10. Illustrate simple expressions in C++, including unary and binary operator expressions, with practical examples to reinforce understanding.	

solutions effectively. **SO1.5**.Explore different programming methodologies and understand their implications on software development, equipping students with the knowledge to choose suitable methodologies for various project requirements and contexts.			

1CS201.2: Learn to formulate iterative solutions and array processing algorithms for problems.

Approximate Hours

Item	Appx Hours
Cl	10
LI	4
SW	1
SL	1
Total	15

Session Outcomes (SOs)	(LI)	Classroom Instruction (CI)	(SL)
SO2.1 Understand and apply conditional statements (if, switch) for decision-making. **SO2.2**Implement iterative statements (while, do-while, for) with break and continue for loop control. **SO2.3**Utilize nested statements for complex decision-making and loops. **SO2.4**Master top-down function design, including predefined and user-defined functions. **SO2.5**Differentiate between local and global variables, grasp default	**LI2.1** Program on Conditional statements **LI2.2** Program on Loop. **LI2.**3 Program on functi	**Unit 2.** 2.1.Introduce conditional statements (if-else, switch-case) and their syntax. 2.2. Explain iterative statements (while, do-while, for) with examples. 2.3. Discuss the use of break and continue within loops for control flow. 2.4. Explore nested statements for creating complex conditional and iterative structures. 2.5. Teach top-down function design principles and the difference between predefined and user-defined functions. 2.6. Explain the concept of local and global variables within functions.	

arguments, call-by-value, call-by-reference, and recursion principles in functions.	on. **LI2.**4 Program on function.	2.7. Demonstrate functions with default arguments and parameter passing methods (call-by-value, call-by-reference). 2.8. Introduce recursion and its implementation in functions. 2.9. Discuss member accessing in structures and demonstrate pointers to structures. 2.10. Explain the interaction between structures and functions, including arrays of structures.	

1CS201.3: Will be familiar with fundamental data structures, their implementation; become accustomed to the description of algorithm in both functional and procedural styles

Approximate Hours

Item	Appx Hours
Cl	15
LI	4
SW	1
SL	1
Total	20

Session Outcomes (SOs)	**(LI)**	**Classroom Instruction (CI)**	**(SL)**
SO3.1 Understand fundamental concepts of data structures, distinguishing between linear and non-linear structures. **SO3.2**Comprehend the representation of arrays, including single and two-dimensional arrays, as well as sparse matrices, in both array and linked list implementations. **SO3.3**Master stack operations and implementations using arrays and linked lists, and apply stacks in applications such as infix to postfix conversion, postfix expression evaluation, and recursion. **SO3.**4 Learn about singly linked lists, including operations and concatenation.	**LI3.1** Program on one and 2 dimensional array implementation **LI3.2** Program on array and linked representation of stack. **LI3.3**. Program for implementing link list.	**Unit-3 :** 3.1 Introduce basic concepts of data structures, emphasizing the distinction between linear and non-linear structures. 3.2. Explain the representation of arrays, covering single and two-dimensional arrays, and sparse matrices in both array and linked list forms. 3.3.Demonstrate stack operations and implementations using both array and linked list approaches. 3.4Illustrate applications of stacks including infix to postfix conversion, postfix expression evaluation, and recursion. 3.5Teach the implementation of singly linked lists, covering operations such as insertion, deletion, and traversal. 3.6Discuss concatenation operations in singly	

SO3.5 Explore circularly linked lists, understanding their operations and applications. **SO3.6**Understand doubly linked lists, including their operations and advantages over singly linked lists. **SO3.7**Apply knowledge of linked lists to solve practical problems and understand their significance in data structure implementations.		linked lists. 3.7Introduce circularly linked lists, explaining their operations and advantages. 3.8Explain the concept of doubly linked lists and compare them with singly linked lists. 3.9 Demonstrate operations like insertion, deletion, and traversal in doubly linked lists. 3.10 Discuss the application of linked lists in practical scenarios. 3.11 Conduct exercises to reinforce understanding and problem-solving skills related to data structures. 3.12 Provide examples of real-world applications that utilize data structures covered in the lesson. 3.13 Encourage students to brainstorm and discuss potential use cases for each data structure. 3.14Assign programming exercises to implement and manipulate data structures studied in class. 3.15 Conclude the session with a recap of key concepts and their practical relevance.	

1CS201.4: Have knowledge of complexity of basic operations like insert, delete, search on these data structures.

Approximate Hours

Item	Appx Hours
Cl	15
LI	4
SW	1
SL	1
Total	20

Session Outcomes (SOs)	(LI)	Classroom Instruction (CI)	(SL)

SO4.1 Understand queue operations and implementations. **SO4.2**Master circular queue insertion and deletion. **SO4.3**Learn dequeue (double-ended queue) operations. **SO4.4**Explore priority queue implementation. **SO4.5**Understand binary tree representation and traversals. **SO4.6**Master graph ADT and representations. **SO4.7**Learn graph traversals and searching algorithms.	**LI4.1**Program for implementing Queue and its operation LI4.2 Program for implementing Dqueue . LI4.3 Program for implementing traversing algorithm.	**Unit-4 :** **4.1**Introduction to queues: Define queues, discuss basic operations (enqueue, dequeue), and introduce implementations using arrays and linked lists. **4.2**Exploring circular queues: Explain circular queue concept, demonstrate insertion and deletion operations. **4.3**Understanding dequeues: Introduce double-ended queues, discuss insertion and deletion at both ends. **4.4**Implementing priority queues: Cover priority queue concept and implementation methods. **4.5**Introduction to trees: Define trees, discuss binary trees, and explain their properties. **4.6**Tree representations: Compare array and linked representations of binary trees, highlighting advantages and disadvantages. **4.7**Binary tree traversals: Teach inorder, preorder, and postorder traversals, with examples. **4.8**Understanding threaded binary trees: Explain threaded binary tree concept and advantages. **4.9**Introduction to graphs: Define graph ADT, discuss graph representations (adjacency matrix, adjacency list). **4.10**Graph traversals: Cover depth-first search (DFS) and breadth-first search (BFS) algorithms. **4.11**Graph searching algorithms: Introduce Dijkstra's algorithm and A* algorithm for graph searching. **4.12**Practical exercises: Assign exercises to implement and manipulate queues, trees, and graphs. **4.13**Interactive demonstrations: Conduct demonstrations to illustrate queue, tree, and graph operations. **4.14**Group activities: Organize group discussions and problem-solving sessions on queue, tree, and graph topics. **4.15**Recap and review: Summarize key concepts and provide opportunities for students to ask questions and clarify doubts.	

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1CS201.5: Possess ability to choose a data structure to suitably model any data used in computer applications.

Approximate Hours

Item	Appx Hours
Cl	10
LI	6
SW	1
SL	1
Total	15

Session Outcomes (SOs)	(LI)	Classroom Instruction (CI)	(SL)
SO5.1Understand heaps: Definition, insertion, deletion. **SO5.2**Learn about hashing: Introduction, hash tables, functions, overflow handling. **SO5.3**Explore sorting methods: Comparison and characteristics. **SO5.4**Study search trees: Binary search trees, AVL trees. **SO5.5** Master searching algorithms: Linear and binary search.	**LI5.1.**Program on search algorithms. **LI 5.**2Program on implementing heap **LI5.3**.Program for implementing tree. **LI5.4.**Program on search algorithms. **LI 5.**5Program on implementing heap **LI5.6**Program for implementing tree.	**Unit 5:** **1**Introduce heaps: Define heaps and discuss their importance in data structure. **2**Heap operations: Teach insertion and deletion operations in heaps with examples. **3**Introduction to hashing: Discuss the concept of hashing and its applications. **4**Hash tables: Explain hash tables, hash functions, and methods for handling overflow. **5**Sorting methods: Present various sorting algorithms and their efficiency, including comparison-based and non-comparison-based methods. **6**Comparison of sorting methods: Compare and contrast different sorting algorithms based on their time complexity and suitability for various data sets. **7**Binary search trees (BSTs): Define BSTs and discuss their structure and operations. **8**AVL trees: Introduce AVL trees, explaining their self-balancing property and benefits. **9**Examples of AVL trees: Provide examples to illustrate the operations and advantages of AVL trees.	

		10Searching algorithms: Cover linear search and binary search algorithms, discussing their implementation and efficiency.	

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
1CS201.1: Develop simple algorithms and flow charts to solve a problem with programming using top down design principles.	10	12	1	1	24
1CS201.2: Learn to formulate iterative solutions and array processing algorithms for problems.	10	12	1	1	24
1CS201.3: Will be familiar with fundamental data structures, their implementation; become accustomed to the description of algorithm in both functional and procedural styles	15	12	1	1	29
1CS201.4: Have knowledge of complexity of basic operations like	15	12	1	1	29

1CS201.5: Possess ability to choose a data structure to	10	12	1	1	14
Total Hours	60	60	05	05	130

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Introduction to Programming	03	01	01	05
CO-2	Conditional Statements	01	01	03	05
CO-3	Data Structure Introduction	8	03	02	13
CO-4	Queue and Tree	2	03	8	13
CO-5	Heap introduction	01	03	10	14
Total		15	11	24	50

Legend: R:Remember, U:Understand, A:Apply

The end of semester assessment for Financial Accounting will be held with written examination of 50 marks

Suggested Instructional/Implementation Strategies:

10. ImprovedLecture
11. Tutorial
12. CaseMethod
13. GroupDiscussion
14. Brainstorming

Suggested Learning Resources:

(b) **Books**:

S. No.	Title	Author	Publisher	Edition&Year
1	outline series Data structures	Lipschutz: Schaum's	Tata McGraw-Hill	-
2	Problem Solving and Program Design in C	J. R. Hanly and E. B. Koffman	Pearson, 2015	-

3	C++ The Complete Reference	Herbertz Shield	TMH Publication ISBN 0-07-463880-7	-
4	Data Structures and algorithm in C++	Adam Drozdek	Cengage Learning.	Third Edition

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Cos, Pos and PSO Mapping

Course Code – 1CS201
Course Title- Programming Methodologies and data Structure

Cos	Description	Program Outcomes												Program Specific Outcome			
		PO1 Knowledge	PO2 Research Aptitude	PO3 Communication	PO4 Problem Solving	PO5 Individual and Team Work	PO6 Investigation of Problems	PO7 Modern Tool usage	PO8 Science and Society	PO9 Life-Long Learning	PO10 Ethics	PO11 Project Management	PO12 Environment and sustainability	PSO1	PSO2	PSO3	PSO4
CO1	Develop simple algorithms and flow charts to solve a problem with programming using top down design principles.	3	2	3	2	1	3	3	3	3	-	3	-	3	1	3	2

CO2	Learn to formulate iterative solutions and array processing algorithms for problems.	3	2	3	3	2	2	2	2	2	-	3	-	3	2	3	2
CO3	Will be familiar with fundamental data structures, their implementation; become accustomed to the description of algorithm in both functional and procedural styles	3	3	2	3	3	2	2	2	2	-	2	3	2	3	3	3
CO4	Have knowledge of complexity of basic operations like insert, delete, search on these data structures.	3	3	2	3	2	2	3	3	2	-	2	3	3	3	2	3
CO5	Possess ability to choose a data structure to suitably model any data used in computer applications	3	3	3	2	2	2	3	2	3	-	3	3	3	3	3	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map

POs&PSOsNo.	COsNo.&Titles	SOsNo.	LaboratoryInstruction(LI)	Classroom Instruction(CI)	Self Learning (SL)
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	CO-1Develop simple algorithms and flow charts to solve a problem with programming using top down design principles	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1,2,3,	Unit-1 1,2,3,4,5,6,7,8,9,10	
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	CO2 Learn to formulate iterative solutions and array processing algorithms for problems.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	1,2,3,	Unit-2 1,2,3,4,5,6,7,8,9,10	1
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	CO3 Will be familiar with fundamental data structures, their implementation; become accustomed to the description of algorithm in both functional and procedural styles	SO3.1 SO3.2 SO3.3 SO 3.4 SO 3.5 SO 3.6 SO 3.7	1,2,3	Unit-3 : 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	CO 4Have knowledge of complexity of basic operations like insert, delete, search on these data structures.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5 SO4.6 SO4.7	1,2,3	Unit-4 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1

PO1,2,3,4,5,6,7 ,8,9,10,11,12 PSO 1,2,3,4	CO 5Possess ability to choose a data structure to suitably model any data used in computer applications.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	1,2,3,	Unit5: 1,2,3,4,5,6,7,8,9,10	

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Course Code: **1MS201**
Course Title : **Calculus and differential equations**
Pre- requisite: Students should have basic knowledge of calculus

Rationale: The program aims to develop advanced problem-solving and analytical .
skills

and prepares students for careers in academia, research, industry, or other sectors that require advanced mathematical expertise

Course Outcome :

CO1- 1MS201.1 The Student will aware of history of mathematics and hence of its Past, present and future role as part of our culture.

CO2-1MS201.2 the Student will Sketch curves in a plane using its mathematical properties in the different coordinate systems of reference.

CO3- 1MS201.3 The Students will Using.the derivatives optimization,social Sciences,physics and life sciencs etc.

CO4-1MS201.4 the student will Formulate the differential equation for various mathematical models.

CO5-1MS201.5 The Students wil Using techniques to solve and analyze various mathematical models.

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Program Core (DCC)	1MS201	Calculus and differential equations.	6[5+1]	0	1	1	8	6

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA + ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+ AT)		
PCC	1MS201	Calculus and differential equations.	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1- 1MS101.1 Student will aware of history of mathematics and hence of its Past, present and future role as part of our culture.

Approximate Hours

Item	AppX Hrs
Cl	18
LI	0
SW	1
SL	1
Total	20

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Student will aware of history of mathematics **SO1.2** Student will aware of contribution of Indian Mathematicians in field of Mathematics **SO1.3** Understand its Past, present and future role of Mathematics as part of our culture. **SO1.4**	-	**Unit-1.0** 1.1Historical background: 1.2Development of Indian Mathematics 1.3: Later Classical Period (500 -1250) 1.4A brief biography of Bhaskaracharva. 1.5 A brief biography of Madhav, 1.6 Successive differentiation : Leibnitz theorem, 1.7 Maclaurin's series expansion 1.8 Taylor s series expansion. 1.9 Tutorial-I 1.10 Partial Differentiation; Partial derivatives of higher order. 1.11 Homogeneous function. 1.12 Eular s function on homogeneous function 1.13 Tutorial-II 1.14 Asymptotes; Asymptotes of algebraic curves. 1.15 Parallel Asymptotes. 1.16 Asymptotes of Polar curves. 1.17 Theorem on Asymptotes. 1.18 Tutorial-III	**SL.1** Student will aware about Indian Mathematics **SL.2** Student will learn the **SL.3** Student will learn to homogeneous function. **SL.4** Student will learn to Asymptotes.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i.

ii. Application of Calculus in real life.

iii. Derivation of Partial derivatives of higher order

iv. Eular theorem on homogeneous.

b. Other Activities (Specify):
Quiz, Class Test.

CO2-1MS201.2 the Student will Sketch curves in a plane using its mathematical properties in the different coordinate systems of reference.

Approximate Hours

Item	AppX Hrs
Cl	18
LI	0
SW	1

SL	1
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO2. 1 The understanding concavity and convexity. **SO2.2 The** concept of curvature at origin. **SO2.3** Understand curves Represention by Cartesian equation. **SO2.4**		**Unit 2 Curvature &Convexity of Curves.** **2.1 Curvature; formula for radius of curvature.** **2.2 curvature at origin.** **2.3 centre of curvature.** **2.4 concavity and convexity.** **2.5 concavity and convexity of curves.** **2.6 the point of inflecion.** **2.7 singular point.** **2.8 the multiple points.** **2.9 tutorial 1.** **2.10 The tracing of curves.** **2.11 curves represented by cartesian equation.** **2.12 curves represented by polar equation.** **2.13 tutorial** 2 2.14 the Student will Sketch curves at origin. 2.15 question based on the singular point. 2.16. Concavity of singular point. 2.17 Curves Represented by polar equations. 2.18 tutorial 3	**SL.1** **Knowledge of formula for radius of curvature.** **SL.2** **knowledge of convexity.** **SL.3** **to learn point of inflecion.**

SW-2 Suggested Sessional Work (SW):
a. Assignments:
i. Relationships between **concavity and convexity of curves.**

ii. Application of convexity.
iii. the Student will Sketch curves at origin.
iv. Curves Represented by polar equations.
V. Concavity of singular point.

CO3- 1MS201.3 The Students will Using.the derivatives optimization,social Sciences,physics and life sciences.

Approximate Hours]

Item	AppX Hrs
Cl	18
LI	0
SW	1
SL	1
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO3.1 Understand The concept of transcendental function. SO3.2 Understand the concept of quadrature for cartesian coordinates. **SO3.3 U**nderstand the rectification for cartesian coordinates. SO3.4		**Unit 3 . Integration, Quadrature, &Rectification for Cartesian coordinates.** **3.1** definition of Integration. 3.2 integration of transcendental function. 3.3 introduction of double integral . 3.4 introduction of triple integral. 3.5 the reduction formula. 3.6 Quadrature . 3.7 quadrature for cartesian coordinates. 3.8 tutorial 1. 3.9 quadrature for polar coordinates. 3.10 the rectification. 3.11 the rectification for cartesian coordinates. 3.12 question based on reduction formula. 3.13 numerical based on rectification 3.14 tutorial 2 3.15 question based on double and triple integral. 3.16 definition and example for cartesian co-ordinate. 3.17 the rectification for polar cartesian coordinate. 3.18 tutorial 3	**● knowledge of Integration.** **● to learn quadrature , rectification**

SW-3 Suggested Sessional Work (SW):

a. Assignments:
i. question based on reduction formula.
ii. question based on double and triple integral.
iii. definition and example for cartesian co-ordinate.
iv. Rectification for cartesian coordinate.
V. Rectification for polar cartesian coordinate.

CO4-1MS201.4 the student will Formulate the differential equation for various mathematical models.

Approximate Hours

Item	AppX Hrs
Cl	18
LI	0
SW	1
SL	1
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO4.1 Understand the differential equations of first order. **SO4.**2 the concept of solvable equations.		Unit 4 linear differential equation: 4.1 Introduction of linear differential equation. 4.2 definition and example linear equation. 4.3 the equation reducable to the linear form. 4.4 change of variables. 4.5 exact differential equation of first order 4.6 exact differential equation of higher order. 4.7 introduce the differential equation. 4.8 tutorial 1 4.9 the equation solvable for x ,y and p. 4.10 the equation homogeneous in X and Y 4.11 Clairaut's equations. 4.12 the concept of singular solutions 4.13 numerical based on differential equation. 4.14 Questions based on the Clairaut's equations. 4.15 tutorial 2 4.16 Geometrical meaning of differential equations. 4.17 the Orthogonal trajectories. 4.18 tutorial 3	**SL.1** knowledge of the differential equations. **SL.2** to learn definition and example linear equation. **SL.**3 Question based on the solvable equations.

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. numerical based question on differential equation.
ii. Application of solvable equations.
iii. Geometrical meaning of differential equations.
iv. the Orthogonal trajectories.

CO5-1MS201.5 The Students wil Using techniques to solve and analyze various mathematical models.

Approximate Hours

Item	AppX Hrs
Cl	18
LI	0
SW	1
SL	1
Total	20

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)

SO5.1 understand the linear differential equation. **SO5.2 the concept of homogeneous equation.** **SO5. 3 Understand The homogeneous linear ordinary Differential Equation.** **SO4. Transformation of equations.**		Unit 5 Linear differential equations with Constant Coefficient: 5.1 introduction of linear differential equation. 5.2 constant coefficient. 5.3 homogeneous linear ordinary Differential Equation. 5.4 definition of linear differential equation. 5.5 linear differential equation of second order. 5.6 transformation of equation. 5.7 the transformation of equation by changing the Independent variable. 5.8 tutorial 1 5.9 question based on linear differential equation. 5.10 definition and example of homogeneous equation. 5.11 question based on homogeneous equation. 5.12 question based on transformation of equation. 5.13 method of variation of parameters. 5.14 define the parameters. 5.15 question based on the parameters. 5.16 tutorial 2 5.17 methods of variation 5.18 tutorial 3	● to solve linear differential equations. ●to define the homogeneous equations with Constant Coefficient.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
CO1- 1MS201.1 Student will aware of history of mathematics and hence of its Past, present and future role as part of our culture.	18	1	1	
CO1-1MS201.2 the Student will Sketch curves in a plane using its mathematical properties in the different coordinate systems of reference.	18	1	1	20
CO3- 1MS201.3 The Students will using. The derivatives optimization, social Sciences, physics and life sciences.	18	1	1	20
CO4-1MS201.4 the student will Formulate the differential equation for various mathematical models.	18	1	1	20
CO5-1MS201.5 The Students wil Using techniques to solve and analyze various mathematical models.	18	1	1	20
Total Hours	90	5	5	100

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	**Unit -1** Development of Indian Mathematics &Successive differentiation.	02	02	01	05
CO-2	**Unit -2 Curvature &Convexity of Curves**	02	08	05	15
CO-3	**Unit -3 . Integration, Quadrature, &Rectification for Cartesian coordinates**	03	07	05	15
CO-4	Unit-4 linear differential equation, solvable equations.	02	07	01	10
CO-5	Unit -5 Linear differential equations with Constant Coefficient:	02	02	01	05
Total		11	26	13	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies

1. Improved Lecture
2. Tutorial
3. Presentation
4. Group Discussion
5. Online sources
6. Seminar
7. Workshop

Suggested Learning Resources:

a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Differential Calculus	Corakh Prasad	Pothishala private	Allahabad 2016

2	Integral Calculus	Corakh Prasad	Pothishala private	Allahabad 2015
3	Ordinary and partial differential equations	M.D. Raisinghania.	S Chand &Co	Ltd 2017
4	Differential and Integral Calculus.	N. Piskunov	CBS Publishers	1996

Suggested Digital Platforms Web links:	https://epgp. infl ibnet.ac. in hnps://freevideolectures.com/university/i it-roorkee https://www.h ighereducation.mp.gov.in/?page=xhzlQmpZwkylQo2bYo2FySGTwok3DVo3D https://www.bhojvirtualuniversity.com
Suggested Equivalent online courses:	https://nptel.ac.inlcourses/l I | 106100/ ://nptel.ac.inlcourses/ | | | / | 0 I / | | | I 0 | 080/

AKS University
Faculty of Basic Science
Department of Mathematics
Curriculum & Syllabus of B.Sc. Mathematics program
Semester-I

<u>COs,POs and PSOs Mapping</u>

Course Code : 1MS201

Course Title: Calculus and differential equations.

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PS

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Semester-I

	Knowledge	Research Aptitude	Communication	Problem Solving	Individual and Team	Investigation of Problems	Modern Tool usage	Science and Society	Life-Long Learning	Ethics	Project Management	Environment and sustainability	The detailed functional knowledge of theoretical conceptsand experimental aspects of science	To integrate the gained knowledge with various contemporary and evolving areas in chemical sciences, physical science and mathematical science like analytical, synthetic, pharmaceutical etc	To un ta an e, an in m qu at as w as qu ta an ic sy tic ph m n- ba pr m ch ca sc es si sc e m m l sc e.

CO1-02MS101.1 Student will aware of history of mathematics and hence of its Past, present and future role as part of our culture.	2	3	2	2	1	2	2	2	1	1	1	1	2	1	1
CO2-02MS101.2 the Student will Sketch curves in a plane using its mathematical properties in the different coordinate systems of reference.	1	3	2	1	1	1	1	2	1	2	3	1	3	1	1
CO3- 02MS101.3 **The** Students will Using.the derivatives optimization,social Sciences,physics and life sciences	2	3	2	2	3	1	3	2	1	1	3	1	2	1	2
CO4-02MS101.4 the student will Formulate the differential equation for various mathematical models.	2	3	2	2	1	1	3	2	2	1	3	1	2	1	2
CO5-02MS101.5 **The** Students wil Using techniques to solve and analyze various mathematical models.	2	3	2	2	1	1	3	2	1	1	3	1	2	1	2

Legend: 1 – Low, 2 – Medium, 3 – High

AKS University
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Semester-I

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction (CI)	Self l (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO1-1MS101.1 Student will aware of history of mathematics and hence of its Past, present and future role as part of our culture	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 Development of Indian Mathematics &Successive differentiation 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10 1.11 1.12 1.13 1.14 1.15 1.16 1.17 1.18	SL1. SL1.
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO2-1MS101.2 the Student will Sketch curves in a plane using its mathematical properties in the different coordinate systems of reference	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-2 Curvature &Convexity of Curves. 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10 2.11 2.12 2.13 2.14 2.15 2.16 2.17 2.18	SL2. SL2.
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO3-.1MS101.3 **The** Students will Using.the derivatives optimization,social Sciences,physics and life sciences	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-3 Integration, Quadrature, &Rectification 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8,3.9,3.10 3.11 3.12 3.13 3.14 3.15 3.16 3.17 3.18	SL3. SL3.
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO4-1MS101.4 the student will Formulate the differential equation for various mathematical models. .	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-4 linear differential equation, solvable equations. 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8,4.9,4.10 4.11 4.12 4.13 4.14 4.15 4.16 4.17 4.18	SL4. SL4.
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO5-1MS101.5 **The** Students wil Using techniques to solve and analyze various mathematical models	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-5Linear differential equations with Constant Coefficient: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8,5.9,5.10 5.11 5.12 5.13 5.14 5.15 5.16 5.17 5.18	SL5. SL5.

AKS University
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Curriculum & Syllabus of B.Sc. Mathematics program
Semester-I

Curriculum Development Team

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6. Mr.Ghanhyam sen, Assistant Professor, Department of Mathematics.
7. Ms. Pushpa Kushwaha, Assistant Professor, Department of Mathematics.
8. Ms. Arpana Tripathi, Assistant Professor, Department of Mathematics.

Course Code: 1PH201

Course Title: **Thermodynamics and Statistical Physics**

Pre-requisite: Student should have basic knowledge of thermodynamics, laws of thermodynamics and basic knowledge of statistical physics.

Rationale: The students studying Physics should possess foundational understanding about historical background of Thermodynamics and Statistical Physics.

Course Outcomes:

1PH201.1 The course would enable the students to understand the basic Physics of heat and temperature in relation to energy, work, radiation and matter.

1PH201.2 The students are expected to learn that "how laws of thermodynamics are used in a heat engine to transform heat into work".

1PH201.3 Understandthetheoriesandmathematicalapproachesofstatisticalensembles,equi-partitiontheoremandMaxwell-Boltzmannstatistics.

1PH201.4 This course will also develop an understanding of the various concepts of statistics and the methods to apply them in thermodynamics.

1PH201.5 Students will understand the importance of studying statistical mechanics with the behaviour of particles under classical and quantum conditions.

Scheme of Studies

Board of Study	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Program Core (PCC)	1PH201	**Thermodynamics and Statistical Physics**	4	4	1	1	10	6

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial

(T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Seasonal Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment: Theory

Board of Study	Course code	Course Title	**Scheme of Assessment(Marks)**							
			Progressive Assessment(PRA)						**End Semester Assessment (ESA)**	**Total Marks (PRA+ ESA)**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test2 (2bestout of3) 10marks each (CT)	Seminar one (SA)	Class Activity anyone (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
DCC	1PH201	Thermodynamics and Statistical Physics	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1PH201.1The course would enable the students to understand the basic Physics of heat and temperature in relation to energy, work, radiation and matter.

ApproximateHours

Item	AppXHrs
Cl	12
LI	12
SW	1
SL	1
Total	26

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO1.1 To understand the historical background of thermodynamics and statistical Physics in the context of India and Indian culture. **SO1.2**Learn about laws of Thermodynamics and their consequences **SO1.3**Learn about heat engine and Carnot's cycle. **SO1.4**Identity perfect gas scale and absolute scale and Heat death of the universe **SO1.5**Understand Kelvin's thermodynamic scale of temperature	**1.**Determination of efficiency of electrical Kettle with variable Voltages. **2.** Determination of the mechanical equivalent of heat by Callendar & Barne's method.	**Unit-I (Historical background & Laws of thermodynamics)** 1.1 A brief historical background of thermodynamics and statistical Physics in the context of India and Indian Culture 1.2 Contribution of S. N. Bose in statistical Physics 1.3 Laws of thermodynamics: Thermodynamical system and thermodynamical Coordinates 1.4 Thermal equilibrium, Zeroth law of thermodynamics 1.5 The concept of path function and pointfunction, Work done by and on the system. 1.6 First law of thermodynamics, Internal energy as a state function 1.7 Reversible and irreversible	1. Introduction of thermodynamics and laws of thermodynamics

		change, Heat engine and its efficiency 1.8 Carnot's cycle, Carnot's engine and its efficiency, Carnot's theorem 1.9 Otto engine, Otto cycle, diesel engine. 1.10 Second law of thermodynamics, Statement of Kelvin-Plank and Clapeyron Absolute scale of temperature: 1.11 Zero of absolute scale, Size of degree 1.12 Identity of a perfect gas scale and absolute scale.	

SW-1 Suggested Sessional Work(SW):

a. *Assignments:*
Explain Laws of Thermodynamics and their consequences, Thermodynamic and chemical potentials and phase equilibrium condition.

b. Other Activities(Specify):
Present any one topic of this unit by power point presentation in front of departmental student and faculty.

1PH201.2The students are expected to learn that "how laws of thermodynamics are used in a heat engine to transform heat into work".

Approximate Hours

Item	AppX Hrs
Cl	12
LI	12
SW	1
SL	1
Total	26

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Sel f Le arn ing (SL)**
SO2.1 Understand the concept of entropy. **SO2.2** To understand contact between statistics and thermodynamics **SO2.3** Understand heat death of universe. **SO2.4** Learn about principle of increase of Entropy. **SO2.5** understand physical significance of Entropy	.3. Determination of electromotive force of a thermocouple. 4. Determination of thermal conductivity of a bad conductor by Lee's disc method.	**UNIT-II (Entropy)** 2.1 Concept of entropy 2.2Clausius theorem 2.3 Entropy as a point function 2.4 Change in entropy in reversible and irreversible processes 2.5 Change in entropy of an ideal gas 2.6 Change in entropy when two liquids at different temperatures are mixed (or two bodies at different temperatures are kept in contact) 2.7 Principle of increase of Entropy 2.8 Change in entropy of the universe in an irreversible process 2.9 Disorder and heat death of universe 2.10 Physical significance of Entropy 2.11 Temperature - entropy	1. Reversible process, Entropy, Ideal gas.

		(T - S) diagram 2.12 third law of thermodynamics	

SW-2 Suggested Sessional Work (SW):

a. **Assignments:**

Explain Change in entropy when two liquids at different temperatures are mixed.

b. **Other Activities(Specify):**
Present any one topic of this unit by power point presentation in front of departmental student and faculty.

1PH201.3 Understand the theories and mathematical approaches of statistical ensembles, equipartition theorem and Maxwell-Boltzmann statistics.

Approximate Hours

Item	AppX Hrs
Cl	12
LI	12
SW	1
SL	1
Total	26

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)

SO3.1 **Understand thermodynamic potential and its application** SO3.2 **Derive Maxwell's relations from thermodynamic Potentials.** SO3.3 **Express Thermodynamic energy equation for ideal and van der Waal gas.** SO3.4 **Understand principle of refrigeration.** SO3.5 **Understand Kinetic theory of gases.**	5. Verification of Newton's law of cooling. 6. Determination of specific heat of a liquid with the help of Newton's law of cooling..	UNIT – III (Thermodynamic potentials and kinetic theory of gases) **3.1 Thermodynamic potential and its application:** **3.2 Thermodynamic potentials, Thermal equilibrium, Internal energy, Helmholtz free energy, Enthalpy and Gibbs free energy.** **3.3 Derivation of Maxwell's relations from thermodynamic** **Potentials** **3.4 Gibbs - Helmholtz equation** **1.5 Thermodynamicenergy equation for ideal and van der Waal gas.** **3.6TdS equation, Derivation of expressions for CP-CV and** **their special cases for ideal and van der Waal gases** **3.7 derivation of the expression Es⁄Et= CP/Cv.** **1.8Clausius - Clapeyron latent heat equation, Temperaturechange in adiabatic process, Principle of refrigeration** **3.9 Joule -Thomson effect, Cooling by adiabaticdemagnetization, Production and measurement of very low temperatures.** **3.10 Kinetic theory of gases:** **Behavior of a real gas and its deviation from an ideal gas** **3.11 Virial equation, Andrews experiment on CO2 gas.** **3.12 Critical constant, continuity**	**1. Understand terms Potential, Enthalpy, Adiabatic, Real gas, Critical constant.**

		of the liquid and gaseous state, Vapour and gas state, Boyle temperature, vander Waals equation for real gas, Values of critical constants, Law of the corresponding state.	

SW-3SuggestedSessionalWork(SW):

a. *Assignments:*

   Explain Critical constant, continuity of the liquid and gaseous state, Vapour and gas state, Boyle temperature, vander Waals equation for real gas, Values of critical constants, Law of the corresponding state..

b. *OtherActivities(Specify):*
   Present any one topic of this unit by power point presentation in front of departmental student and faculty.

1PH201.4 This course will also develop an understanding of the various concepts of statistics and the methods to apply them in thermodynamics.

ApproximateHours

Item	AppXHrs
Cl	12
LI	12
SW	1
SL	1
Total	26

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO4.1 ***Learn aboutProbability.*** *SO4.2* ***Learn aboutProbability distribution and its narrowing with the increase in number of particles*** *SO4.3* ***Learn aboutEnsemble theory.*** *SO4.4* ***Learn aboutBoltzmann Canonical distribution law.*** *SO4.5* ***Learn aboutBoltzmann partition function and derivation.***	7. Determination of the coefficient of thermal conductivity of a metal by Searle's method. 8.Determination of mechanical equivalent of heat (J) using Joule Calorimeter..	***UNIT – IV (Classical Statistics)*** *4.1 Probability, Distribution of N particles in two identical Boxes* *4.2 Probability of occurrence of either event* *4.3 Probability of composite events, Weightage probability.* *4.5 Probability distribution and its narrowing with the increase in number of particles* *4.6 Expression for average properties, constraints, Accessible and non - accessible microstates.* *4.7 Ensemble theory (Micro-canonical, Canonical and Grand-canonical), Macro and micro states with examples, Principle of equal a prior probability, Concept of phase space.* *4.8 Boltzmann Canonical distribution law* *4.9 Application:average energy of one-dimensional harmonic osciIlator,* *4.10 Derivation of law of equipartition of energy from statistics, Equilibrium between two system in thermal contact and β parameter* *4.11 Statistical interpretation of entropy and relation S=k logW.* *4.12 Boltzmann partition function and derivation of expression for Internal energy, Helmholtz free energy, Enthalpy andGibbs free energy.*	1.Fundamental of Probability, Microstate, Ensemble theory, Partition function.

SW-4 SuggestedSessionalWork(SW):

a. *Assignments:*
Derive law of equi-partition of energy from statistics, Equilibrium between two system in thermal contact and β parameter.

b. OtherActivities(Specify):
Present any one topic of this unit by power point presentation in front of departmental student and faculty.

1PH201.5 Students will understand the importance of studying statistical mechanics with the behavior of particles under classical and quantum conditions.

ApproximateHours

Item	AppXHrs
Cl	12
LI	12
SW	1
SL	1
Total	26

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO5.1 Understand Indistinguishability of particles. **SO5.2**Understand M.B. Statistics **SO5.3** To Understand and evaluate Quantum statistics. **SO5.4**Derive Planck's radiation law fromB-E statistics. **SO5.5**Explainfree electron theory, Fermi level and Fermi energy.	**9**.Study of statistical distribution and determination of standard Deviation with the help of black and white dice. **10**.Determination of the temperature coefficient of a resistance with the help of Carey-Foster bridge.	**UNIT – V (Quantum statistics)** 5.1 Indistinguishability of particles and its consequences 5.2 Maxwell - Boltzmann statistics (Classical statistics) 5.3 Maxwell- Boltzmann distribution law of velocity and speed 5.4 Maxwell – Boltzmann statistics and its distribution law. 5.5 Quantum statistics: Bose-Einstein statistics and distribution law, 5.6 Derivation of Planck's radiation law from B-E statistics	General theory of Indistinguishability, Velocity distribution, Fermi level.

		5.7 Rayleigh-Jeans law 5.8Wein's displacement law and Stefan's law 5.9 Fermi - Dirac statistics and its distribution law 5.10 Explanation of free electron theory, Fermi level and Fermi energy 5.11 Comparison between the Maxwell – Boltzmann 5.12 Bose-Einstein and Fermi – Dirac statistics.	

SW-5 Suggested Sessional Work (SW):

a. *Assignments:*
Discuss about free electron theory, Fermi level and Fermi energy.

b. *Other Activities (Specify):*
Present any one topic of this unit by power point presentation in front of departmental student and faculty.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Totalhour (Cl+SW+Sl)
1PH201.1 The course would enable the students to understand the basic Physics of heat and temperature in relation to energy, work, radiation and matter.	**12**	12	1	1	26
1PH201.2 The students are expected to learn that "how laws of thermodynamics are used in a heat engine to transform heat into work".	12	12	1	1	26
1PH201.3 Understand the theories and mathematical approaches of statistical	12	12	1	1	26

ensembles, equi-partition theorem and Maxwell-Boltzmann statistics.					
1PH201.4 This course will also develop an understanding of the various concepts of statistics and the methods to apply them in thermodynamics.	12	12	1	1	26
1PH201.5 Students will understand the importance of studying statistical mechanics with the behavior of particles under classical and quantum conditions.	12	12	1	1	26
TotalHours	**60**	60	**5**	**5**	**130**

Suggestion for End Semester Assessment

Suggested SpecificationTable (For ESA)

CO	**UnitTitles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	**Historical background & Laws of thermodynamics**	03	04	03	10
CO-2	**Entropy**	03	04	03	10
CO-3	**Thermodynamic potentials and kinetic theory of gases**	03	04	03	10
CO-4	**Classical Statistics**	03	04	03	10
CO-5	**Quantum statistics**	03	04	03	10
Total		15	20	15	50

Legend: R: Remember, U:Understand, A:Apply

The end of semester assessment for Introduction to Thermodynamics will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to Science Museum
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a)Books:

S.No.	Title	Author	Publisher	Edition &Year
1	Statistical Mechanics	R.K. Pathria	Elsevier	1916
2	Statistical Mechanics	Satya Prakash	KNRN	2004
3	Fundamentals of Statistical and Thermal Physics	F. Reif	McGraw Hill, New York	1965
4	Statistical Mechanics	K. Huang	Wiley	2^{nd} Ed. 1987
5	Lecture note provided by Department of Physics, AKS University, Satna (M. P.)			

<u>Cos, PO sand PSOs Mapping</u>

Course Title: B.Sc.

Course Code: 1PHY201

CourseTitle: Thermodynamics and Statistical Physics

CourseOutcomes	Program Outcomes												ProgramSpecificOutcome			
	PO 1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO8	PO 9	PO10	PO1 1	PO1 2	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conductinvestigationsofcomplexproblems	Modern toolusage	The engineer andsociety	Environment and sustainability:	Ethics	Individual andteam work:	Communication:	Projectmanagement and finance:	Life-longlearning	Theabilitytoapply technical&engineeringknowledgeforproductionqualitycement	Abilitytounderstandthe day toplantoperational problems ofcement manufacture	Ability tounderstandthelatestcementmanufacturing technology.	Abilitytousetheresearchbasedinnovative knowledgeforSDGs
1PH201.1 The course would enable the students to understand the basic Physics of	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1

heat and temperature in relation to energy, work, radiation and matter.																
1PH201.2 The students are expected to learn that "how laws of thermodynamics are used in a heat engine to transform heat into work".	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
1PH201.3 Understand the theories and mathematical approaches of statistical ensembles, equi-partition theorem and Maxwell-Boltzmann statistics.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
1PH201.4 This course will also develop an understanding of the various concepts of statistics and the methods to apply them in thermodynamics.	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**

1PH201.5 Students will understand the importance of studying statistical mechanics with the behavior of particles under classical and quantum conditions.	**2**	**2**	**2**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend:1–Low,2–Medium,3– HighCourseCurriculumMap:

Pos & PSOs No.	Cos No. &Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6, 7,8,9,10,11,12 PSO1,2,3,4,5	**1PH201.1** The course would enable the students to understand the basic Physics of heat and temperature in relation to energy, work, radiation and matter	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1,1.2	**UNIT-I (Historical background & Laws of thermodynamics)** 1.1,1.2,1.3,1.4,1.5,1.6,1.7, 1.8, 1.9, 1.10, 1.11, 1.12	
PO 1,2,3,4,5,6 7,8,9,10,11,12	**1PH201.2** The students are expected to learn that "how laws of thermodynamics are used in a heat engine to transform heat into work".	SO2.1 SO2.2 SO2.3	2.1,2.2	**UNIT-II (Thermodynamic potentials and kinetic theory of gases)** 2.1,2.2,2.3,2.4,2.5,2.6,2.7,	

PSO1,2,3,4,5		SO2.4 SO2.5		2.8,2.9,2.10, 2.11, 2.12	As mentioned in Page number 2to6
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	**1PH201.3** Understand the theories and mathematical approaches of statistical ensembles, equi-partition theorem and Maxwell-Boltzmann statistics.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1,3.2	**UNIT – III (Entropy)** 3.1, 3.2,3.3,3.4,3.5,3.6,3.7,3.8, 3.9, 3.10, 3.11, 3.12	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	**1PH201.4** This course will also develop an understanding of the various concepts of statistics and the methods to apply them in thermodynamics.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1,4.2	**UNIT – IV (Classical Statistics)** 4.1, 4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10, 4.11, 4.12	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	**1PH201.5** Students will understand the importance of studying statistical mechanics with the behavior of particles under classical and quantum conditions.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1,5.2	**UNIT – V (Quantum Statistics)** 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12	

Curriculum Development Team

1. Dr. O. P. Tripathi, Head Of Department of Physics, AKS University Satna (M.P.)
2. Dr. C.P. Singh, Assistant Professor, Department of Physics, AKS University Satna (M.P.)
3. Dr. Lovely Singh, Assistant Professor, Department of Physics, AKS University Satna (M.P.)

4. Dr. Saket Kumar, Assistant Professor, Department of Physics, AKS University Satna (M.P.)
5. Mr. Manish Agrawal, Assistant Professor, Department of Physics, AKS University Satna (M.P.)
6. Ms. Swati Kushwaha, Lab Assistant, Department of Physics, AKS University Satna (M.P.)

Course Code: 1CH201

Course Title: Fundamentals Of Chemistry

Pre- requisite: To study this course our students must have had the subject Chemistry in class +2 or equivalent.

Rationale: Up on completion of the course student shall be able to learn about Chemical techniques, Elementary idea of the properties of the elements, Acid-Base concept and Fundamentals of Organic Chemistry Structure.

Course Outcomes:- By the end of this course students will learn the following aspects of Chemistry:

1. Various theories and principles applied to reveal atomic structure.
2. Significance of quantum numbers.
3. Concept of Periodic table & periodic properties of elements of elements.
4. Theories related to chemical bonding.
5. Acid-base concept, ph, buffer and Properties of electrolytes and Basics and mechanism of chemical kinetics.
6. Factors responsible for reactivity of organic molecules.

Unit -1

Atomic Structure:

Dual nature of particles and waves, de Broglie's equation, Heisenberg's Uncertainty principle and its significance. Quantum
numbers and their significance. Rules for filling electrons in various orbitals, Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau principle and its limitations, Variation of orbital energy with atomic number. Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

UNIT -2

Periodic table & periodic properties

Effective nuclear number (EAN), shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table., Atomic radii (van der Waals) lonic and crystal radii, Covalent radii (octahedral and tetrahedral)
lonization energy and factors affecting ionization energy, Applications of it.
Electronegativity- Pauling's/ Mulliken's electronegativity scales, Variation of electronegativity with bond order, partial charge.

UNIT-3

Chemical Bonding

Ionic bonding & Energy: lattice & solvation energies and their importance in the context of stability and solubility of ionic
compounds. Statement of Born-Landé equation for calculation of lattice energy. Born-Haber cycle and its applications Covalent character in ionic compounds, polarizing power and polarizability, Fajans rules.

Covalent bonding: Lewis structure, Valence Bond theory (Heitler- London approach).
Hybridization- Concept, types (SP, SP2, SP3 ,dSP2 ,d2SP suitable examples of inorganic and organic molecules
Valence shell electron pair repulsion theory (VSEPR) theory: Assumptions, need of theory, application of theory to explain geometries or shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements as: NH3, H2O, SF4, CIF3, PCl5, SF6, XeF4

Molecular orbital (MO) concept of bonding

The approximations of the theory, Linear combination of atomic orbitals (LCAO) (elementary pictorial approach)
Rules for the LCAO method, bonding and antibonding MOs. Characteristics for ss, sp and p - p combinations of atomic orbitals, nonbonding combination of orbitals. MO diagrams of homonuclear diatomic molecules: H2, N2, O2 F2 and their ions. Molecular orbitals of heteronuclear diatomic molecules: NO, CO.

Unit-4

Acid-Base concept &Ionic Equilibria:

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water .Common ion effect, Salt hydrolysis-calculation of hydrolysis constant. Solubility and solubility product of sparingly soluble salts-applications of solubility product.
Arrhenius concept, Bronsted-Lowry's concept, conjugate acids and bases, relative strength of acids, Lewis concept. pH, buffer solutions. Acid-base neutralisation curves, Handerson equation.

Chemical kinetics

Rate of reaction, Definition and difference of order and molecularity. Derivation of rate constants for first, second, third and zero order reactions and examples. Derivation for half-life period. Methods to determine the order of reactions. Effect of
temperature on rate of reaction. Arrhenius equation, concept of activation energy.

Unit-5 Structure, reactivity and stereochemistry of organic molecules:

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation.
Cleavage of Bonds: Homolysis and Heterolysis.Reactive Intermediates: Carbocations, Carbanions and free radicals. Nucleophiles and electrophiles. Determination of configuration of geometric isomers. E & Z system of nomenclature,
Elements of symmetry, molecular chirality, enantiomers& their properties,stereogenic centre, optical activity of enantiomers. Concept of chirality (up to two carbon atoms): chiral and achiral molecules with two stereogenic centres,
diastereomers, threo and erythroisomers, meso. isomer, resolution of enantiomers, inversion, retention and racemization.
Relative and absolute configuration, sequence rules, D & L. and R & S systems of nomenclature. Conformations and Conformational analysis Conformations of ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newman, Sawhorse and Fischer representations.

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits(C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
ProgramCore (PCC)	1CH201	FUNDAMENTAL CHEMISTRY	4	4	1	1	6	6

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) And others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment: Theory

Board of Study	Couse Code	Course Title	**Scheme of Assessment (Marks)**						
			Progressive Assessment (PRA)					**End Semester Assessment**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Attendance (AT)	Total Marks (CA+CT+SA +AT)	**(ESA)**	(PRA+ ESA)
DCC	1CH201	Fundamentals of Chemistry (Paper I)	15	20	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1CH201- . Various theories and principles applied to reveal atomic structure, Significance of quantum numbers.

Approximate Hours

Activity	**Apex Hrs**
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes **(SOs)**	**Laboratory Instruction** **(LI)**	**Class room Instruction** **(CI)**	**Self Learning** **(SL)**
SO1.1 Discuss about development and limitations of atomic models, De Broglie's equation, Heisenberg's SO1.2 Restate quantum numbers and their significance. Uncertainty principle and its significance. SO1.3 Explain and apply the concept of rules for filling electrons in various orbital's and its limitations. SO1.4 Explain and apply the variation of orbital energy with atomic number. Electronic configurations of the atoms SO1.5 Describe broader vision of exchange of energy and relative energies of atomic orbitals. .	**Unit-1** **Qualitative inorganic analysis** **1.1** Identification of simple inorganic mixture (5 radicals) with two/three acidic and two/three basic radicals (including typical combinations), **1.2** special emphasis on learning theoretical concepts of strong, moderate and weak electrolytes, **1.3** ionic products, common ion effect. Solubility and solubility product.	**Atomic Structure:** 1.1 Dual nature of particles and waves, de Broglie's equation, Heisenberg's. 1.2 Uncertainty principle and its significance. Quantum numbers and their significance. 1.3 Rules for filling electrons in various orbitals, Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau principle and its limitations. 1.4 Variation of orbital energy with atomic number. Electronic configurations of the atoms. 1.5 Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.	Electronic configurations of the 1 to 30 elements in periodic table.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

Explain Dual nature of particles and waves, de Broglie's equation and Heisenberg's.

b. Mini Project:

Concept of Quantum numbers and their significance

c. Other Activities (Specify):

Electronic configurations of the atoms and Stability of half-filled & completely filled orbitals.

1CH201-Concept of Periodic table & periodic properties of elements of elements..

Approximate Hours

Activity	AppX Hrs
Cl	13
LI	12
SW	2
SL	1
Total	28

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Discuss about brief history of development of periodic table and its significance. SO2.2 Restate Effective nuclear number (EAN), shielding or screening effect & Slater rules. SO2.3 Explain and apply the concept of Atomic radii and crystal radii. SO2.4 Explain and apply the variation lonization energy and factors affecting it. SO2.5 Describe broader vision of Electronegativity and types of electronegativity scales .	1. Detection of hetero-elements (N, S, Cl, Br, I) in organic compounds 2. Functional group tests for alcohol, aldehyde, carboxylic acid. carbohydrate, phenols, nitro, amine and amide. 3.Quantitative analysis of acid, alkali and buffer solutions	**Periodic table & periodic properties** 2.1 Brief history of development of periodic table and its significance. 2.2 Effective nuclear number (EAN), shielding or screening effect. Slater rules, variation of effective nuclear charge in periodic table. 2.3 Atomic radii (vander Waals) lonic and crystal radii, Covalent radii (octahedral and tetrahedral). 2.4 lonization energy and factors affecting ionization energy, Applications of it. 2.5 Electronegativity- Pauling's/ Mulliken's electronegativity scales, Variation of electronegativity with bond order, partial charge.	Determination of Effective nuclear number (EAN) by Slater rules for some elements of s & p block.

SW-2 Suggested Sessional Work (SW):

A .Assignments:

Determination of Effective nuclear number (EAN) by Slater rules for some elements of s & p block.

b. Mini Project:

lonization energy and factors affecting ionization energy, Applications of it.

c. Other Activities (Specify):

Write an essay on Atomic radii (vander Waals) lonic and crystal radii.

1CH201-Theories related to chemical bonding.

Approximate Hours

Activity	AppX Hrs
Cl	11
LI	12
SW	2
SL	1
Total	26

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Discussion about Ionic bonding & Energy: lattice & solvation energies. SO3.2 Restate Born-Landé equation for calculation of lattice energy. Born-Haber cycle. SO3.3 Explain and apply the concept of Covalent character, polarizability and Fajans rules.	**Unit -3** **Ionic Equilibria** 1. Measurement of pH of different solutions of acids and alkalies using pH- meter (may use aerated drinks, fruit juices, shampoos and soaps) Note-use dilute solutions of soups and shampoos to prevent damage to the	**UNIT-3** **Chemical Bonding** 3.1 Ionic bonding & Energy: lattice & solvation energies and their importance. 3.2 Statement of Born-Landé equation for calculation of lattice energy. Born-Haber cycle and its applications.	Discuss hybridization with suitable examples of linear, trigonal planar, square planar etc.

SO3.4 Explain and apply the Covalent bonding by VBT, Hybridization, (VSEPR) theory. SO3.5 Describe broader concept of Molecular orbital (MO) bonding & MO diagram,(LCAO). .	glass electrode 2. Measurement of the pH of buffer solutions and comparison of the values with theoretical values. 3. Preparation of buffer solutions and determination of their pH and buffer capacity: (1) Sodium acetate-acetic acid (ii) Ammonium chloride-ammonium hydroxide	3.3 Covalent character in ionic compounds, polarizing power and polarizability, Fajans rules. 3.4 Covalent bonding, Lewis structure, VBT, Hybridization, (VSEPR) theory. 3.5Molecular orbital (MO) concept of bonding (LCAO)MO diagrams of homonuclear diatomic molecules: H_2, N_2, O_2 F_2 and their ions. Molecular orbitals of heteronuclear diatomic molecules: NO, CO.	

SW-3 Suggested Sessional Work (SW):

a. Assignments:

Discuss hybridization with suitable examples of linear, trigonal planar, square planar etc.

b. Mini Project:

Hybridization- Concept, types (SP, SP2, SP3 , dSP2 ,d2SP suitable examples of inorganic and organic molecules

c. Other Activities (Specify):

Explanatory note on Rules for the LCAO method, bonding and anti-bonding MOs. Characteristics for ss, sp and p - p combinations of atomic orbitals, nonbonding combination of orbitals.

1CH201- Acid-base concept, ph, buffer and Properties of electrolytes and Basics and mechanism of chemical kinetics.

Activity	AppX Hrs
Cl	13
LI	12
SW	2
SL	1
Total	28

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Discussion about electrolytes and its types degree of ionization, factors affecting it. SO4.2 Restate common ion effect Solubility and solubility product. SO4.3 Explain and apply the concept of acids and bases, relative strength pH, buffer solutions. SO4.4 Explain and apply Rate of reaction, order and molecularity. SO4.5 Describe broader concept of first, second, third and zero order reactions.		**Unit-4** **Acid-Base concept &Ionic Equilibria:** 4.1 Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. 4.2 Common ion effect, Salt hydrolysis. Solubility and solubility product of sparingly soluble salts-applications of solubility product. 4.3 Arrhenius concept, Bronsted-Lowry's concept, conjugates acids and bases, relative strength of acids, Lewis concept. pH, buffer solutions. 4.4 Chemical kinetics Rate of reaction, Definition and difference of order and molecularity. 4.5 Derivation of rate constants for first, second, third and zero order reactions and examples. Derivation for half-life period.	Discuss degree of ionization, factors affecting degree of ionization.

SW-4 Suggested Sessional Work (SW):

Assignments:

pH, buffer solutions. Acid-base neutralization curves, Henderson equation

Mini Project:

Methods to determine the order of reactions.

Other Activities (Specify):

Solubility and solubility product of sparingly soluble salts-applications of solubility product.

1CH201-Factors responsible for reactivity of organic molecules.

Activity	AppX Hrs
Cl	11
LI	12
SW	2
SL	1
Total	26

Session Outcomes (SOs)	Laboratory Instruction(LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Discussion about Electronic Displacements SO4.2 Restate Cleavage of Bonds and explain reactive Intermediates like Carbocations, Carbanions & FR. SO4.3 Explain and apply the concept of configuration of geometric isomers. E & Z, D & L system of nomenclature. SO4.4 Explain and apply configuration of geometric isomers. SO4.5 Describe broader concept Relative and absolute configuration. Conformations isomerism.	.	**Unit-5 Structure, reactivity and stereochemistry of organic molecules:** 5.1 Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. 5.2 Cleavage of Bonds: Homolysis and Heterolysis. Reactive Intermediates Carbocations, Carbanions and free radicals. Nucleophiles and electrophiles. 5.3 Determination of configuration of geometric isomers. E & Z , D & L system of nomenclature. 5.4symmetry, chirality, enantiomer stereogeniccentre, optical activity diastereomers, threo and erythroisomers, meso , Isomer. 5.5 Relative and absolute	chiral and achiral molecules with two stereogeniccentres, diastereomers, threo and erythroisomers, meso isomer.

		configuration, sequence rules, Conformations of ethane, butane and cyclohexane. Sawhorse and Fischer representations .	

SW-5 Suggested Sessional Work (SW):

Assignments:

Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation.

Mini Project:

Conformations and Conformational analysis Conformations of ethane, butane and cyclohexane.

Other Activities (Specify):

Elements of symmetry, molecular chirality, enantiomers& their properties, stereogeniccentre, optical activity .

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+ Sl)
1CH201 **Various theories and principles applied to reveal atomic structure. Significance of quantum numbers.**	12	12	02	01	27
1CH201- **Concept of Periodic table & periodic properties of elements of elements.**.	13	12	02	01	28
1CH201 **Theories related to chemical bonding**	11	12	02	01	26
1CH201 **Acid-base concept, ph, buffer and Properties of electrolytes and Basics and mechanism of chemical kinetics**	13	12	02	01	28

1CH201 **Factors responsible for reactivity of organic molecule**	11	12	02	01	26
Total Hours	60	60	10	05	135

Suggestion for End Semester Assessment

Suggested Specification Table (For ES

CO	Unit Titles	Marks Distribution			Total Marks
		R	**U**	**A**	
CO-1	**Atomic Structure**	03	01	01	05
CO-2	**Periodic table & periodic properties**	02	06	02	10
CO-3	**Chemical Bonding**	03	04	03	10
CO-4	**Acid-Base concept &Ionic Equilibria:**	-02	08	05	15
CO-5	**Structure, reactivity and stereochemistry of organic molecules**	03	02	-05	10
Total		13	21	16	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Organic Chemistry I will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks.Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion

5. Role Play
6. Visit to NCL, CSIR laboratories
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT,Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorm

Suggested Learning Resources:

(a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Concise Inorganic Chemistry	Lee, J.D.	ELBS	1991
2	J., Chemistry For B.Sc. Ist Year	Khera, H.C., Gurtu, J.N., Singh	Pragati prakashan	First Edition 2010
3	Molecular Modeling in Drug Design	Rebecca Wade and Outi Salo-Ahen ,	MDPI	March 2019
4	Bariyar, A. & Goyal, S	B.Sc. Chemistry Combined	Krishna Educational Publishers Year: 2019	2021
5	Puri, B. R., Pathania, M.S., Sharma, L. R	Physical Principles Chemistry	Vishal Publishing Co.	2020.

Mode of Delivery: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point;

LMS/ICT Tools: Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Course Title: FUNDAMENTAL CHEMISTRY **Course Code : 1CH201**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Knowledge	Research Aptitude	Communication	Problem Solving	Individual and Team Work	Investigation of Problems	Modern Tool usage	Science and Society	Life-Long Learning	Ethics	Project Management	Environment and sustainability	The detailed functional knowledge of theoretical concepts and experimental aspects of chemistry	To integrate the gained knowledge with various contemporary and evolving areas in chemical sciences like	understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomeno n-	Provide opportunities to excel in academics, research or Industry by research based innovative knowledge for sustainable develo

														analytical, synthetic, pharmaceutical etc.	based problems in chemical sciences.	pment in chemical science
1CH201 Various theories and principles applied to reveal atomic structure, Significance of quantum numbers.	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**
1CH201 Concept of Periodic table & periodic properties of elements of elements..	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
1CH201 Theories related to chemical bonding	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**

1CH201 Factors responsible for reactivity of organic molecules	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
1CH201 Related the structure and physical properties of drugs to their pharmacological activity. Explain physio-chemical properties related to QSAR.	**2**	**1**	**1**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend:1–Low,2–Medium, 3–High

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

POs &PSOsNo.	**Cos No. &Titles**	**SOsNo.**	**Laboratory instruction (LI)**	**Classroom Instruction(CI)**	**Self Learning(SL)**
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	1CH201 **1:** Various theories and principles applied to reveal atomic structure, Significance of quantum numbers .	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 Symmetry and Group Theory 1.1,1.2,1.3,1.4,1.5,1.6,1.7	Character tables and their use in spectroscopy.
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	1CH201 Concept of Periodic table & periodic properties of elements of elements..	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2 **Vibrational Spectroscopy** 2.1,2.2,2.3,2.4,2.5, 2.6, 2.7, 2.8,2.9	Resonance Raman Spectroscopy, coherent anti-stokes Raman Spectroscopy (CARS).
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	1CH201 Theories related to chemical bonding	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3 : **Mössbauer Spectroscopy** 3.1, 3.2,3.3,3.4,3.5,3.6,3.7	Nature of M-L bond, coordination number, structure and detection of oxidation state.
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	1CH201 Factors responsible for reactivity of organic molecules	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4 : : **Magnetic Resonance Spectroscopy** 4.1, 4.2,4.3,4.4,4.5,4.6,4.7	Quadrupole nuclei, quadrupole moments, electric field gradient, coupling constant splitting. Applications
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	1CH201 Related the structure and physical properties of drugs to their pharmacological activity. Explain physio-chemical	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit 5: X-ray Diffraction , Electron Diffraction** **Neutron Diffraction** 5.1,5.2,5.3,5.4,5.5	Low energy electron diffraction and structure of surfaces. ,

	properties related			,5.6,5.7	

Curriculum Development Team:

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Course Code: **2GO201**

Course Title: **Crystal and Mineral Science**

Pre-requisite: To study this course, a student must have had the subject maths group or biology group in class 12 th.

Rationale: The students studying Bachelor of Sciences (Geology) Course should possess foundational understanding of principles crystallography and mineral sciences including minerology, symmetry, optical minerology .They must have the knowledge of economic importance of ore and rock forming minerals. They should be able to identify various minerals in lab as well as in fields.

Course Outcomes

2GO201.1: Describe theIntroduction to Crystallography

2GO201.2: Demonstrate the Crystallography in the Study of Minerals

2GO201.3: AnalyseMinerals including their physical and chemical properties

2GO201.4: Explain the Optical Minerology in detail including basic concepts

2GO201.5: Discuss Minerals and Lithosphere including composition of later.

Scheme of Studies:

Board of Study	Course Code	Course Title			Scheme of studies(Hours/Week)			Total Credits
			Cl	LI	SW	SL	Total Study Hours(CI+LI+SW+SL)	(C)
Program Core (DSE)	**2GO201**	Crystal and Mineral Science	3	4	1	1	5	6

Legend

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others,

LI: Laboratory Instruction (Includes Practical performances in laboratory, workshop, field or other locations using different instructional strategies)

SW: Seasonal Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment

Theory

<table>
<tr><td>Board of Study</td><td>Course Code</td><td>Course Title</td><td colspan="8">Scheme of Assessment (Marks)</td></tr>
<tr><td rowspan="3">Board of Study</td><td rowspan="3">Course Code</td><td rowspan="3">Course Title</td><td colspan="8">Scheme of Assessment (Marks)</td></tr>
<tr><td colspan="6">Progressive Assessment (PRA)</td><td rowspan="2">End Semester Assessment</td><td rowspan="2">Total Marks</td></tr>
<tr><td>Class/Home Assignment 5 number
3 marks each</td><td>Class Test 2
(2 best out of 3)
10 marks each</td><td>Seminar one</td><td>Class Activity any one</td><td>Class Attendance</td><td>Total Marks</td></tr>
</table>

			(CA)	(CT)	(SA)	(CAT)	(AT)	(CA+CT+SA+CAT+AT)	**(ESA)**	(PRA + ESA)
PCC	2GO201	Crystal and Mineral Science	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

2GO201.1: Describe the Introduction to Crystallography

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 Demonstrate the concept of minerals and crystals. **SO1.2**Describe the elements and forms of crystals. **SO1.3**Interprete the systems of crystal notations. **SO1.4** Explain the concept of Bravias Lattices **SO1.5** Describe the rock forming and ore forming minerals.	1.1 Study of Symmetry Elements of crystals (Models) of Normal Classes	**UNIT 1 Introduction to Crystallography** 1.1 Mineral and Crystal. 1.2 Rock forminig and ore forming minerals. 1.3 Crystal structure. 1.4 The Concept of Unit cells. 1.5 Bravias Latticees. 1.6 Elements of crystal. 1.7 Forms of Crystals. 1.8 Crystallographic axes and axial angles. 1.9 Weiss parammeters of crystal notations. 1.10 Miller Indices System of crystal notation. 1.11 Application of Crystallography. 1.12 classification of crystallography.	1. Definition and concept of Crystallography. 2. Concept of crystal structure and unit cells.

SW-1 Suggested Sessional Work (SW)

a. Assignments:

i. Concept of crystallographic axes, axial ratio,and the axial angles.
ii. Miller Indices system of crystal notations
iii. The concept of unit cell.

b .Mini Project:

Study of crystal forms with the help of models

c . Other Activities (Specify):

Note on Crystallography

2GO201.2: Demonstrate the igneous rocks - its forms, structures, texture and classification.

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 Describe the laws of crystallography. **SO2.2** Explain the concept of crystal symmetry. **SO2.3** Analyse the classification of crystal systems. **SO2.4** Discuss the concept of twinning of crystals **SO2.5** Evaluate the laws of twinning.	2.1 Study of Fundamental Forms of crystals (models) of normal classes	**UNIT 2: Crystallography** 2.1 Laws of crystallography 2.2 Interfacial Angle and its measurement 2.3 Crystal symmetry I 2.4 Crystal symmetry II 2.5 Concept of Symmetry 2.6 Measurement of Interfacial Angles. 2.7 Classification of crystal into systems and classes – part 1 2.8 Classification of crystal into systems and classes - part 2 2.9 Classification of crystal into systems and classes - part 3 2.10 Symmetry and forms of normal classes 2.11 Twinning of Crystals 2.12 Common Twinning Laws	I. Concept of Symmetry II. Measurement of Interfacial Angles

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Various laws of Crystallography.
ii. Concept of twinning of crystals
iii. Symmetry of crystals

b. Mini Project:

Model study of crystal forms

c. Other Activities (Specify):

Give an account of the Gonimeter and measurement of axial angles.

2GO201.3: Analyse the Minerals including their physical and chemical propertie

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes(SOs)	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
SO3.1 Explain the concept of silicate structures **SO3.2** Assess the chemical properties of minerals **SO3.3** Discuss concept of isomorphism and solid solutions. **SO3.4** Analyse the various physical properties of minerals.	3.1Verification of Euler's Theorm	**Unit-3 :Minerals** 3.1 Silicate mineral structures 3.2 classification of silicates 3.3 Bonding in minerals 3.4 Isomorphism and Solid Solutions Part-1 3.5 Isomorphism and Solid Solutions Part -2 3.6 Polymorphism and pseodomorphism 3.7 Introduction of Physical properties of minerals 3.8 Physical properties of	i. Classification of sillicate structures ii. Chemical properties of minerals

SO3.5 Assess the concept of polymorphism and pseudomorphism.		minerals – part 1 3.9 Physical properties of minerals – part 2 3.10 Introduction of Chemical properties of minerals 3.11 Chemical properties of minerals– part 1 3.12 Chemical properties of minerals– part 2	

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Concept and classification of sillicate structures
ii. Physical properties of minerals
iii. Chemical properties of minerals

b. Mini Project:

Identification of minerals by their physical properties

c. Other Activities (Specify):

Collect data of various physical properties of minerals

2GO201.4: Explain the Optical Minerology in detail including basic concepts.

Approximate Hours

Items	Approx Hours
CI	12
LI	12
SW	3
SL	2
TOTAL	29

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO4.1 Explain the fundamentals of optical peoperties **SO4.2**Assess the functioning of a polarizing microscope **SO4.3**Discuss the optical properties of minerals **SO4.4** Demonstrate the Nicole prism. **SO4.5** Evaluate the concept of refrective index	4.1 Studiy of Physical Properties of Minerals.	**Unit-4:Optical Minerology** 1. Refractive index; Critical angle and Total internal reflection 2. Introduction of Double refraction 3. Double refraction 4. Introduction of Nicol prism 5. Nicol prism - construction and working 6. Introduction to polaroids 7. Polarizing microscope: Parts and working 8. Concept of optical properties. 9. Optical properties of minerals - part 1 10. Optical properties of minerals - part 2 11. Introduction of Petro	i. Concept of optical properties. ii. Petrographical microscope

		graphical microscope Part -1 12. Petro graphical microscope Part -2	

SW-4 Suggested Sessional Work (SW)

a. Assignments:

I. Various optical properties of minerals
II. Refractive index;critical angle, total internal reflection and double refraction.
III. Parts and working of polarizing microscop

d. Mini Project:

Study various optical properties of important rock forming minerals

e. Other Activities (Specify):

Power Point Presentation on optical properties of important rock forming minerals.

2GO201.5: Discuss Minerals and Lithosphere including composition of later.

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes(SOs)	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning (SL)
SO5.1 Describe the physical and optical properties of garnet and mica. **SO5.2** Explainthe physical and optical properties of pyroxene **SO5.3** Analyse classification, physical and optical properties of Amphiboles **SO5.4** Evaluateclassification, physical and optical properties of Feldspar and silica. **SO5.5** Evaluate the general composition of lithosphere.	5.1 Study of Optical properties of Important Rock Forming Minerals Using Polarizing Microscope	**Unit 5 : Minerals and Lithosphere** 1. composition, classification physical and optical properties of Garnet 2. composition, classification physical and optical properties of Mica 3. composition, classification physical and optical properties of Pyroxenes 4. composition, classification physical and optical properties of Amphiboles 5. composition, classification physical and optical properties of Feldspar 6. composition, classification physical and optical properties of Silica 7. composition, classification Chemical properties of Mica 8. composition, classification Chemical properties of Pyroxenes 9. composition, classification Chemical properties of Amphiboles 10. composition, classification Chemical properties of Silica 11. Composition of lithosphere 12. General characteristics of igneous, sedimentary and metamorphic rocks	I. Concept of lithosphere II. General characteristics of varipous rock types.

SW-5 Suggested Sessional Work (SW)

a. Assignments:

I. Give an account of the general composition of the lithosphere.
II. Explain the general characteristics of the various rock types

III. Discuss the composition, classification, physical and optical properties of quart

b. Mini Project:

Study on the general composition of lithosphere.

c. **Other Activities(Specify):**

Power point presentation on general characteristics of various rock types

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
2GO201.1: Describe theIntroduction to Crystallography	12	12	2	1	27
2GO201.2: Demonstrate the Crystallography in the Study of Minerals	12	12	2	1	27
2GO201.3: AnalyseMinerals including their physical and chemical properties	12	12	2	1	27
2GO201.4: Explain the Optical Minerology in detail including basic concepts.	12	12	3	2	29
2GO201.5: Discuss Minerals and Lithosphere including composition of later.	12	12	2	1	27
Total Hours	60	60	11	6	137

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Introduction to Crystallography	03	01	01	05
CO-2	Crystallography	02	06	02	10
CO-3	Minerals	03	07	05	15
CO-4	Optical Minerology	-	10	05	15
CO-5	Minerals and Lithosphere	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U:Understand, A:Apply

The end of semester assessment for Igneous and Metamorphic Petrology will be held with written examination of 50 marks.

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to geological sites
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

SN	Title	Author	Publisher	Edition&Year

1	A Text Book of Minerology	E. S. Dana & W.S.Ford	John Willey and Sons, London	4th Edition, 1958
2	Dana's Manual of Minerology	C.S.Hurlbut, Jr.	John Willey and Sons, London	16th Edition, 1965
3	A Text Book of Geology	P.K.Mukherjee	The World Press Private Limited, Kolkata	13th Edition, 2010
4	Rutley's Elements of Mineralogy	C.D.Gribble	CBS Publishers and Distributors Private Limited, New Delhi	27th Edition, 1991.
5	Engineering and General Geology	Pravin Singh	S.K.Kataria & Sons, New Delhi.	8th Edition, 2008.

Course Title: Crystal and Mineral Sciences **Course Code:** 2GE201

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Knowledge.	Research aptitude.	Communication.	Problem solving.	Individual and team work.	Investigation of Problem.	Modern tool usage	Science and Society.	Life-long learning	Ethics	Project management	Environment and	The detailed functional knowledge of Theoretical	Ability Word skills and advanced GIS, statistics,	Develop a research design, which has an appropriate problem related to earth	Provide an excellent preparation for a career in professional practice in industrial or

CO.1 Describe the Introduction to Crystallography	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**
CO.2 Demonstrate the Crystallography in the Study of Minerals	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
CO.3 Analyses Minerals including their physical and chemical properties	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO.4 Explain the Optical Minerology in detail including basic concepts	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**

CO.5 Discuss Minerals and Lithosphere including composition of later.	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,67,8,9,10,11,12 PSO1,2,3,4	CO.1 Describe the Introduction to Crystallography system.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1 1.2	Introduction to Crystallography 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9 Tutorial 1.1, 1.2, 1.3	As mention in page number 2 to 6
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO.2 Demonstrate the Crystallography in the Study of Minerals	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1 2.2	UNIT 2: Crystallography 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9 Tutorial 2.1, 2.2, 2.3	
PO1,2,3,4,5,6 7,8,9,10,11,12	CO.3 Analyses Minerals	SO3 .1 SO3	3.1 3.2	Unit-3 :Minerals	

PSO1,2,3,4	including their physical and chemical properties	.2 SO3.3 SO3.4 SO3.5		3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9 Tutorial 3.1, 3.2, 3.3	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO.4 Explain the Optical Minerology in detail including basic concepts	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1 4.2	Unit-4:Optical Minerology 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9 Tutorial 4.1, 4.2, 4.3	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO.5 Discuss Minerals and Lithosphere including composition of later.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1 5.2	Unit 5 : Minerals and Lithosphere 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9 Tutorial 5.1, 5.2, 5.3	

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AKS University
Faculty of Basic Science
Curriculum of B. Sc. (Honours / By Research) Program
(Revised as on 01 August 2023)
B.Sc. (IIIrd semester)

Course Code: **1SE301**

Course Title : **Web Designing**

Pre-requisite: Student should have basic knowledge of computer.

Rationale: Study of this subject will develop different skills in students to create and manage the websites. Concepts like Html, CSS and JavaScript will helpful to develop front end static and dynamic web pages design of website.

Course Outcomes:
On successful completion of this course, the students will be able to:
1SE301.1 Have knowledge of HTML, its essential tags, Attributes, Text styles, Links to External Documents and different sections of a HTML page.
1SE301.2 Develop skills to generate HTML and CSS page and have knowledge of Java Script assisted style sheets.
1SE301.3 Have knowledge of CSS, CSS Syntax, Comments, Level of CSS, Embedding HTML in CSS, JavaScript pre-defined and used defined.
1SE301.4 Develop skills to generate Static and dynamic application designing, Google form designing.

Scheme of Studies:

Legend: **CI:**Class room Instruction(Includes different instructional strategies i.e. Lecture(L) and Tutorial (T) and others),
LI: Laboratory Instruction(Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Assignment 5 number 3 marks each	(2 best out of 3) 10 marks each	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
SE	**1SE301**	Web Designing	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1SE301.1: Have knowledge of HTML, its essential tags, Attributes, Text styles, Links to External Documents and different sections of a HTML page.

Approximate Hours

Item	AppX Hrs
Cl	09
LI	06
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO1.1 Understand basics of HTML **SO1.2** Understanding various tags used with HTML **SO1.3** Understanding types of List in Html. **SO1.4** Understanding different input types **SO1.5** Understand client server architecture . .	1 Design web pages for your college containing a description of the courses, departments, faculties, library, etc, use href, list tags. 2 Create your class time table using the table tag. 3 Create user Student feedback form (use textbox, text area, checkbox, radio button, select box,	**1.1** ntroduction to Internet World Wide Web. **1.2** nternet Addressing, Browser, URL, Web server, Website, homepage, Domain, Basic concepts. **1.3** oftwares for web Designing: -Notepad/ Notepad++, Dreamweaver, Blue Griffon, Net beans, Sea Monkey, Word press, Sublime. **1.4** Introduction to HTML: HTML Tags & attributes, HTML Basic Tags, Formatting Tags, **1.5** HTML color Coding, Div and Span Tags for Grouping.**List:** Unordered Lists, Ordered Lists, Definition list, Images: Image and Image Mapping.	1. Learning various concepts related with internet.

	etc.)	**1.6** Hyperlink: URL – Uniform Resource Locator, URL Encoding, Table:<table>, <th>,<tr>,<td>,<caption>,<thead>,<tbody>,<tfoot>,<colgroup>,<col>, Attributes Using Iframe as the Target. **1.7 Form:** <input>,<textarea>,<button>, <select>,<label> **1.8 Headers:** Title, Base, Link, Styles, Script **1.9 HTML:** Title, Base, Link, Styles, Script HTML Meta Tag, XHTML, HTML Deprecated Tags & Attributes.	

SW-1 Suggested Sessional Work(SW):

a. **Assignments:**
   i. Explain basic terminologies used with HTML.
   ii. Explain various types of tags.
b. **Mini Project:**

1SE301.2: Develop skills to generate HTML and CSS page and have knowledge of Java Script assisted style sheets (JSSS).

Approximate Hours

Item	AppX Hrs
Cl	9
LI	6
SW	2
SL	1
Total	18

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1 To Understand the concept of web server. **SO2.2**To learn about Cascading Style Sheet.	4 Create a web page using the frame. Divide the page into two parts with 5 Create your resume using HTML tags also	Unit-2 **CSS:** **2.1** Introduction, Features & benefits of CSS, CSS Syntax, External Style Sheet using <link>, Multiple Style Sheets,	Try to Implement VB Script and Java Script

SO2.3 To implement VB Script and Java Script. **SO2.4** To understand Document Object Model. **SO2.5** To learn about JRE (JavaScript Runtime Environment).	experiment with colors, text, links, size, and also other tags you studied. 6 Create a web page by making use of the following tags: Head, Body, Bgcolor. 7 Write a HTML program to implement different types of CSS.	Value Lengths and Percentages. **2.2** Selectors: ID selectors, Class Selectors, Grouping Selectors, **2.3** Universal Selector, Descendant/ Child Selectors, **2.4** Attribute Selectors, CSS- Pseudo Classes. **2.5** Color Background Cursor: background-image, background-repeat, background-position, **2.6** CSS Cursor. **2.7** Text Fonts: Color, background-color, **2.8** text-decoration, text-align, vertical- align, **2.9** font- family, font-size, font-style, font-variant, font-weight.	

SW-2 Suggested Sessional Work(SW):

a. Assignments:

i. Explain client-side scripting VBScript and JavaScript.
ii. Explain web database connectivity using DBC and ODBC.

b. Mini Project:

Create an user interface.

1SE301.3 : Have knowledge of PHP, PHP Syntax, Comments, Variables and Constants, Embedding PHP in HTML pre-defined and used defined.

Approximate Hours

Item	AppX Hrs
Cl	9
LI	6
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 Learning server-side scripting language PHP. **SO3.2**Will learn PHP Syntax, Comments Tags and Attributes . **SO3.3** Learn CSS and JavaScript run time data communications . **SO3.4**Creating forms using HTML. **SO3.**5 Implement front end to back end any data base communication .	**1**. Acquaintance with elements, tags and basic structure of HTML files. **2**. Practicing basic and advanced text for formatting. **3**. Practice use of image, video and sound in HTML documents. **4**. Designing of web pages- Document layout, list, tables. **5**. Practicing Hyperlink of web pages, working with frames. **6**. Working with forms and controls. **7**. Working with background, text, font, list properties **8** Write a JavaScript program to design a simple calculator. **9** Write a JavaScript program to find the factorial of given number by using function. **10** Write a JavaScript program to form validation in HTML	**Unit-3 : CSS** **3.1** List- style-type, list-style-position, list-style-image, list-style, **3.2** SS Tables (border, width & height, text-align, virtual-align,padding, color) **3.3** Box Model: Borders & Outline, Margin & Padding, **3.4** Height and Width, CSS Dimensions. **3.5** Display Positioning: CSS Visibility, CSS Display, CSS Scrollbars, **3.6** CSS Positioning (Static Positioning, Fixed Positioning Relative Positioning, Absolute Positioning), **3.7** CSS Layers with Z –index. **3.8** Floats: The Float Property, The Clear Property, The Clear fix Hack. **3.9** Implement front end to back end any data base communication	Learning various attributes of HTML tags.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Explain basic PHP tags and their properties.
ii. Create an HTML page that contains a CSS.

b. Mini Project:

iii. Create an admission form using HTML tags& CSS.

c. Other Activities (Specify):

Use of latest editors for web development like. VSCode, Notepad++ etc.

1SE301.4: Have knowledge of basic PHP.

Approximate Hours

Item	AppX Hrs
Cl	9
LI	6
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO4.1 Understanding functions of PHP . **SO4.2**Learn variable scope **SO4.3**Learn string handling operations. **SO4.4**Learn Accessing Data from regular expressions. **SO4.**Understand working of client side and server side of PHP.	11 Create a web form using php for login page. 12 Create a simple xml document with following details: Rollno, Sname, Contact, Email & Address. 13 Write a simple PHP script to perform crud operations. 14 Create a web form using php for enquiry details.	**Unit-4: The JavaScript** **4.1** Nature of JavaScript. **4.2** Script Writing Basics, Enhancing HTML Documents with JavaScript, The Building Blocks. **4.3** Introduction to JavaScript, JavaScript Engines. Variables & Operators, **4.4** Variable Mutation, Basic Operators, Operator Precedence, **4.5** JavaScript Types, Definition, Types in JavaScript, **4.6** Objects, Type Conversion and Coercion, Static vs Dynamic Type Checking. **4.7** JavaScript Conditionals: Introduction to Conditionals, Conditionals in JavaScript, Ternary Operators and Conditionals Ladders & Switch Statement.	Learn Accessing Data from regular expressions

		4.8 JavaScript Conditionals: Introduction to Arrays, Declaring and Mutating Arrays, **4.9** Array Method and Properties, Replication with Array Methods, Multi- dimensional Arrays.	

SW-4 **Suggested Sessional Work (SW)**

a. Assignments:

i. Write down the features of PHP.

ii. Explain client side and server side of PHP.

a. Mini Project:

i. Design a web page And use PHP.

b. Other Activities(Specify):

Implementing CSS in your previously created web page.

1SE301.5: Develop skills to generate Static and dynamic application designing, Google form designing.

Approximate Hours

Item	AppX Hrs
Cl	9
LI	6
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO5.1 Learn Static and dynamic application designing. **SO5.2**Implementing session and cookies. **SO5.3**Learn file and directory open, close etc operations. **SO5.4** Implementing template customization and develop dynamic applications **SO5.**5 Learn file handling with PHP.	1.Customize a template using PHP 2. Create a MYSQL data base and connect with PHP. 3. Write PHP script for storing and retrieving user information from my SQL	**Unit-5** **5.1** Introduction to Loops, Loops in JavaScript, While and Do/ While Loops, For Loops, **5.2** Break and Continue in Loops, Iterating Arrays, Iterating Objects. **5.3** JavaScript Functions: Introduction to Functions, Functions in JavaScript, Nested Functions in JavaScript, 5.4Arrow Functions in JavaScript, Function as an Argument,	Learn PHP as server side scripting.

	table. a. Write a HTML page which takes Name, Address, Email and Mobile number from user (register PHP). b. Store this data in MySQL data base. c. Next page displays all user in HTML table using PHP (display PHP). 4 Write a PHP program to print first ten Fibonacci numbers.	Function as the Returned Object. **5.5** JavaScript Scope: Scope Introduction, Scope in JavaScript, Lexical Scope, Module Scope. **5.6** Method of Adding Interactivity to a Webpage, Creating Dynamic Web Pages; Concept of Java Scripting the Forms **5.7** Java Scripting the Forms, Basic Script Construction, Talking to the Form Objects, Organizing the Objects and Scripts, Field- Level Validation **5.8** Check Required Fields like Validating Zip Code, Automated Formatting, Format **5.9**Phone, Format Money, automatic Calculation, Calculate Expire Date, Calculate Amount etc.	

SW-5 Suggested Sessional Work (SW):

a. **Assignments**
i. Write a PHP program to print first ten Fibonacci numbers.
ii. Create HTML page with java script which takes integer number as a input and tells whether the number is divisible by 4 or not.

b. **Mini Project:**
i. Using HTML, CSS, Javascript, PHP, MySQL, design and authentication module of a web page.

c. **Other Activities(Specify):**
Create form validation using PHP.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Lab Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)

1SE301.1: Have knowledge of HTML, its essential tags, Attributes, Text styles, Links to External Documents and different sections of a HTML page.	9	6	2	1	18
1SE301.2: Develop skills to generate HTML and CSS page and have knowledge of Java Script assisted style sheets (JSSS).	9	6	2	1	18
1SE301.3: Have knowledge of PHP, PHP Syntax, Comments, Variables and Constants, Embedding PHP in HTML pre-defined and used defined.	9	6	2	1	18
1SE301.4 : Have knowledge of functions of PHP Fundamentals of PHP,	9	6	2	1	18
1SE301.5 : Develop skills to generate Static and dynamic application designing, Google form designing, file handling of PHP	9	6	2	1	18
Total Hours	45	30	10	5	90

Suggestion for End Semester Assessment

Suggested Specification Table(ForESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
1SE301.1	Have knowledge of HTML, it's essential tags, Attributes, Text styles, Links to External Documents and different sections of a HTML page.	02	01	01	04
1SE301.2	Develop skills to generate HTML and CSS page and have knowledge of Java Script assisted style sheets (JSSS).	02	06	02	10
1SE301.3	Have knowledge of PHP, PHP Syntax, Comments, Variables and Constants, Embedding PHP in HTML pre-defined and used defined.	03	07	05	15
1SE301.4	Have knowledge of functions of PHP Fundamentals of PHP,	02	10	05	17
1SE301.5	Develop skills to generate Static and dynamic application designing, Google form designing, file handling of PHP	03	02	02	07
Total		12	26	15	53

Legend: R:Remember, U:Understand, A:Apply

The end of semester assessment for Web Technology will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role-play
6. Visit to cement plant
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,WhatsApp,Mobile,Onlinesources)
9. Brainstorming

sted Learning Resources:

(a) **Books**:

S. No.	Title	Author	Publisher	Edition &Year
1	Beginning PHP5, Apache, and MySQL Web Development	Elizabeth Naramore, Jason Gerner, Yann Le Scouarnec, Jeremy Stolz	Glass Wrox Publication	2005
2	Beginning HTML, XHTML, CSS, and JavaScript 2010	Jon Duckett	Wiley Publishing	2010
3	Web Technologies, Black Book, Dream Tech Press 2010	Kogent	Learning Solutions Inc Dream Tech Press	2010
4	HTML, XHTML and CSS Bible	Bryan Pfaffenberger, Steven M. Schafer, Chuck White	**John Wiley & Sons**	2004

CO, PO and PSO Mapping

Course Code: 1CS301

Course Title: Web Designing

PO NO.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Program Outcomes	**Engineering knowledge**	**Problem Analysis**	**Design/development of solutions**	**Conduct studies of difficult problems**	**Utilization of modern tools**	**Engineers and society**	**Environment and sustainability**	**Ethics**	**Individual and team work**	**Communication**	**Project management and finance**	**Life-long learning**
CO1:-Have knowledge of HTML, its essential tags, Attributes, Text styles, Links to External Documents and different sections of a HTML page.	2	2	3	3	3	1	1	3	1	1	1	3
CO2: Develop skills to generate HTML and CSS page and have knowledge of Java Script assisted style sheets (JSSS).	1	3	2	3	2	2	2	2	1	1	1	3

CO3: Have knowledge of PHP, PHP Syntax, Comments, Variables and Constants, Embedding PHP in HTML pre-defined and used defined.	2	2	2	3	3	2	1	2	1	1	1	3
CO4: Have knowledge of functions of PHP Fundamentals of PHP,	1	2	3	2	3	2	1	3	1	2	1	3
CO5: Develop skills to generate Static and dynamic application designing, Google form designing, file handling of PHP	1	2	2	2	3	2	1	3	1	1	1	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO:1,2,3,4,5,6,7,8,9,10, 11,12 **PSO:1,2,3,4,5**	**CO1:** Have knowledge of HTML, its essential tags, Attributes, Text styles, Links to External Documents and different sections of a HTML page.	**SO1.1** **SO1.2** **SO1.3** **SO1.4** **SO1.5**	**1.1** **1.2**	Unit 1 1.1,1.2,1.3,1.4,1.5 ,1.6,1.7, 1.8,1.9,1.10, 1.11, 1.12	**As mentioned in page number 2 to 10**
PO:1,2,3,4,5,6,7,8,9,10, 11,12 **PSO:1,2,3,4,5**	**CO2:** Develop skills to generate HTML and CSS page and have knowledge of Java Script assisted style sheets (JSSS).	**SO2.1** **SO2.2** **SO2.3** **SO2.4** **SO2.5**	**2.1** **2.2**	Unit 2 2.1,2.2,2.3,2.4,2. 5,2.6,2.7,	
PO:1,2,3,4,5,6,7,8,9,10, 11,12 **PSO:1,2,3,4,5**	**CO3:** Have knowledge of PHP, PHP Syntax, Comments, Variables and Constants, Embedding PHP in HTML pre-defined and used defined.	**SO3.1** **SO3.2** **SO3.3** **SO3.4** **SO3.5**	**3.1** **3.2**	Unit 3 3.1, 3.2,3.3,3.4,3.5,3.6 ,3.7.3.8,3.9,3.11	

PO:1,2,3,4,5,6,7,8,9,10, 11,12 PSO:1,2,3,4,5	**CO4:** Have knowledge of functions of PHP Fundamentals of PHP,	**SO4.1 SO4.2 SO4.3 SO4.4 SO4.5**	**4.1 4.2**	Unit 4 4.1, 4.2,4.3,4.4,4.5,4.6,4.7.4.8.4.9,4.10,4.11	
PO:1,2,3,4,5,6,7,8,9,10, 11,12 PSO:1,2,3,4,5	**CO5:** Develop skills to generate Static and dynamic application designing, Google form designing, file handling of PHP	**SO5.1 SO5.2 SO5.3 SO5.4 SO5.5**	**5.1 5.2**	Unit 5.1, 5.2,5.3,5.4,5.5,5.6,5.7.5.8.5.9,5.10,5.11	

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Course Code: **1CS301**

Course Title : **Computer Network and Information Security**

Course Code: 1CS301

Course Title : Computer Network & Information Security

Pre- requisite: A pragmatist approach would allow all stakeholders to create the sets of rights through never-ending dialogue, but this does not seem to be the path followed. There also needs to be agreement on the prerequisites before network rights can be addressed. The computer network used for various purposes, among the most prevalent, for communication, technology driven applications in computer industry.

Rationale: information communication technology-A well-designed technology solution can be used to disseminate resources, connect students to information, enhance teachers' practices and students' performance in all subject areas, improve network management and support data-driven policymaking, developing quality assurance for sustainable growth in computer network and information security.

Course Outcomes (CO):

Course Code	Course Outcomes
CO1	Acquire the knowledge of the Use of Computer Network : Access to information
CO2	Acquire the basic and advance knowledge of Guided Transmission Media, Wireless transmission
CO3	Acquire the basic and advance knowledge data link control, framing , Flow and Error Control
CO4	Acquire the basic and advance knowledge of Network layer issues , Routing Algorithms
CO5	Acquire the basic and advance knowledge of Network Security and Information Security
CO6	Acquire the basic and advance knowledge of Computer and Cyber – crimes

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Program Core	1CS301	Computer Network & Information Security	4	4	1	1	10	6

Legend:

CI	**Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others)**
LI	**Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)**
SW	**Sessional Work (includes assignment, seminar, mini project etc.)**
SL	**Self Learning**
C	**Credits**

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment (Theory +Practical):

Theory

Board of Study	Couse Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	**(ESA)**	(PRA+ ESA)
	1CS301	Computer Network & Information Security	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1: Acquire the knowledge of the Use of Computer Network : Access to information

Approximate Hours

Item	CL	LI	SW	SL	Total
Approximate Hours	12	12	01	01	26

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI) Unit-1	Self Learning (SL)
SO1.1Introduction to Computer Network SO1.2 Introduction of electronic commerce SO1.3 Introduction to Broadband access network SO1.4 Working with transit network , Enterprise network SO1.5 Introduction to Reference model : OSI , TCP/IP	**1.1 Introduction of network** **1.2 LAN**	1.1 Use of Computer Network 1.2 Access to information , person to person communication 1.3 electronic commerce , internet of things . 1.4 Types of computer network 1.5 Broadband access network 1.6 Mobile and wireless network , 1.7 Content delivery network , transit network , Enterprise network . 1.8 Network Technology : Personal Area Network , Local Area Network , Metropolitan Area Network , Wide Area Network , internetworks , 1.9 Example of networks (internet , mobile network , wireless network- Wi-Fi) 1.10 Reference model : OSI , TCP/IP , 1.11 Critique of the OSI and TCP/IP reference models . Policy , legal & social issues 1.12 Online speech , net neutrality , security & priavacy , disinformation .	1.study electronic commerce

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Elaboration of Internet of Things .

CO2: Acquire the basic and advance knowledge of Guided Transmission Media, Wireless transmission

Approximate Hours

Item	CL	LI	SW	SL	Total
AppX Hrs	12	12	01	01	26

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI) Unit-2	Self Learning (SL)
SO2.1Introduction to Physical layer : Guided Transmission Media SO2.2Wireless transmission : The electromagnetic spectrum SO2.3 Introduction to frequency hopping spread spectrum SO2.4Working 6 Cellular network : common concepts – cells , handoff, paging ; SO2.5 Introduction to 1G , 2G , 3G , 4G & 5G technology .	2.1 LAN CABLES 2.2 UTP,STP,OPTICAL FIBRE	2.1 Physical layer : Guided Transmission Media : Twisted pair cable , 2.2 Coaxial cable , Fibre Optics cable . 2.3 Wireless transmission : The electromagnetic spectrum, 2.4 Introduction to frequency hopping 2.5 Frequency hopping spread spectrum 2.6 Wireless transmission : The electromagnetic spectrum 2.7 Working 6 Cellular network: common concepts – cells, handoff, paging ; 2.8 Direct sequence spread spectrum , 2.9 Ultra – wideband communication. 2.10 Cellular network : common concepts – cells , handoff, paging 2.11 Introduction to 1G , 2G , 3G , 4G & 5G technology . 2.12 1G , 2G , 3G , 4G & 5G technology .	study Fiber Optics cable

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Elaboration cables.

CO3: Acquire the basic and advance knowledge data link control, framing , Flow and Error Control

Item	CL	LI	SW	SL	Total
AppX Hrs	12	12	01	01	26

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI) Unit-3	Self Learning (SL)
SO3.1Introduction to Data link layer SO3.2 Introduction to framing , Flow and Error Control , Error Detecting codes SO3.3 Introduction to Data link protocols SO3.4Working with Sliding window protocol SO3.5 Introduction to 8Network Devices & Drivers : Router	**3.1 Error correcting code** **3.2 switch**	3.1 Data link layer : Service provided to network layer data link control, 3.2 framing , Flow and Error Control , Error Detecting codes , Error correcting codes 3.3 Data link protocols : Basic transmission and receipt , 3.4 Simplex link layer protocol , Full duplex 3.5 Sliding window protocol , Packet over SONET , 3.6 ADSL, Point – to – Point Protocol . 3.7 Switching techniques : Packet Switching , Circuit Switching , Datagram Networks , 3.8 Virtual – circuit Networks , and Structure of a Switch . 3.9 Network Devices & Drivers : Router , modem , repeater , hub , 3.10 Switch , Bridge and Gateways (fundamental concepts) 3.11 Working with Sliding window protocol 3.12 Introduction to 8Network Devices & Drivers : Router	1.1 Learn Switching

SW-3 Suggested Sessional Work (SW):
a. Assignments:
i.elaborate packet switching

CO4: Acquire the basic and advance knowledge of Network layer issues , Routing Algorithms

Approximate Hours

Item	CL	LI	SW	SL	Total
AppX Hrs	12	12	01	01	26

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI) Unit-4	Self Learning (SL)
SO4.1Introduction to Network layer issues , Routing Algorithms SO4.2 Distance Vector Routing , Broadcast Routing SO4.3 Introduction to congestion in network , traffic management SO4.4Working IP Addresses , Ipv4 Addresses , Ipv6 Addresses SO4.5Introduction to Transport Layer : Process – Process Delivery	**4.1 IP addressing** **4.2 TCP**	4.1 Network Layer : Network layer issues , Routing Algorithms : Optimality , principle of shortest path algorithm , flooding , 4.2 Distance Vector Routing , Broadcast Routing , 4.3 Congestion in network , 4.4 Traffic management approaches , 4.5 IP Addresses , Ipv4 Addresses , 4.6 Ipv6 Addresses . 4.7 Virtual – Circuit Networks : Frame Relay and ATM. 4.8 Transport Layer : Process – Process Delivery : UDP,TCP. 4.9 Application layers : DNS , SMTP , 4.10 POP , FTP , HTTP and HTTPs . 4.11 Basics of Wi-Fi (Fundamental concepts only).	1. Solving problems of shortest path algorithm

		4.12 Streaming audio and video : digital audio and video, Streaming stored media , real – time streaming .	

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Wifi.

CO5: Acquire the basic and advance knowledge of Network Security and Information Security.

Item	CL	LI	SW	SL	Total
AppX Hrs	12	12	01	01	26

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI) Unit-5**	**Self Learning (SL)**
SO5.1Introduction Network Security and Information Security SO5.2 Principles of security and attack , Security goals SO5.3 Introduction3 Overview of Security Threats and Vulnerability SO5.4 Understanding E-mail threats , Web threats SO5.5 Security Technology : Firewalls	5.1Cryptography 5.2 Cryptography algorithm	**5.1** Network Security and Information Security : Fundamentals of network and information security , **5.2** Principles of security and attack , Security goals (Confidentiality , **5.3**Integrity and Availability) , Non – Repudiation . **5.4** Overview of Security Threats and Vulnerability : Types of attacks on Confidentiality , Integrity , and Availability . **5.5** Vulnerability and Threats : Phishing Attacks , **5.6** E-mail threats , Web threats , Intruders and Hackers , Insider threats , SQL injection Attacks , Ransomware **5.7** Malware : Worms , Virus , Spams , Adware , Spyware, Trojans . **5.8** Security Technology :	1 .Study network and information security

		Firewalls , Intrusion detection and prevention systems , Scanning and **5.9** Analysis Tools : Biometric Access Controls. **5.10** Cipher methods , Cryptographic algorithms **5.11** Cryptographic tools **5.12** Protocols for secure communication.	

SW-3 Suggested Sessional Work (SW):
a. Assignments:
i. elaborate Security on computer

CO6: Acquire the basic and advance knowledge of Computer and Cyber – crimes

Item	CL	LI	SW	SL	Total
AppX Hrs	12	12	01	01	26

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI) Unit-6**	**Self Learning (SL)**
SO6. 1 Computer and Cyber – crimes SO6.2 Crimes and conventional crimes SO6.3 Introduction to Cyber Laws : Introduction to IT laws & Cyber crimes- Internet SO6.4 Hacking , Cracking , Viruses , Virus attacks Formulas SO6.5Introduction to Cyber law in India with special	**6.1 Anti Virus** **6.2 IT ACT 2000**	6.1 Computer and Cyber – crimes : Cyber – crimes and related concepts , 6.2 Distinction between cyber – crimes and conventional crimes , 6.3 Cyber criminals and their objectives . Kinds of cyber – crimes : cyber stalking , forgery , and fraud , crimes related to IPRs , 6.4 Cyber terrorism , Ransom ware attacks , 6.5 Computer vandalism . Cyber Laws : Introduction to IT laws & Cyber crimes- Internet , 6.6 Hacking , Cracking , Viruses , Virus attacks, Software Piracy , 6.7 Intellectual Property ,	1. Cyber law in India

reference to Information Technology Act 2000		Legal system of Information Technology , 6.8 Social Engineering , Mail Bombs , Bug Exploits , 6.9 Scope of cyber laws : e-commerce , online contracts , 6.10 IPRs (copyright , trademarks and software patenting) , e – taxation , 6.11 e – governance and cyber – crimes , 6.12 Cyber law in India with special reference to Information Technology Act 2000 , and Recent amendments **.**	

SW-3 Suggested Sessional Work (SW):
a. Assignments:
i. IT ACT 2000.

Brief Hours suggested for the course outcomes

Course Outcomes	Class Lecture (CL)	Lab Instruction (LI)	Sessional Work (SW)	Self Learning (SL)	Total Hours(CL+SW+SL)
CO.1 Acquire the knowledge of the Use of Computer Network : Access to information	12	12	1	1	26
CO.2 Acquire the basic and advance knowledge of Guided Transmission Media, Wireless transmission	12	12	1	1	26
CO.3 Acquire the basic and advance knowledge data link control, framing , Flow and Error Control	12	12	1	1	26
CO.4 Acquire the basic and advance knowledge of Network layer issues , Routing Algorithms	12	12	1	1	26
CO.5 Acquire the basic and advance knowledge of Network Security and Information Security	12	12	1	1	26
CO.6 Acquire the basic and advance	12	12	1	1	26

knowledge of Computer and Cyber – crimes					
Total	72	72	6	6	156

Suggestion for End Semester Assessment

CO Unit Titles	Marks Distribution			Total Marks
	R	U	A	
CO.1 Acquire the knowledge of the Use of Computer Network : Access to information	1	3	5	9
CO.2 Acquire the basic and advance knowledge of Guided Transmission Media, Wireless transmission	1	3	5	9
CO.3 Acquire the basic and advance knowledge data link control, framing , Flow and Error Control	1	3	5	9
CO.4 Acquire the basic and advance knowledge of Network layer issues , Routing Algorithms	1	3	5	9
CO.5 Acquire the basic and advance knowledge of Network Security and Information Security	1	3	5	9
CO.6 Acquire the basic and advance knowledge of Computer and Cyber – crimes	2	3	-	**5**
Total	7	18	25	**50**

Suggested Specification Table (For ESA)

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Processing of Spice and Plantation Crops will be held with written examination of 50 marks.

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks.
Teachers can also design different tasks as per requirement, for end semester assessment.
Suggested Instructional/Implementation Strategies:

1. Improved Lecture and Tutorial
2. Case Method
3. Group Discussion and Role Play
4. Visit to food plant
5. Demonstration
6. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Instagram, WhatsApp, Mobile and other Online sources)
7. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Internet and e-commerce		pragya	

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Cos, Pos and PSOs Mapping

Course Code: 1CS301

Course Title : Computer Network & Information Security

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
	Engi ne erin g kno wle dge	Pro b le m ana l ysi s	Desi g n/de v elop men t of solu ti ons	Co nd uct inv est igat io ns of co mpl ex pro bl ems	Mod e rn tool usag e	Th e eng i a na ma a soc i ety	Env iron me nt and sust ain abil ity:	Ethi cs	Ind ivi du al an d tea m wo rk:	Co m mu nic atio n:	Proj ect an ama men t and finan ce:	Life-long lear ning	The abili ty to appl y tech nica l & engi neeri ng kno wle dge for pro duct	Abili ty to und ersta nd the day to plan t o p er at io n al	Abil ity to und erst and the late st foo d man ufac turi n g tech nolo	Abi lity to use the res ear ch ba se d in n o v at iv

													ion and quality of food manufacture.	problems of food manufacture	gy.	eknowledge for SDGs
CO.1 Acquire the knowledge of the Use of Computer Network_: Access to information	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**2**
CO.2 Acquire the basic and advance knowledge of	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**3**	**3**	**2**	**2**

Guided Transmission Media, Wireless transmission																
CO.3 Acquire the basic and advance knowledge data link control, framing , Flow and Error Control	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**2**
CO.4 Acquire the basic and advance knowledge of Network layer issues , Routing Algorithms	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**2**
CO.5 Acquire the basic and advance	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**

knowledge of Network Security and Information Security																
CO.6 Acquire the basic and advance knowledge of Computer and Cyber – crimes	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**3**	**3**	**2**	**2**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO:1,2,3,4,5,6,7,8,9,10, 11,12 **PSO:1,2,3,4,5**	**CO.1** Acquire the knowledge of the Use of Computer Network : Access to information	**SO1.1** **SO1.2** **SO1.3** **SO1.4** **SO1.5**	**1.1** **1.2**	Unit 1 1.1,1.2,1.3,1.4,1.5 ,1.6,1.7, 1.8,1.9,1.10, 1.11, 1.12	**As mentioned in page number 2 to 10**
PO:1,2,3,4,5,6,7,8,9,10, 11,12 **PSO:1,2,3,4,5**	**CO.2** Acquire the basic and advance knowledge of Guided Transmission Media, Wireless transmission	**SO2.1** **SO2.2** **SO2.3** **SO2.4** **SO2.5**	**2.1** **2.2**	Unit 2 2.1,2.2,2.3,2.4,2. 5,2.6,2.7,	
PO:1,2,3,4,5,6,7,8,9,10, 11,12 **PSO:1,2,3,4,5**	**CO.3** Acquire the basic and advance knowledge data link control, framing , Flow and Error Control	**SO3.1** **SO3.2** **SO3.3** **SO3.4** **SO3.5**	**3.1** **3.2**	Unit 3 3.1, 3.2,3.3,3.4,3.5,3.6 ,3.7.3.8,3.9,3.11	

PO:1,2,3,4,5,6,7,8,9,10, 11,12 PSO:1,2,3,4,5	**CO.4** Acquire the basic and advance knowledge of Network layer issues , Routing Algorithms	**SO4.1 SO4.2 SO4.3 SO4.4 SO4.5**	**4.1 4.2**	Unit 4 4.1, 4.2,4.3,4.4,4.5,4.6 ,4.7.4.8.4.9,4.10,4 .11	
PO:1,2,3,4,5,6,7,8,9,10, 11,12 PSO:1,2,3,4,5	**CO.5** Acquire the basic and advance knowledge of Network Security and Information Security	**SO5.1 SO5.2 SO5.3 SO5.4 SO5.5**	**5.1 5.2**	Unit 5.1, 5.2,5.3,5.4,5.5,5.6 ,5.7.5.8.5.9,5.10,5 .11	
PO:1,2,3,4,5,6,7,8,9,10, 11,12 PSO:1,2,3,4,5	**CO.6** Acquire the basic and advance knowledge of Computer and Cyber – crimes	**SO5.1 SO5.2 SO5.3 SO5.4 SO5.5**	**6.1 6.2**	Unit 6.1, 6.2,6.3,6.4,6.5,6.6 ,6.7.6.8.6.9,6.10,6 .11,6.12	

Curriculum Development Team:

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Course Code: **1MS301**

Course Title : Abstract Algebra and Linear Algebra

Pre- requisite: Students should have basic knowledge of group theory

Rationale: The objective of Abstract Calculus and Linear Algebra is essential for students pursuing degrees . in mathematics, science, engineering, computer science, and other related fields. These topics lay the groundwork for more advanced studies in mathematics and provide powerful tools for analyzing and solving problems in various disciplines

Course Outcome :

CO1-1MS301.1 Understand the importance of algebraic properties with regard to working within various number systems.

CO2-1MS301..2. Students will determine whether a given binary operation on the given set gives a group structure by applying the axioms.

CO3-1MS301.3. The fundamental concept of rings, fields, subrings, integral domains and the corresponding morphism.

CO4-1MS301..4 Analyze whether a finite set of vectors in a vector space is linearly independent. Explain the concepts of basis and dimension of a vector space.

CO5-1MS301..5 Students will understand the Basic concepts of linear transformations, dimension theorem, matrix representation of a linear transformation .

Scheme of Studies:

Board of Study	**Course Code**	**Course Title**	**Scheme of studies (Hours/Week)**					**Total Credits (C)**
			Cl	**LI**	**SW**	**SL**	**Total Study Hours (CI+LI+SW+SL)**	
Program Core (DCC)	01MS301	Abstract Algebra And Linear Algebra	6[5+1]	0	1	1	8	6

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,

C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA + ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+ AT)		
DCC	01MS301	Advanced Abstract Algebra-I	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1-1MS301.1

Understand the importance of algebraic properties with regard to working within various number systems.

Approximate Hours

Item	AppX Hrs
Cl	18
LI	0
SW	1
SL	1
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO1.1 Understand the concept of Group. **SO1.2** Understand the relationships between abstract algebraic structures with familiar numbers systems such as the integers and real numbers **SO1.3** Understand the relation between order of group and all its possible subgroups. **So1.4** Understand the hypothesis of Cauchy's Theorem **So1.5** Understand the statement of Lagrange's theorem and Fermat's theorem	-	**Unit-1.0 Historical background** 1.1 A brief historical background of the Algebra in the context of India and Indian heritage and culture 1.2 A brief biography of Brahmagupta 1.3 Groups 1.4 Properties of Groups 1.5 Subgroups 1.6 Tutorial-I 1.7 Theorems on Groups 1.8 Cyclic groups 1.9 Theorems on Cyclic groups 1.10 Coset decomposition 1.11 Tutorial-II 1.12 Lagrange's theorem 1.13 Fermat's theorem 1.14 Normal subgroups 1.15 Theorems on Normal subgroups 1.16 Quotient groups. 1.17 Theorems on Quotient groups. 1.18 Tutorial-III	**SL.1** Understand the concept of Set theory. **SL.2** Understand to Find a generator for a subgroup of a given order.

SW-1 Suggested Sessional Work (SW):

a. Assignments:
Historical background:-
A brief historical background of the Algebra in the context of India and Indian heritage and culture, A brief biography of Brahmagupta, Groups, Subgroups and their basic properties, Cyclic groups, Coset decomposition, Lagrange's and Fermat's theorem, Normal subgroups , Quotient groups.

iv. Mapping defined on groups

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO2-1MS301..2. Students will determine whether a given binary operation on the given set gives a group structure by applying the axioms.

Approximate Hours

Item	AppX Hrs
Cl	18
LI	0
SW	1

SL	1
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO2.1 Understand the relationships between operations and mapping. **SO2.2** Learn about structure preserving maps between groups and their consequences. **SO2.3** Understand the concept of Homomorphism and Isomorphism of groups **SO2.4** Understand the Uses of Permutation group **SO2.5** Understand the statement of Cayley's theorem		**Unit-2.0 Homomorphism and Isomorphism of groups** **2.1** Homomorphism and Isomorphism of groups **2.2** properties of homomorphism, **2.3** Theorems on Homomorphism of groups **2.4** Isomorphism of groups 2.5 properties of isomorphism 2.6 kernel of homomorphism **2.7** Fundamental theorem of homomorphism **2.8** Tutorial-I **2.9** Cycle notation for permutations **2.10** properties of permutations **2.11** even and odd permutations **2.12** permutation group **2.13** Tutorial-II **2.14** Cayley's theorem **2.15** automorphism of groups **2.16** Inner automorphism **2.17** Group of automorphism **2.18** Tutorial-II	**SL.1** Verify relationships between operations satisfying various properties. **SL.2** Present concepts of the relationships between Homomorphism and Isomorphism of groups

SW-2 Suggested Sessional Work (SW):
a. Assignments:

Homomorphism and Isomorphism of groups, Fundamental theorem of homomorphism, Transformation and permutation group Sn (n<5), Cayley's theorem, Group automorphism, Inner automorphism, Group of automorphisms.

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):

Quiz, Class Test.

CO3-1MS301.3. The fundamental concept of rings, fields, subrings, integral domains and the corresponding morphism.

Approximate Hours

Item	AppX Hrs
Cl	18
LI	0
SW	1
SL	1
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO3.1 Understand the relationships between operations and mapping. **SO3.2** Structural Understanding: Exploring rings and subrings **SO3.3** understand the underlying structure of mathematical objects, providing insight into their properties and behaviors. **SO3.4** Understand the Ideal **SO3.5** Understand the properties of field		**Unit-3.0 Ring** **3.1** Ring: Definition **3.2** Basic properties of rings **3.3** Types of Ring **3.4** Ring homomorphism **3.5** Kernel of homomorphism of rings 3.6 Theorems on Ring 3.7 Tutorial-I **3.8** Subring 3.9 Theorems on SubRing **3.10** Ideals **3.11** Quotient ring **3.12** Fundamental theorem on ring 3.13 Tutorial-II **3.14** Polynomial ring **3.15** Degree of Polynomial ring **3.16** Integral domain **3.17** Field 3.18 Tutorial-III	**SL.1** Understand the concept of homomorphism. **SL.2** Understand the structure of kernel of Mapping

SW-3 Suggested Sessional Work (SW):
a. Assignments:
i. Relationships between algebraic structures of ring with familiar numbers systems.
Definition and basic properties of rings, Ring homomorphism , Subring, Ideals, Quotient ring, Polynomial ring , Integral domain, Field.

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO4-1MS301..4 Analyze whether a finite set of vectors in a vector space is linearly independent. Explain the concepts of basis and dimension of a vector space.

Approximate Hours

Item	AppX Hrs
Cl	18
LI	0
SW	1
SL	1
Total	20

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Understand the meaning of dimension of Vector space **SO4.2** Understand the importance of Basis and linear span in V.S. **SO4.3** Understand difference between Linear dependence and linear independence **SO4.4** Understand The Existence theorem **SO45** Understand The Dimension of Quotient space		**Unit-4.0 Vector space** 4.1 Definition 4.2 Examples of Vector space 4.3 Subspaces 4.4 Sum and direct sum of subspaces 4.5 Linear span 4.6 Tutorial-I 4.7 Linear dependence 4.8 linear independence 4.9 Basic properties of L.I. and L.D. 4.10 Basis 4.11 Finite dimensional vector space and its dimension 4.12 Tutorial-II 4.13 Existence theorem 4.14 Invariance of the number of elements 4.15 Dimension of sum of subspaces 4.16 Quotient space 4.17 Dimension of Quotient space 4.18 Tutorial-III	**SL.1** learn the internal and external compostion **SL.2** Basic properties of Basis and Linear span

SW-4 Suggested Sessional Work (SW):

a. Assignments:

Definition and examples of Vector space, Subspaces, Sum and direct sum of subspaces Linear span, Linear dependence, linear independence and their basic properties, Basis, Finite dimensional vector space and dimension, Existence theorem, Extension theorem, Invariance of the number of elements, Dimension of sum of subspaces , Quotient space and its dimension.

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Tes

CO5-1MS301.5 Students will understand the Basic concepts of linear transformations, dimension theorem, matrix representation of a linear transformation

Approximate Hours

Item	AppX Hrs
Cl	18
LI	0
SW	1
SL	1
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO5.1 Understand the concept of left and right ideal **SO5.2** Understand the relationships between quotent ring and Ideal. **SO5.3** Understand the relationships between ring and Ideal		**Unit-5.0 Linear transformation** 5.1 Linear transformation 5.2 matrix representation of Linear transformation 5.3 Algebra of linear transformation, 5.4 Rank-Nullity theorem 5.5 Tutorial-I 5.6 Change of basis 5.7 dual space 5.8 bi-dual space 5.9 natural isomorphism 5.10 Adjoint of a linear transformation 5.11 Tutorial-II 5.12 Eigen values of 2x2matrix 5.13 Eigen values of 2x2matrix 5.14 Eigen values of 3x3matrix 5.15 Eigen vectors of a linear transformation of 2x2matrix 5.16 Eigen vectors of a linear	**SL.1** Verify relationships between operations satisfying various properties. **SL.2** understand the criteria to be a subring. **SL.3** Basic properties of Quotient ring .

		transformation of 3x3matrix 5.17 Diagonalization 5.18 Tutorial-III	

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
CO1-1MS301.1 Understand the importance of algebraic properties with regard to working within various number systems.	18	1	1	20
CO2-1MS301.2. Students will determine whether a given binary operation on the given set gives a group structure by applying the axioms.	18	1	1	20
CO3-1MS301.3. The fundamental concept of rings, fields, subrings, integral domains and the corresponding morphism.	18	1	1	20
CO4-1MS301..4 Analyze whether a finite set of vectors in a vector space is linearly independent. Explain the concepts of basis and dimension of a vector space.	18	1	1	20
CO5-1MS301..5 Students will understand the Basic concepts of linear transformations, dimension theorem, matrix representation of a linear transformation	18	1	1	20
Total Hours	90	1	1	100

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Group-I	05	03	02	10
CO-2	Group-II	05	03	02	10
CO-3	Ring	05	03	02	10

CO-4	Integral Domain and Field	05	04	01	10
CO-5	Ideals	05	04	01	10
Total		**25**	**17**	**08**	**50**

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies

1. Improved Lecture
2. Tutorial
3. Presentation
4. Group Discussion
5. Online sources
6. Seminar
7. Workshop

Suggested Learning Resources:

a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Topics in Algebra	N. Herstein Wiley	Eastern Ltd. New Delhi.	1977
2	Matrix and Linear Algebra	K. B. Datta	Prentice hall of India Pvt. Ltd. New Delhi.	2000
3	Contributions to the History of Indian	Gerard G. Emch, R. Sridharan and M. D. Srinivas	Mathematics. Hindustan Book Agency	Vol. 3, 2005.
4	Linear Algebra. 2nd Edition	K. Hoffiman and R. Kunze	Prentice Hall Englewood Cliffs, New Jersey	1971
5	Linear Algebra,	A. R. Vasishtha and J. N. Sharma	Krishna Prakashan Media (P) Ltd.	2019

b) Reference Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Modern Algebra	Surjeet Singh and Qazi Zameeruddin	Vikas Publishing House Pv	2006, Eighth edition
2	Basic Algebra, Vol. I and II, W. II	N. Jacobson	Freeman	1980
3	Algebra, Vol. I and II,	I. S. Luther and I. B. S. Passi	Narosa Publishing House	1970
4	A text Book of Modern Abstract Algebra	Shanti Narayan	S. Chand and Company. Delhi	1967
5	Modern Algebra	A. K. Vasishtha and A. R. Vasishtha	Krishna Publication; New	2015, 68th edition

Suggested Digital Platforms Web links:	https://epgp.inflibnet.ac.in https://www.highereducation.mp.gov.in/?page=xhzlQmpZwkylQo2b%2Fy5G7w%3D%3D http://www.bhojvirtualuniversity.com
Suggested Equivalent online courses:	https://nptel.ac.in/courses/111/106/111106137/ https://nptel.ac.in/courses/111/105/111105112/ https://ugemoocs.inflibnet.ac.in/index.php/courses/view ug/32

Cos, POs and PSOs Mapping
Course Code : 01MS301
Course Title: Abstract Algebra And Linear Algebra

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Knowledge	Research Aptitude	Communication	Problem Solving	Individual and Team Work	Investigation of Problems	Modern Tool usage	Science and Society	Life-Long Learning	Ethics	Project Management	Environment and sustainability	Thedetailed functional knowledge of theoretical	To integrate the gained knowledge with various	To understand, analyze, plan and implement qualitative as well as quantitative	Provide opportunities to excel in academics, research or Industry by research based
CO1-01MS301.1 Understand the importance of algebraic properties with regard to working within various number systems.	2	3	1	2	2	2	2	2	3	3	1	1	2	1	1	3
CO2-01MS301.2. Students will determine whether a	1	3	2	1	1	1	1	1	1	2	3	1	3	1	1	2

given binary operation on the given set gives a group structure by applying the axioms.																
CO3-01MS301.3. The fundamental concept of rings, fields, subrings, integral domains and the corresponding morphism.	2	3	2	2	1	1	3	2	1	2	3	1	2	1	2	2
CO4-01MS301..4 Analyze whether a finite set of vectors in a vector space is linearly independent. Explain the concepts of basis and dimension of a vector space.	2	3	2	2	1	1	3	2	1	1	3	1	2	1	2	2

CO5-01MS301..5 Students will understand the Basic concepts of linear transformations , dimension theorem, matrix representation of a linear transformation	2	3	2	2	1	1	3	2	1	1	3	1	2	1	2	3

Legend: 1 – Low, 2 – Medium, 3 – High

AKS University
Faculty of Basic Science
Department of Mathematics
Curriculum & Syllabus of B.Sc. Mathematics program
Semester-I

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO1-**01MS301.1** Understand the importance of algebraic properties with regard to working within various number systems.	**SO1.1 SO1.2 SO1.3 SO1.4 SO1.5**		**Unit-1.0 Group 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10**	**SL1.1 SL1.2**
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO2-01MS301.2. Students will determine whether a given binary operation on the given set gives a group structure by applying the axioms.	**SO1.1 SO1.2 SO1.3 SO1.4 SO1.5**		**Unit-2 Ring 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10**	**SL2.1 SL2.2**
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO3-01MS301.3. Students will be able to describe all elements in a cyclic subgroup by using generators.	**SO1.1 SO1.2 SO1.3 SO1.4 SO1.5**		**Unit-3 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10**	**SL3.1 SL3.2**
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO4-01MS301.4 Connecting ring theory to other areas of mathematics or applications in computer science, physics, or cryptography.	**SO1.1 SO1.2 SO1.3 SO1.4 SO1.5**		**Unit-4 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10**	**SL4.1 SL4.2**
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO5-01MS301.5 Students will create the concept of a group action to real life problems such as Counting.	**SO1.1 SO1.2 SO1.3 SO1.4 SO1.5**		**Unit-5 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10**	**SL5.1 SL5.2 SL5.3**

Curriculum Development Team

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AKS University
Faculty of Basic Science
Department of Mathematics
Curriculum & Syllabus of B.Sc. Mathematics program
Semester-I

CourseCode:	1PH301
CourseTitle:	**Waves and Optics**
Pre-requisite:	Students with the necessary background to tackle the more advanced concepts in polarization, anisotropic crystals, and optical activity outlined in the main syllabus. The prerequisite course ensures that students are equipped with the fundamental knowledge required to engage with more complex aspects of wave optics.
Rationale:	The outlined courses provide a comprehensive and interconnected study of various aspects of wave phenomena and optics. These topics not only form the foundation for understanding classical physics but also lay the groundwork for exploring more advanced principles and their applications in modern technology and research. Students who complete these courses will be well-equipped with a broad and deep understanding of wave mechanics and optics.

CourseOutcomes:

1PH301.1: Fundamental principles in physics related to oscillations and wave motion, providing a solid foundation for further studies in this field.

1PH301.2: Sound and wave optics, providing students with a comprehensive understanding of the physics of sound and light waves, as well as their practical applications.

1PH301.3: Interference and interferometer, providing students with a deep understanding of wave optics principles and their practical applications. Students will gain hands-on experience with various experimental setups to observe and analyze interference patterns.

1PH301.4: Wave optics, focusing on the principles and applications of diffraction, with a particular emphasis on Fresnel and Fraunhoffer diffraction. Students will gain theoretical knowledge as well as practical skills in analyzing diffraction patterns.

1PH301.5: The principles and applications of polarized light, including its production, interaction with anisotropic crystals, and optical activity. Students will gain a solid foundation in the theory and practical aspects of polarization.

Scheme of Studies:

Boardof Study	Course Code	CourseTitle	Scheme of studies(Hours/Week)					TotalCredits (C)
			Cl	LI	SW	SL	TotalStudyHours (CI+LI+SW+SL)	
Program Core (DCC)	1PH301	Wave and optics	4	4	1	1	10	6

Legend: **CI:** Classroom Instruction (Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work(includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacher to ensure outcome of Learning.

SchemeofAssessment:

Theory

Board ofStudy	CouseCode	CourseTitle	SchemeofAssessment(Marks)							
			ProgressiveAssessment(PRA)						EndSemesterAssessment (ESA)	Total Marks (PRA+ ESA)
			Class/HomeAssignment5 number 3marks each (CA)	ClassTest2 (2bestout of3) 10marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	ClassAttendance (AT)	TotalMarks (CA+CT+SA+CAT+AT)		
DCC	1PH301	Wave Optics	15	20	5	5	5	50	50	100

Course-CurriculumDetailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1PH301.1: Fundamental principles in physics related to oscillations and wave motion, providing a solid foundation for further studies in this field.

ApproximateHours	
Item	AppX Hrs
Cl	13
LI	12
SW	02
SL	3
Total	29

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1. Understand the concept of superposition and the characteristics of oscillations . **SO1.2.**Explain how the superposition principle applies to harmonic oscillations and discuss mathematical analysis of the superposition with different frequencies. **SO1.3.**Define beats and explain how they occur in oscillatory systems and explain the concept of superposition in perpendicular harmonic oscillations. **SO1.4.**Define Lissajous figures and **d**efine wave intensity and calculate it using appropriate formulas . **SO1.5.**Discuss the measurement of wavelength and refractive index using Newton's rings.	**1.1.** To determine the Refractive Index of the Material of a given Prism. 1.2 To determine Dispersive Power of the Material of a given Prism using Mercury Light.	**Unit-1.Waves** **1.1.** Introduction to superposition and the principle of superposition **1.2.** Collinear harmonic oscillations with equal frequencies **1.3.** Linearity and the superposition principle **1.4.** Harmonic oscillations with different frequencies **1.5.** Beats and their characteristics **1.6.** Harmonic oscillations with different frequencies **1.7.** Beats and their characteristics **1.8.** Superposition of perpendicular harmonic oscillations **1.9.** Lissajous figures and their uses **1.10.** Transverse waves on a stretched string **1.11.** Travelling and standing waves & Normal modes of a string **1.12.** Phase velocity	**i.** Wave **ii.** Harmonic Oscillator **iii.** Frequency & Amplitude

		and group velocity, **1.13.** Plane and spherical waves and Wave intensity	

SW-1 Suggested Sessional Work (SW):

a. Assignments:
   i. Beats and their characteristics.
   ii. Phase velocity and group velocity

1PH301.2: Sound and wave optics, providing students with a comprehensive understanding of the physics of sound and light waves, as well as their practical applications.

ApproximateHours	
Item	AppX Hrs
Cl	12
LI	12
SW	2
SL	3
Total	29

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1. Understand the propagation of sound waves and explain the concept of simple harmonic motion (SHM). **SO2.2** Define sound intensity and loudness and explain the relationship between intensity and amplitude. **SO2.3.** Explain the concept of musical notesand discuss different types of musical scales (e.g., major, minor and analyze the construction of musical scales. **SO2.4.** Define absorption coefficient and its role in acoustics and discuss the practical application of these concepts in room acoustics. **SO2.5.** Explain methods for measuring reverberation time and explain Huygens'	**2.1.** To determine wavelength of sodium light using Fresnel Biprism. **2.2.** Determine the radius of curvature of a plano-convex lens by Newton's rings.	**Unit-2Sound and light wave** **2.1.** Introduction to sound and its properties **2.2.** Simple harmonic motion and its relation to sound waves **2.3.** Forced vibrations and resonance **2.4.** Fourier's theorem and its application to sound waves **2.5.** Intensity and loudness of sound **2.6.** Musical notes and their frequencies **2.7.** Musical scales **2.8.** Reverberation and time of reverberation **2.9.** Absorption coefficient and Sabine's formula **2.10.** Measurement of reverberation time **2.11.** Acoustic aspects of halls and auditoria **2.12.** Electromagnetic nature of light and Huygens' principle	**i.** Intensity of Sound **ii.** Noise & Loudness **iii.** Musical Sound

principle			

SW-2 Suggested SessionalWork(SW):

a. Assignments:

i. Electromagnetic nature of light and Huygens' principle

ii. Fourier's theorem and its application to sound waves

iii.

PHY301.3: Interference and interferometry, providing students with a deep understanding of wave optics principles and their practical applications. Students will gain hands-on experience with various experimental setups to observe and analyze interference patterns.

ApproximateHours	
Item	AppXHrs
Cl	11
LI	12
SW	2
SL	3
Total	28

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
S**O3.1.**Define interference in the context of wave phenomena and understand how these concepts relate to interference. **SO3.2.**Describe the components of the Young's Double Slit experiment and understand how interference is used in various technologies . **SO3.3.**Understand the strengths and limitations of different interference techniques and discuss when each method is most applicable. **SO3.4.**Explain how interference occurs in	**3.1.** To determine wavelength of Sodium light (Dl and D2 lines) using plane diffraction Grating. **3.2.** To determine the Resolving Power of Telescope. **3.3.** Determination of specific rotation of sugar solution by polarimeter.	**Unit-3.Interference of light** **3.1.** Definition of interference in the context of waves. **3.2.** Brief overview of division of amplitude and division of wave front. **3.3.** Description of the Young's Double Slit apparatus and applications of Young's experiment. **3.4.** Analysis of interference patterns. **3.5.** Comparison with other interference methods. **3.6.** Explanation of the relationship between interference and film thickness. **3.7.** Mathematical formulation of Stokes' Law. **3.8.** Fringes of equal inclination (Haidinger Fringes) and equal thickness (Fizeau Fringes). **3.9.** Dielectric Mirrors & Interference filters.	**i.**Interference of Light **ii.**Light Wave behavior **iii.**Slit

thin films and define Stokes' Law and its relevance to interference in thin films. **SO3.5.** Define and explain Haidinger and Fizeau fringes and describe the formation of Newton's Rings.		**3.10.** Newton's Rings. (Derivation of the equations). **3.11.** Michelson Interferometer (Derivation for measuring refractive index).	

SW-3SuggestedSessionalWork(SW):

a. Assignments:
   i. Michelson Interferometer (Derivation for measuring refractive index).
   ii. Newton's Rings. (Derivation of the equations).

1PH301.4. Wave optics, focusing on the principles and applications of diffraction, with a particular emphasis on Fresnel and Fraunhoffer diffraction. Students will gain theoretical knowledge as well as practical skills in analyzing diffraction patterns.

ApproximateHours	
Item	App X Hrs
Cl	12
LI	12
SW	2
SL	3
Total	29

SW-4SuggestedSessionalWork (SW):

a. Assignments:
   i. Resolving and Dispersive Power and Telescope
   ii. Huygens - Fresnel's Theory

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO4.1 Understand the fundamental role of interference and diffraction in optics and Identify key differences between interference and diffraction. **SO4.2.**Explain the distinctions between Fresnel and Fraunhoffer diffraction. Introduce Huygens-Fresnel principle. **SO4.3.**Apply Huygens-Fresnel principle to Fresnel diffraction. And understand the practical aspects of Fresnel diffraction. **SO4.4.**Define the half-period zone and its significance in diffraction. And explain the diffraction patterns produced by a straight edge . **SO4.5.**Understand the conditions for Fraunhoffer diffraction and explain diffraction patterns produced by a single slit.	**4.1.** To determine the wavelength of sodium source using Michelson's interferometer. **4.2.** Study of diffraction at straight edge.	**Unit-4 : Diffraction** **4.1.** Importance of interference and diffraction in optics. **4.2.** Distinction between interference and diffraction. **4.3.** Definition and fundamental principles of diffraction. **4.4.** Fresnel and Fraunhoffer Diffraction **4.5.** Huygens - Fresnel's Theory **4.6.** Application to Fresnel diffraction. **4.7.** Definition and significance of the half-period zone. **4.8.** Diffraction at Straight Edge and Circular Aperture **4.9.** Fraunhoffer Diffraction **4.10.** Diffraction due to Single, Double, and N Slits **4.11.** Plane Diffraction Grating **4.12.** Resolving and Dispersive Power and Telescope	**i.** Reflection of Light **ii.**Interference of Light **iii.** Circular Aperture

1PH301.5: The principles and applications of polarized light, including its production, interaction with anisotropic crystals, and optical activity. Students will gain a solid foundation in the theory and practical aspects of polarization.

ApproximateHours	
Item	AppXHrs
Cl	12
LI	12
SW	2
SL	2
Total	28

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO5.1. Understand the concept of polarized light and define the differences between polarized and unpolarized light. **SO5.4.** Explain the applications of polarization in sunglasses Recognize the role of polarization in photography **SO5.6.** Explain how polarized light is produced through reflection. define Brewster's Law and understand its implications. **SO5.8.** Understand Malus law and its significance. Derive the mathematical expression for Malus law and apply Malus law to analyze the intensity of polarized light. **SO5.5.** Define anisotropic crystals and apply Huygens theory to explain polarization by double refraction.	**5.1.** Verification of Brewster's law with the help of spectrometer **5.2.** To determine the wavelength of laser light with the help of plane transmission grating.	**Unit-5:Polarization** **5.1.** Introduction to Polarized Light **5.2.** Difference in Polarized and Unpolarized Light **5.3.** Types of Polarization (linear, circular, and elliptical). **5.4.** Applications of Polarization (Sunglasses and Three-Dimensional Movies) **5.5.** Photography **5.6.** Production of Polarized Light (Reflection, Refraction, and Scattering) **5.7.** Brewster's Law (Polaroid Sheets and Polarizer and Analyzer) **5.8.** Malus law and its mathematical expression. **5.9.** Anisotropic crystals and their properties. **5.10.** Doubly Refracting Crystals (Extra and Ordinary Rays) **5.11.** Polarization by Double Refraction and Huygens Theory **5.12.** Nicol Prism and Retardation Plates (Half &Biquartz)and Retardation Plates (Half &Biquartz)	**i.** Polarized Light and Unpolarized Light **ii.** Anisotropic crystals

SW-5SuggestedSessionalWork (SW):

a. Assignments:
   i. Polarization by Double Refraction and Huygens Theory
   .
   ii. Nicol Prism and Retardation Plates (Half & Biquartz)and Retardation Plates (Half & Biquartz)

Brief of Hours suggested for the Course Outcome

CourseOutcomes	**Class Lecture (Cl)**	Laboratory Instruction (LI)	**Sessional Work (SW)**	**Self Learning (Sl)**	**Total hour (Cl+SW+ Sl)**
1PH301.1: Fundamental principles in physics related to oscillations and wave motion, providing a solid foundation for further studies in this field.	13	12	2	**3**	29
1PH301.2: Sound and wave optics, providing students with a comprehensive understanding of the physics of sound and light waves, as well as their practical applications.	12	12	2	**3**	29
1PH301.3: Interference and interferometer, providing students with a deep understanding of wave optics principles and their practical applications. Students will gain hands-on experience with various experimental setups to observe and analyze interference patterns.	11	12	2	**3**	28
1PH301.4: Wave optics, focusing on the principles and applications of diffraction, with a particular emphasis on Fresnel and Fraunhoffer diffraction. Students will gain theoretical knowledge as well as practical skills in analyzing diffraction patterns.	12	12	2	**3**	29
1PH301.5: The principles and applications of polarized light, including its production, interaction with anisotropic crystals, and optical activity. Students will gain a solid foundation in the theory and practical aspects of polarization.	12	12	2	**3**	28
Total Hours	60	60	10	**15**	145

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	UnitTitles	Marks Distribution			Total Marks
		R	**U**	**A**	
CO-1	**Wave**	03	01	01	05
CO-2	**Sound and light wave**	02	06	02	10
CO-3	**Interference of light**	03	07	05	15
CO-4	**Diffraction**	-	10	05	15
CO-5	**Polarization**	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U: Understand, A:Apply

TheendofsemesterassessmentforIntroductiontoPortlandcementwillbeheldwithwritten examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks.
Teachers can also design different tasks as per requirement, for end semester assessment.

SuggestedInstructional/ImplementationStrategies:

i. ImprovedLecture
ii. Tutorial
iii. CaseMethod
iv. GroupDiscussion
v. RolePlay
vi. Visittocementplant
vii. Demonstration
viii. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
ix. Brainstormin

Suggested Learning Resources:

(a)Books**:**

S. No.	Title	Author	Publisher	Edition & Year
1	Electricity, Magnetism & Electromagnetic Theory	Mahajan S. and Choudhury	Tata McGraw	2012
2	Electricity and Magnetism, 3rd Edn	Griffiths D.J	Benjamin Cummings	1998

3	Electricity and magnetism	Tayal D. C	Himalaya Publishing Co.	1988
4	Electricity and magnetism	Murugesan	S. Chand & Co.	2019
5	Feynman Lectures Vol.2	Feynman R. P., Leighton R.B., Sands M	Pearson Education	2008
6	Electromagnetic field theory.	Kshetrimayun R. S.	Cengage Learning	2012
5	Notes Provided by University			

AKS University
Faculty of Basic Science
Curriculum of B. Sc. (Honours / By Research) Program
(Revised as on 01 August 2023)

Cos, Pos and PSOs Mapping

CourseTitle:Wave and optics **Course Code: 1PH301**

CourseOutcomes `	ProgramOutcomes												ProgramSpecificOutcome				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
	Engineering knowledge	**Problem analysis**	**Design/developmentof solutions**	**Conduct investigationsof complex problems**	**Modern toolusage**	**Theengineerandsociety**	**Environment and sustainability:**	**Ethics**	**Individualandteamwork:**	**Communication:**	**Projectmanagement and finance:**	**Life-longlearning**	Identify,formulate,andsolvePhysicsproblems.	Designandconduct experiments, aswell astoanalyseandinterpretdata.	Apply knowledge of Physics in a different stream of science and to communicate effectively.	Ability to use the techniques, skills, and modern physical tools in real world application.	Engage in life-long learning and will have recognition.

1PHY301.1: Fundamental principles in physics related to oscillations and wave motion, providing a solid foundation for further studies in this field.	**1**	**1**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**2**	**1**
1PHY301.2: Sound and wave optics, providing students with a comprehensive understanding of the physics of sound and light waves, as well as their practical applications.	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**
1PHY301.3: Interference and interferometry, providing students with a deep understanding of wave optics principles and their practical applications. Students will gain	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**3**	**2**

hands-on experience with various experimental setups to observe and analyze interference patterns.																	
1PHY301.4.: Wave optics, focusing on the principles and applications of diffraction, with a particular emphasis on Fresnel and Fraunhofer3diffraction. Students will gain theoretical knowledge as well as practical skills in analyzing diffraction patterns.	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**	**2**
1PHY301.5: The principles and applications of polarized light, including its production, interaction with anisotropic crystals, and optical activity. Students will gain a solid foundation in the theory and	**-**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**	**3**

practical aspects of polarization																	

Legend:1–Low,2–Medium,3– High

CourseCurriculumMap:

POs&PSOs No.	COsNo.&Titles	SOsNo.	Laboratory Instruction(LI)	ClassroomInstruction(CI)	Self-Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11, 12 PSO1,2,3,4 ,5	**1PHY301.1:** Fundamental principles in physics related to oscillations and wave motion, providing a solid foundation for further studies in this field.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1,1.2,	Unit-1.0**Wave** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11,1.12, 1.13	i.ii,iii
PO 1,2,3,4,5,6 7,8,9,10,11, 12 PSO1,2,3,4, 5	**1PHY301.2:** Sound and wave optics, providing students with a comprehensive understanding of the physics of sound and light waves, as well as their practical applications.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1,2.2	Unit-2**Sound and light wave** 2.1,2.2,2.3,2.4,2.5,2.6,2.7, 2.8,2.9,2.10,2.11,2.12	i.ii,iii
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4, 5	**1PHY301.3:** Interference and interferometry, providing students with a deep understanding of wave optics principles and their practical applications. Students will gain hands-on experience with various experimental setups to observe and analyze interference patterns.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1,3.2,3.3	Unit-3:**Interference of light** 3.1, 3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11	i.ii,iii
PO 1,2,3,4,5,6 7,8,9,10,11, 12 PSO1,2,3,4, 5	**1PHY301.4.:** Wave optics, focusing on the principles and applications of diffraction, with a particular emphasis on Fresnel and Fraunhofer3diffraction. Students will gain theoretical knowledge as well as practical skills in analyzing diffraction patterns.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1,4.2	Unit-4 : **Diffraction** 4.1, 4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12	i.ii,iii
PO 1,2,3,4,5,6 7,8,9,10,11, 12 PSO1,2,3,4, 5	**1PHY301.5:** The principles and applications of polarized light, including its production, interaction with anisotropic crystals, and optical activity. Students will gain a solid foundation in the theory and practical aspects of	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1,5.2	Unit5:**Polarization** 5.1,5.2,5.3,5.4,5.5,5.6, 5.7,5.8,5.9,5.10.5.11,5.12	i.ii,iii

	polarization				

Curriculum Development Team

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Course Code	Course Title	L	T	P	Total Credits
1CH301	Reaction, Reagents and Mechanism in organic Chemistry	**3**	**1**	**2**	**6**

Pre-requisite: Students must have fundamental knowledge of mathematics, valence shell electron pair repulsion theory, and different concentration terms to understand the concept of analytical chemistry.

Rationale: The students studying analytical chemistry should possess foundational understanding about basic mathematics, valence shell electron pair repulsion theory, and different concentration terms to understand the basic principle of chromatography and spectroscopic analysis.

Course Outcomes:

After the completion of this course, the learner will able to

01CH301.1: Explain Nucleophilic substitution , Electrophilic Substitution,Benzyne,SN1, SN2, SNi,SNAr.
01CH301.2:Describe the Additionreaction,Eliminationreactions,chemo-selectivity,orientation and reactivity, Markownikov and Anti markonikov s addition, Saytzeff and Hafmann rule.

01CH301.3: Explain Regent and catalyst, Grignard reagent, N- bromo Succinamide Rearrangement, pinacol pinacolone Benzilic acid and Wagner –meerwein.

01CH301.4: **d**iscuss principle of oxidation reactions, Reduction reactions . Oppenauer oxidation

01CH301.5: discuss basic concept of photo- chemical reaction and Paricyclic Reactions ,Norrish type-I and II reactions and cis- trans isomerisations pericyclic reaction and their classification 2 + 2 and 4 + 2 cycloaadition ,

Reaction,Reagents and Mechanism in organic Chemistry (Paper III)

CLO: - By the end of this course students must have had the subject chemistry in class or equivalent

1. Basic concepts of Nucleophilic substitution , Electrophilic Substitution,Benzyne,SN1, SN2, SNi,SNAr.
2. Addition reaction, Elimination reactions,
3. Regent and catalyst, Grignard reagent, N- bromo Succinamide Rearrangement, pinacol pinacolone Benzilic acid and Wagner –meerwein.
4. oxidation reactions, Reduction reactions
5. Photo-chemical Reactions, Paricyclic Reactions,) 2 + 2 and 4 + 2 cycloaadition

Unit-1 (1CH301.1): (A) Aliphatic nucleophilic substitution: Introduction, the SN1 SN2 and SNi mechanism , Neighbouring group participation, effect of substrate, nucleophilie, leaving group and reaction medium.
(B) Aliphatic Electrophilic Substitution: Elementary treatment.
(C) Aromatic Nucleophilic Substitution: the SNAr,SN1 and benzyne mechanisms, effect of substrate, nucleophile, leaving group and reaction medium.
(D) Aromatic Electrophilic Substitution,: arenium ion mechanism, orientation/directive influence (electronic explanation only) and reactivity, diazonium coupling,vilsmeier reaction.

Keywords/Tags:- Nucleophilic substitution , Electrophilic Substitution,Benzyne,SN1, SN2, SNi,SNAr.

Unit-2 (1CH301.2): -(A)Addition reaction : Introduction, reactions involving addition of nucleophile, electrophile and free radicals regio-selectivity and chemo-selectivity ,orientation and reactivity, Markownikov and Anti markonikov s addition.
(B) Elimination reactions: introduction E1,E2 ,E1cb mechanism,effect of substate attacking species leaving group and reaction medium orientation Saytzeff and Hafmann rule.
Keywords/Tags:-Additionreaction,Eliminationreactions,chemo-selectivity,orientation and reactivity, Markownikov and Anti markonikov s addition, Saytzeff and Hafmann rule.

Unit-3 (1CH301.3): Regent and catalyst: preparation properties and applications of important regents and catalyst in organic synthesis with mechanistic details : Grignard reagent and N- bromo Succinamide (NBS) diazomethane, anhydrous aluminium chloride($AlCl_3$) sodamide ($NaNH_2$) ziegler natta catalyst.
Rearrangement (Reactions,Mechanism and applications): introduction types of rearrangement , Rearrangement to electron deficient carbon (pinacol pinacolone Benzilic acid and Wagner -meerwein) , rearrangement to electron deficiency nitrogen halfman lotion tests and backman rearrangement to electron deficient oxygen where villager and Deccan to electron rich carboniting aromatic rearrangement freez and clezen,
Keywords/Tags:- Regent and catalyst, Grignard reagent, N- bromo Succinamide Rearrangement, pinacol pinacolone Benzilic acid and Wagner –meerwein.

Unit-4 (1CH301.4): oxidation reactions: Introduction metal based oxidation and nonmetal base oxidation oxidation of electron to carbonil carbonium manganese and silver base regions alkys to apoxide peroxide

alkene to die manganese and awesome based to carbonyl with bond cleavage manganese and lead based. Oppenauer oxidation
Oxidation of amino groups to nitro groups : oxidation by alkaline KMno4 oxidation of aliphatic and aromatic Amines by peracids ,oxidation of primary and secondary amines to hydroxylamine by hydrogen peroxide.
Reduction reactions: introduction reduction of carbon - carbon multiple bonds carbonyl group and nitro compounds catalytic hydrogenation : heterogeneous (palladium carbon and raney nickel) homogeneous(wilkinsons catalyst) hydride transfer reagents: sodium borohydride and lithium aluminium hydride, metal based reductions: Birch reduction clemmensen reduction, Reduction of nitro compounds by catalytic hydrogenation and metals (with mechanism).

Keywords/Tags:-. oxidation reactions, Reduction reactions, catalytic hydrogenation and metals

Unit-5 (1CH301.5): Photo-chemical Reactions: Introduction of photo- chemistry ,Electronic excitations Jablonski diagram, Norrish type-I and II reactions and cis- trans isomerisations.
Paricyclic Reactions: Introduction of pericyclic reaction and their classification ,(electrocyclic, Sigmatropic rearrangement and cycloaadition) 2 + 2 and 4 + 2 cycloaadition claisen and cope rearrangement.
Keywords/Tags:- Photo-chemical Reactions, Paricyclic Reactions,) 2 + 2 and 4 + 2 cycloaadition ,

Learning Resources

1. https://nptel.ac.in/course.html
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5
3. https://swayam.gov.in/explorer?category=Chemistry

MODE OF TRANSACTION: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources

Scheme of Studies:

Board of Study	**Course Code**	**Course Title**	**Scheme of studies (Hours/Week)**						**Total CreditsI**
			Cl	**T**	**LI**	**SW**	**SL**	**Total Study Hours (CI+LI+SW+SL)**	
Program Core (PCC)	1CH301	**Reaction, Reagents and Mechanism in organic Chemistry**	4	0	2	1	1	8	6

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment: Theory

Board of Study	Course Code	Course Title	**Scheme of Assessment (Marks)**						
			Progressive Assessment (RA)					**End Semester Assessment (ESA)**	**Total Marks** (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each	Class Test 2 (2 best out of 3) 10 marks each	Seminar one	Class Attendance (AT)	Total Marks (CA+CT+SA +AT)		
PCC	1CH301	**Reaction,Reagents and Mechanism in organic Chemistry**	15	20	10	5	50	50	100

Course-Curriculum Detailing:
This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (Sos), culminating in the overall achievement of Course Outcomes (Cos) upon the course's conclusion.

Unit-1 (1CH301.1): (A) Aliphatic nucleophilic substitution: Introduction, the SN1 SN2 and SNi mechanism , Neighbouring group participation, effect of substrate, nucleophilie, leaving group and reaction medium.
(B) Aliphatic Electrophilic Substitution: Elementary treatment.
(C) Aromatic Nucleophilic Substitution: the SNAr,SN1 and benzyne mechanisms, effect of substrate, nucleophile, leaving group and reaction medium.
(D) Aromatic Electrophilic Substitution,: arenium ion mechanism, orientation/directive influence (electronic explanation only) and reactivity, diazonium coupling,vilsmeier reaction.

Activity	**Appx Hrs**
Cl	12
LI	6
SW	2
SL	1
Total	21

Session Outcomes (SOs)	LI	CI	SL
After the completion of topics: students will be able to SO1.1 Discuss the concept of Aliphatic nucleophilic substitution SO1.2 Explain SN1 SN2 and SNi mechanism SO1.3 discuss differentiation of important Electrophilic Substitution and Nucleophilic Substitution reaction. SO1.4 discuss arenium ion mechanism SO1.5 discusses diazonium coupling,and vilsmeier reaction.		**Unit-1 (1CH301.1):** **1.1** **(A) Aliphatic nucleophilic substitution**: Introduction, **1.2** SN1 SN2 and SNi mechanism , **1.3** Neighbouring group participation, effect of substrate, **1.4** nucleophilie, leaving group and reaction medium. **1.5** **(B) Aliphatic Electrophilic Substitution**: **1.6** Elementary treatment. **1.7** **(C) Aromatic Nucleophilic Substitution**: the SNAr,SN1 **1.8** benzyne mechanisms, effect of substrate, **1.9** nucleophile, leaving group and reaction medium. **1.10** **(D) Aromatic Electrophilic Substitution**,: **1.11** arenium ion mechanism, **1.12** orientation/directive influence (electronic explanation only) reactivity, **1.13** diazonium coupling, **1.14** vilsmeier reaction.	• Introduction to nucleophilic substitution • And electrophilic substitution reaction diazonium coupling, • vilsmeier reaction •

SW-1 Suggested Sessional Work (SW):
Assignments: SN1 SN2 and SNi mechanism
Mini Project: Software's for drawing structures and molecular formulae.
Other Activities (Specify): Introduction to graph and its types in different ways to represent data

Unit-2 (1CH301.2): -(A)Addition reaction : Introduction, reactions involving addition of nucleophile, electrophile and free radicals regio-selectivity and chemo-selectivity ,orientation and reactivity, Markownikov and Anti markonikov s addition.
(B) Elimination reactions: introduction E1,E2 ,E1cb mechanism,effect of substate attacking species leaving group and reaction medium orientation Saytzeff and Hafmann rule.

Activity	AppX Hrs
Cl	13
LI	6
SW	2
SL	1
Total	22

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
After the completion of topics students will be able to **SO2.1** explain Addition reaction **SO2.2** explain Elimination reactions **SO2.3** discuss Markownikov and Anti markonikov s addition **SO2.4** discuss E1,E2 ,E1cb mechanism,effect of substate **SO2.5** Estimate Saytzeff and Hafmann rule.	•	**Unit-2 (2CH101.2): -** **(A)Addition reaction** : Introduction, reactions involving addition of nucleophile, electrophile and free radicals regio-selectivity and chemo-selectivity ,orientation and reactivity, Markownikov and Anti markonikov s addition. **(B) Elimination reactions**: introduction E1,E2 ,E1cb mechanism,effect of substate attacking species leaving group and reaction medium orientation Saytzeff and Hafmann rule.	• Addition reaction • Elimination reactions • nucleophile, electrophile and free radicals • Saytzeff and Hafmann rule.

SW-2 Suggested Sessional Work (SW):
Assignments: effect of substate attacking species leaving group and reaction
Mini Project: nucleophile, electrophile and free radicals mechanism
Other Activities (Specify): Saytzeff and Hafmann rule.
Unit-3 (1CH301.3): Regent and catalyst: preparation properties and applications of important regents and catalyst in organic synthesis with mechanistic details : Grignard reagent and N- bromo Succinamide (NBS) diazomethane, anhydrous aluminium chloride($AlCl_3$) sodamide ($NaNH_2$) ziegler natta catalyst.
Rearrangement (Reactions,Mechanism and applications): introduction types of rearrangement , Rearrangement to electron deficient carbon (pinacol pinacolone Benzilic acid and Wagner -meerwein) , rearrangement to electron deficiency nitrogen halfman lotion tests and backman rearrangement to electron deficient oxygen where villager and Deccan to electron rich carboniting aromatic rearrangement freez and clezen,

Activity	AppX Hrs
Cl	11
LI	4
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
After the completion of topics students will be able to **SO3.1** explain preparation properties and applications of important regents and catalyst Grignard reagent. **SO3.2** discuss concept of anhydrous aluminium chloride(AlCl3) and NBS diazomethane. **SO3.3** describe sodamide (NaNH2) ziegler natta catalyst. **SO3.4** explain Rearrangement to electron deficient carbon. **SO3.5** describe rearrangement to electron deficiency nitrogen halfman lotion tests and backman rearrangement to electron deficient oxygen	• To study the Determination of free alkali present in different soaps/detergents.	**Unit-3 (2CH101.3): Regent and catalyst**:3.1 preparation properties and applications of important regents and catalyst in organic synthesis with mechanistic details : 3.1 Grignard reagent and N- bromo 3.2 Succinamide (NBS) diazomethane, 3.3 anhydrous aluminium chloride(AlCl3) 3.4 sodamide (NaNH2) ziegler natta catalyst. **Rearrangement (Reactions,Mechanism and applications**): introduction types of rearrangement , **3.5** Rearrangement to electron deficient carbon **3.6** (pinacol pinacolone Benzilic acid and Wagner -meerwein) , 3.7 rearrangement to electron deficiency nitrogen halfman lotion tests and backman rearrangement to electron deficient oxygen 3.9 villager and Deccan to electron rich carboniting aromatic rearrangement freez and clezen,	•

SW-3 Suggested Sessional Work (SW):
Assignments: Concept of chemical potential
Mini Project:
Other Activities (Specify):

Unit-4 (1CH301.4): oxidation reactions: Introduction metal based oxidation and nonmetal base oxidation oxidation of electron to carbonil carbonium manganese and silver base regions alkys to apoxide peroxide alkene to die manganese and awesome based to carbonyl with bond cleavage manganese and lead based. Oppenauer oxidation
Oxidation of amino groups to nitro groups : oxidation by alkaline KMno4 oxidation of aliphatic and aromatic Amines by peracids ,oxidation of primary and secondary amines to hydroxylamine by hydrogen peroxide.
Reduction reactions: introduction reduction of carbon - carbon multiple bonds carbonyl group and nitro compounds catalytic hydrogenation : heterogeneous (palladium carbon and raney nickel) homogeneous(wilkinsons catalyst) hydride transfer reagents: sodium borohydride and lithium aluminium hydride, metal

based reductions: Birch reduction clemmensen reduction, Reduction of nitro compounds by catalytic hydrogenation and metals (with mechanism).

Activity	AppX Hrs
Cl	13
LI	6
SW	2
SL	1
Total	21

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
After the completion of topics students will be able to **SO4.1** Discuss metal based oxidation and nonmetal base oxidation oxidation of electron to carbonil carbonium manganese. **SO4.2** discuss the Oppenauer oxidation. **SO4.3** discusses oxidation by alkaline KMno4 oxidation of aliphatic and aromatic Amines by peracids **SO4.4** explain column chromatography (CC) and gas chromatography (GC) **SO4.5** discuss the reduction of carbon - carbon multiple bonds carbonyl group and nitro compounds catalytic hydrogenation. **SO4.6** explain Birch reduction	Qualitative Analysis • Identification by determination of the Rf values of the given organic / inorganic compounds by paper/ thin layer chromatography. • Systematic identification of organic compound by qualitative analysis	**Unit-4 (2CH101.4): oxidation reactions**: Introduction metal based oxidation and nonmetal base oxidation oxidation of electron to carbonil carbonium manganese and silver base regions alkys to apoxide peroxide alkene to die manganese and awesome based to carbonyl with bond cleavage manganese and lead based. Oppenauer oxidation Oxidation of amino groups to nitro groups : oxidation by alkaline KMno4 oxidation of aliphatic and aromatic Amines by peracids ,oxidation of primary and secondary amines to hydroxylamine by hydrogen peroxide. **Reduction reactions**: introduction reduction of carbon - carbon multiple bonds carbonyl group and nitro compounds catalytic hydrogenation : heterogeneous (palladium carbon and raney nickel) homogeneous(wilkinsons catalyst) hydride transfer reagents: sodium borohydride and lithium aluminium hydride, metal based reductions: Birch reduction clemmensen reduction, Reduction of nitro compounds by catalytic hydrogenation and metals (with mechanism).	To understand the chromatographic principle students must read about • Nature of compound (polar/non-polar)

clemmensen reduction, Reduction of nitro compounds by catalytic hydrogenation and metals			

SW-4 Suggested Sessional Work (SW)
Assignment: Chromatography (HPLC) types of column and column selection
Mini Project:
Other Activities (Specify): Mechanism of separation of components in a mixture: adsorption, partition and ion-exchange

Unit-5 (1CH301.5): Photo-chemical Reactions: Introduction of photo- chemistry ,Electronic Excitations Jablonski diagram, Norrish type-I and II reactions and cis- trans isomerisations.

Paricyclic Reactions: Introduction of pericyclic reaction and their classification ,(electrocyclic, Sigmatropic rearrangement and cycloaadition) 2 + 2 and 4 + 2 cycloaadition claisen and cope rearrangement.

Activity	AppX Hrs
Cl	11
LI	6
SW	2
SL	1
Total	20

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
After the completion of topics students will be able to **SO5.**1 understand Basics of **Photo-chemical Reactions** **SO5.2** discuss the principle of excitations Jablonski diagram **SO5.3** Norrish type-I and II reactions and cis- trans isomerisations. **SO5.**4 describes pericyclic reaction and their classification. **SO5.5** Explain electrocyclic, Sigmatropic rearrangement and cycloaadition . **SO5.6** Explain 2 + 2 and 4 + 2 cycloaadition claisen and cope rearrangement.	.Quantitative Analysis.	**Unit-5 (1CH301.5): Photo-chemical Reactions**: Introduction of photo- chemistry ,Electronic excitations Jablonski diagram, Norrish type-I and II reactions and cis- trans isomerisations. **Paricyclic Reactions**: Introduction of pericyclic reaction and their classification ,(electrocyclic, Sigmatropic rearrangement and cycloaadition) 2 + 2 and 4 + 2 cycloaadition claisen and cope rearrangement.	cis- trans isomerisations. • pericyclic reaction and their classification

SW-5 Suggested Sessional Work (SW):
Assignments:.
Mini Project:
Other Activities (Specify):

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
1CH301.1: Explain Nucleophilic substitution , Electrophilic Substitution,Benzyne,SN1, SN2, SNi,SNAr.	12	6	02	01	21
1CH301.2: Describe the Additionreaction,Eliminationreactions,chemo-selectivity,orientation and reactivity, Markownikov and Anti markonikov s addition, Saytzeff and Hafmann rule.	13	6	02	01	22
1CH301.3: Explain Regent and catalyst, Grignard reagent, N- bromo Succinamide Rearrangement, pinacol pinacolone Benzilic acid and Wagner –meerwein	11	6	02	01	18
1CH301.4: **d**iscuss principle of oxidation reactions, Reduction reactions . Oppenauer oxidation	13	6	02	01	22
1CH301.5:. discuss basic concept of photo-chemical reaction and Paricyclic Reactions ,Norrish type-I and II reactions and cis- trans isomerisations pericyclic reaction and their classification 2 + 2 and 4 + 2 cycloaadition ,	11	6	02	01	20
Total Hours	60	30	10	05	103

Suggestion for End Semester Assessment
Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Aliphatic nucleophilic substitution, Aliphatic Electrophilic Substitution, Aromatic Nucleophilic Substitution, Aromatic	03	01	01	05

	Electrophilic Substitution				
CO-2	Addition reaction, Elimination reactions	02	06	02	10
CO-3	Regent and catalyst, Rearrangement (Reactions,Mechanism and applications	03	04	03	10
CO-4	oxidation reactions and Reduction reactions	-02	08	05	15
CO-5	Photo-chemical Reactions, Paricyclic Reactions	03	02	05	10
Total		13	21	16	50

Legend: R: Remember, U: Understand, A: Apply

The written examination of 50 marks will be held at the end of semester for Inorganic Chemistry

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to NCL, CSIR laboratories
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT,Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher
1	Organic Chemistry	Clayden,J.,Greeves,N.and Warren,S.,"Organic Chemistry" Oxford University press, India, 2012, 2nd Edition.	Sultan Chand and Sons, . Delhi
2	Chemistry	Srivastava, S. S. Gehlot. A.S.	Ratan Prakashan Temple. Indore.
3	Inorganic Chemicals	Sing, DR, Saxena, G, Singh, B.	Shivlal Aggarwal & Company, Agra
4	Bioinorganic Chemistry	AK Das	Prentice -Hall
5	Inorganic chemistry	Gary L. Miessler	Pearson
6	Inorganic chemistry	VK Jaiswal	Shri Balaji

7	Elementary Organic Spectroscopy	Sharma Y.R.	S Chand, 2013
8	Analytical Chemistr	Gupta Alka L	Pragiti Prakashan 2020
9	Analytical Chemistry	Kaur H,	Pragatic Prakashan 2008
10	Advanced Organic Chemistry	Bahl. A. & Bahal. B.S.	S. Chand. 2010
11	Chromatography	Sharma B.K.	Krishna Prakashan, 2019

Suggested Web Sources:

1. https://celqusb.files.wordpress.com/2017/12/inorganic-chemistry-g-l-miessler-2014.pdf
2. https://www.slideshare.net/MANISHSAHU106/inert-and-labile-complexes
3. https://swayam.gov.in/explorer?category=Chemistry

Mode of Delivery: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point;

LMS/ICT Tools: Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

Cos, Pos and PSOs Mapping

Course Title: **Reaction,Reagents and Mechanism in organic** Chemistry **Course Code: 3CH101**

	Program Outcomes												Program Specific Outcome			
	PO1	PO 2	PO3	PO4	PO5	PO 6	PO7	PO8	PO9	PO1 0	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4

Course Outcomes	Knowledge	Research Aptitude	Communication	Problem Solving	Individual and Team Work	Investigation of Problems	Modern Tool usage	Science and Society	Life-Long Learning	Ethics	Project Management	Environment and sustainability	The detailed functional knowledge of theoretical concepts and experimental aspects of chemistry	To integrate the gained knowledge with various contemporary and evolving areas in chemical sciences like	understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and	Provide opportunities to excel in academics, research or Industry by research based innovative knowledge
CO1: Explain Nucleophilic substitution , Electrophilic Substitution,Benzyne,SN1, SN2, SNi,SNAr.	3	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1
CO2: Describe the Additionreaction ,Eliminationreactions,chemo-selectivity,orientation and reactivity,	2	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1

Markownikov and Anti markonikov s addition, Saytzeff and Hafmann rule.																
CO3: Explain Regent and catalyst, Grignard reagent, N-bromo Succinamide Rearrangement, pinacol pinacolone Benzilic acid and Wagner – meerwein	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO4: discuss principle of oxidation reactions, Reduction reactions . Oppenauer oxidation	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**

CO5: discuss basic concept of photo- chemical reaction and Paricyclic Reactions ,Norrish type-I and II reactions and cis- trans isomerisations pericyclic reaction and their classification 2 + 2 and 4 + 2 cycloaadition ,	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: **1–Low,** **2–Medium,** **3–High**

Course Curriculum Map:

POs &PSOsNo.	COs No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO1,2,3,4,5, 6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO1:** Explain Nucleophilic substitution , Electrophilic Substitution,Benzyne,SN1, SN2, SNi,SNAr.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1. 1.1,1.2 ,1.3,1.4,1.5,1.6,1.7	• Significance of differentiation and integration • Introduction to window
PO1,2,3,4,5, 6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO2:** Describe the Additionreaction,Eliminationreactions,chemo-selectivity,orientation and reactivity, Markownikov and Anti markonikov s addition, Saytzeff and Hafmann rule.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2 2.1,2.2,2.3,2.4,2.5,2.6, 2.7, 2.8,2.9	• Some Important units of measurements: SI Unit • distinction between mass and weight • mole, mill mole and numerical problems
PO1,2,3,4,5, 6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO3:** Explain Regent and catalyst, Grignard reagent, N- bromo Succinamide Rearrangement, pinacol pinacolone Benzilic acid and Wagner –meerwein	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3 : Chemical Equilibrium 3.1, 3.2,3.3,3.4,3.5,3.6,3.7	• Gibbs free energy • Van't Hoff factors
PO1,2,3,4,5, 6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO4: d**iscuss principle of oxidation reactions, Reduction reactions . Oppenauer oxidation	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4: 4.1, 4.2,4.3,4.4,4.5,4.6, 4.7	To understand the chromatographic principle students

					must read about • Nature of compound (polar/non-polar)
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO5:** discuss basic concept of photo- chemical reaction and Paricyclic Reactions ,Norrish type-I and II reactions and cis-trans isomerisations pericyclic reaction and their classification 2 + 2 and 4 + 2 cycloaadition ,	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit 5: 5.1,5.2,5.3,5.4,5.5,5.6,5.7	Basics of absorption spectroscopy: • Electromagnetic radiation, • Spectral range • Absorbance Absorptivity, Molar Absorptivity

Curriculum Development Team:

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Course Code: 1GE301

Course Title: Igneous and Metamorphic Petrology

Pre-requisite: To study this course, a student must have some basic knowledge of the subject of **Geology** in the class certificate.

Rationale: The students studying Bachelor of Sciences (Geology) Course should possess foundational understanding of principles of petrology including origin of various rock types.They must have knowledge of economic importance of rocks. They should be able to identify various rock types in lab as well as in fields..

Course Outcomes:

1GE301.1: Describe the evolution and crystallization of magma

1GE301.2: Demonstrate the igneous rocks - its forms, structures, texture and classification

1GE301.3: Analyse the petrography and petrogenesis of Igneous rocks

1GE301.4: Explain the processes of metamorphism and the metamorphic rocks

1GE301.5: Metamormorphism of various rock types, metasomatism and migmatite

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours(CI+LI+SW+SL)	
Program Core (DSE)	2GE301	Igneous, and Metamorphic Petrology	4	2	1	1	5	6

Legend:CI: Classroom Instruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory, workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Board of Study	Course Code	Course Title	Scheme of Assessment (Marks)							
Board of Study	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment	Total Marks
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	(ESA)	(PRA + ESA)
PCC	1GE 301	Igneous and Metamorphic Petrology	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:
This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.
1GE301.1: Describe the evolution and crystallization of magma

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO1.1 Describe the origin and composition of magma **SO1.2** Demonstrate the process of differentiation, assimililation and mixing of magma **SO1.3** Interpret the phase and component, crystallization and phase equilibrium in unicomponent and bicomponent. **SO1.4** Explain the tricomponent magma crystallization system. **SO1.5**Describe the Reaction Principle- Bowen's Reaction Series	1.1 To determine the physical identification of rocks 1.2 To determine the optical identification of rocks	1.Introduction to petrology. 2. Rocks and their composition. 3. General classification of rocks 4.Definition, origin and composition of magma 5.Concept of differentiation and assimilation 6. Phase equilibrium in uni component 7. Phase equiliribrium in bicomponent 8. Phase equilibrium in tricomponent 9.Crystallization of other ternary forms 10. The reaction Principles. 11. Crystallization and phase equilibrium in unicomponent 12. Crystallization and phase equilibrium in bicomponent	1. Definition and concept of magma. 2. Other crystallization forms of magmas.

SW-1 Suggested Sessional Work (SW):

c. Assignments:

1) Explain the Bowen's Reaction Series
2) Discuss the definition, origin and composition of magma

d. Mini Project:
Differentiation, Assimilation and mixing of magmas

e. Other Activities (Specify):
Note on crystallization of magma
1GE301.2: Demonstrate the igneous rocks **-** its forms, structures, texture and classification

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 Describe the rock cut monuments of India. **SO2.2** Explain the various forms of igneous rocks **SO2.3** Analyse the Study of texture and microstructures of igneous rocks. **SO2.4** Discuss the classification of igneous rocks. **SO2.5** Evaluate the structures of igneous rocks.	2.1 To study the polarised optical petrographic microscope. 2.2 To identify the igneous rocks in hand specimen.	**Unit-2:** 1. Origin of Igneous rocks 2. Forms of Igneous rocks 3. Forms in unfolded regions 4. forms in folded regions. 5. Structure of Igneous rocks. 6. Texture and microstructure of Igneous rocks 7. Application of Igneous rocks 8. Classification of Igneous rocks 9. Mineralogical Characteristics of acid and alkaline rocks 10. Basic and ultrabasic rocks. 11. Rock cut monuments of India 12. Evaluate structures of igneous of rocks.	I. Vedic view of the Earth II. Earth Hymn

SW-2 Suggested Sessional Work (SW):

c. Assignments:

i. Origin of Igneous rocks.
ii. Forms of igneous rocks

d. Mini Project:
Show the rock cut historic monuments of India.

e. Other Activities (Specify):
Give an account of the various classifications of igneous rocks.

1GE301.3: Analyse the petrography and petrogenesis of Igneous rocks

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO3.1 Explain the minerological characteristics of various igneous rocks. **SO3.2 Assess** the petrography and petrogenesis of granite, diorite and syenite. **SO3.3** Discuss petrography and petrogenesis of gabro,dolerite and basalt. **SO3.4** Analyse the petrography and petrogenesis of charnockite, anorthite and carbonatite. **SO3.5** Assess the various rocks in construction of monuments in India	3.1 To study the optical Identification of igneous rocks in thin sections. 3.2 To study the identification of sedimentary rocks in hand specimen.	3.1 Petrography and Petrogenesis of Igneous Rocks 3.2 Minerological characteristics of acid and alkaline rocks. basic and ultra 3.3Minerological characteristics of basic and ultra basic rocks. 3.4 Petrography and petrogenesis of granitic rocks. 3.5 Petrography and petrogenesis of diorite and syenite rocks. 3.6 Petrography and petrogenesis of gabro, dolerite and basalt 3.7 Petrography and petrogenesis of charconites 3.8 Petrography and petrogenesis of anorthosite and carbonatite	i. Origin and differentiation of basaltic magmas ii. The igneous rock forming minerals

		3.9 Origin and differentiation of basaltic magmas 3.10 Rocks in construction of historic monuments 3.11 rocks in construction of monuments in India. 3.12 The igneous rock forming minerals	

SW-3 Suggested Sessional Work (SW):

c. **Assignments:**

i. Uses and importance of Rocks in construction of historic monuments of India.
ii. Petrography and Petrogenesis of Igneous Rocks.

d. **Mini Project:**
Petrography and petrogenesis of anorthosite and carbonatite Rocks

e. **Other Activities (Specify):**
Collect data of various intrusive igneous rocks in coal formations.

1GE301.4: Explain the processes of metamorphism and the metamorphic rocks

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)

SO4.1 Discuss the agents and kinds of metamorphism **SO4.2** Relate the Structure and texture of metamorphic rocks. **SO4.3** Evaluate the Metamorphic changes in Igneous rocks. **SO4.4** Demonstrate the types of metamorphic facies. **SO4.5** Evaluate Classification of metamorphic rocks.	4.1 To study the identfication of sedimentary rocks in thin sections. 4.2 To study the identification of metamorphic rocks in hand specimens.	**4.1** Agents, kinds and types of metamorphism **4.2** Grade of metamorphism mineral zones **4.3** Grade of metamorphic mineral zones **4.4** Classification of metamorphic rocks **4.5** Structure of metamorphic rocks **4.6**texture of metamorphic rocks **4.8** Definition of metamorphic facies **4.9**Types of metamorphic facies **4.10** Effects of metamorphism **4.11** Metamorphic changes in Igneous rock **4.12** Effects of metamorphism	Granulites Effects of metamorphism

SW-4 **Suggested Sessional Work (SW):**

b. Assignments:

I Agents and types of metamorphism

II Structure and texture of metamorphic rocks

f. Mini Project:
Prepare a report on the Effects of metamorphism

g. Other Activities (Specify):
Power Point Presentation on metamorphism and metamorphic rocks

1GE301.5: Metamormorphism, metasomatism and migmatites

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO5.1 Describe the metamorphism of argillaceous and arenaceous rocks. **SO5.2**Explain Metamorphism of carbonate rocks. **SO5.3** Analyseorigin and types of migmatites. **SO5.4** EvaluateMetamorphism of basic rocks **SO5.5**Evaluate the granulite terrain of India	5.1 To study the Identification of metamorphic rocks in thin sections. 5.2 To study the important rock types on the outline map of India..	5.1 Metamorphism of argillaceous rocks. 5.2 Metamorphism of arenaceous rocks. 5.3 Metamorphism of carbonate rocks 5.4 Metamorphism of basic rocks 5.5 Introduction to granulite terrain of India 5.6 Elementary idea of metasomatism 5.7 origin and types of migmatites. 5.8 Metamorphism of carbonate rocks 5.9 Metamorphism of basic rocks 5.10 Metamorphism of argillaceous rocks. 5.11 Metamorphism of arenaceous rocks 5.12 Zones of metamorphism	**I.** More on metamorphic rocks **II.** Zones of metamorphism

SW-5 Suggested Sessional Work (SW):

d. Assignments:

I. Concept of Metasomatism.
II. Metamorphism of carbonate rocks

e. Mini Project:
Prepare power point presentation on granulite terrain of India.

f. Other Activities(Specify):
List and discuss the various types of Metamorphic rocks.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
1GE301.1: Describe the evolution and crystallization of magma.	12	12	2	1	27
1GE301.2: Demonstratethe igneous rocks - its forms, structures, texture and classification.	12	12	2	1	27
1GE301.3: Analyse the petrography and petrogenesis of Igneous rocks	12	12	2	1	27
1GE301 .4: Explain the processes of metamorphism and the metamorphic rocks	12	12	2	1	27

1GE301.5 : Evaluate the Metamormorphism of various rock types, metasomatism and migmatites	12	12	2	1	27
Total Hours	60	60	10	5	135

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Evolution and Crystallization of Magma	03	01	01	05
CO-2	Igneous Rocks- forms, structures, textures and classification	02	06	02	10
CO-3	Petrography and petrogenesis of Igneous Rocks	03	07	05	15
CO-4	Process of Metamorphism and Metamorphic Rocks	-	10	05	15
CO-5	Metamorphism, Metasomatism and Migmatites	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U:Understand, A:Apply

The end of semester assessment for Igneous and Metamorphic Petrology will be held with written examination of 50 marks.

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

10. Improved Lecture
11. Tutorial
12. Case Method
13. Group Discussion
14. Role Play
15. Visit to geological sites
16. Demonstration
17. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog ,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
18. Brainstorming

Suggested Learning Resources:

(b) **Books**:

S. No.	Title	Author	Publisher	Edition&Year
1	Principles of Petrology	G.W.Tyrril	Methuren and Co	Students Edition
2	Petrology of Metomorphic Rocks	Roger Mason	Spring SPRINGER SCIENCE+BUSINESS MEDIA, B.V iness Media	Second Edition, 1990
3	Igneous Rocks: A Classification of Glossary of Terms	Maitre, R.W., Le (Editor)	Cambridge Press	2nd Edition, 2002
4	Metamorphic petrology.	Turner, F.J.,	McGraw Hill.	1980.
5	Petrogenesis of Metamorphic Rocks winkler, H.G.C. Narosa Publ 1967			

AKS University
Faculty of Basic Science
Curriculum of B. Sc. (Honours / By Research) Program
(Revised as on 01 August 2023)

COs, Pos and PSOs Mapping

Course Code: 2GE301

Course Title: Igneous and metamorphic petrology

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Knowledge.	Research aptitude.	Communication.	Problem solving.	Individual and team work.	Investigation of Problem.	Modern tool usage	Science and Society.	Life-long learning	Ethics	Project management and finance:	Environment and sustainability.	The detailed functional knowledge of Theoretical concepts and experimental concepts of geology	Ability Word skills and advanced GIS, statistics, databases, spreadsheets, digital drawing through	Develop a research design, which has an appropriate problem related to earth	Provide an excellent preparation for a career in professional practice in or industrial

CO.1 Describe the evolution and crystallization of magma	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**
CO.2 Demonstrate the Crystallography in the Study of Minerals Demonstrate the igneous rocks - its forms, structures, texture and classification	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**

CO.3 Analyse the petrography and petrogenesis of Igneous rocks	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO.4 Explain the processes of metamorphism and the metamorphic rocks	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO.5 Metamormorphism of various rock types, metasomatism and migmatites .	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,67, 8,9,10,11,12 PSO1,2,3,4	CO.1 Describe the evolution and crystallization of magma Demonstrate the Crystallography in the	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1 1.2	Unit-1.0 Dynamic Earth 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9 Tutorial 1.1, 1.2, 1.3	As mention in page number 2 to 6
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO.2 Demonstrate the Crystallography in the Study of Minerals Demonstrate the igneous rocks - its forms, structures, texture and classification	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1 2.2	Unit-2 Dynamic Earth 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9 Tutorial 2.1, 2.2, 2.3	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO.3 Analyse the petrography and petrogenesis of Igneous rocks	SO3 .1 SO3 .2 SO3.3 SO3.4 SO3.5	3.1 3.2	Unit-3 : Geomorphic processes 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9 Tutorial 3.1, 3.2, 3.3	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO.4 Explain the processes of	SO4.1 SO4.2 SO4.3 SO4.4	4.1 4.2	Unit-4: Geological works 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.	

	metamorphism and the metamorphic rocks	SO4.5		8,4.9 Tutorial 4.1, 4.2, 4.3	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO.5 Metamormorphism of various rock types, metasomatism and migmatites .	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1 5.2	Unit5: 5.1,5.2,5.3,5.4,5.5,5.6,5.7, 5.8,5.9 Tutorial 5.1, 5.2, 5.3	

Curriculum Team:

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AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

B.Sc. (IVth semester)

Course Code: 0SE401

Course Title : Desktop Publishing with Advance PageMaker

Pre-requisite: Student should have basic knowledge of computer such as Input devices, central processing unit and output devices. Student should aware of how to power on computer and how to shut down computer.

Rationale: Desktop Publishing refers to the creation of documents using specialized software on a personal computer. It is used to empower users to create professional-quality documents efficiently, cost-effectively, and with a high degree of control and flexibility. Whether for print or digital publishing

Course Outcomes:

0SE401.1: Students will gain a foundational understanding of desktop publishing principles, terminology, and techniques, Navigate and utilize essential tools such as the basics toolbox, control palette, and color palette in PageMaker, create new documents, open existing publications, and manage document settings such as margins, page size, and orientation, Users can easily manipulate text, images.

0SE401.2: Students will learn how to insert various objects such as shapes, images, and text boxes into their publications and apply formatting options including color, size, and style, moving objects within a document and applying transformations such as rotation, reflection, skewing, and resizing to achieve desired effects.

0SE401.3: Students will learn preparing a book manuscript for publication, including combining individual chapters, formatting text, and managing page layout, add page numbers to their book manuscript, including the ability to restart page numbering for different chapters as needed.

0SE401.4: Student will design and create a creating, modifying, and managing tables using the Tables Editor interface, text formatting options including font styles, sizes, colors, and alignment, import external tables into Adobe software from various sources such as Excel or CSV files.

0SE401.5: Knowledge of the differences between linking and embedding objects in documents, Knowledge of keyline customization options, including line weight, style, and color, Story Editor for tasks such as editing text attributes, formatting, and restructuring content.

Scheme of Studies:

Board of Study	Course Code	CourseTitle	Scheme of studies(Hours/Week)					TotalCredits (C)
			Cl	LI	SW	SL	Total StudyHours(CI+LI+SW+SL)	
SEC	**0SE401**	**Desktop Publishing with Advance**	2	4	1	1	10	4

		PageMaker						

Legend: **CI:** Class room Instruction (Includes different instructional strategies i.e. Lecture(L) and Tutorial (T) and others).
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work(includesassignment, seminar, miniprojectetc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Board of Study	Course Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	**(ESA)**	(PRA+ ESA)
SEC	**0SE401**	**Desktop Publishing with Advance Page Maker**	**15**	**20**	**5**	**5**	**5**	**50**	**50**	**100**

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

0SE401.1 Students will gain a foundational understanding of desktop publishing principles, terminology, and techniques, Navigate and utilize essential tools such as the basics toolbox, control palette, and color palette in PageMaker, create new documents, open existing publications, and manage document settings such as margins, page size, and orientation, Users can easily manipulate text, images.

Approximate Hours

Item	Appx Hrs.
Cl	6
LI	10
SW	1
SL	1
Total	18

Session Outcomes (SOs)	(LI)	Class room Instruction (CI)	(SL)
SO1.1 Introduction to DTP and use of basic toolbox. **SO1.2** Formatting and editing a document in PageMaker. **SO1.3** Inserting graphics and page numbering	**Lab** **1.1** Creating and opening a document in Page Maker. **1.2** Saving and printing a given document in Page Maker. **1.3** Formatting and editing a document in PageMaker. **1.4** Insertion of graphics in Page Maker **1.5** Design Letter pad and business card using Page Maker.	**Unit-1** **1.1** Understanding the Introduction to DTP and using the Basics Toolbox. **1.2** Describe the Control Palette and color Palette. **1.3** Describe the Creating, Opening, and Saving a publication. **1.4** Describe the Setting the margins, setting the page size, setting the page orientation. **1.5** Describe the Placing graphics, placing in-line graphics, sizing graphics, cropping graphics. **1.6** Describe the Text wrap	**1** Inserting page number in PageMaker

SW- 1 Suggested Sessional Work (SW):

a. **Assignment:**
   How can you print a publication in PageMaker?
b. **Mini Project**:
c. **Other Activities:**

Presentation

0SE401.2 Students will learn how to insert various objects such as shapes, images, and text boxes into their publications and apply formatting options including color, size, and style, moving objects within a document and applying transformations such as rotation, reflection, skewing, and resizing to achieve desired effects.

Approximate Hours

Item	Appx Hours
Cl	5
LI	10
SW	1
SL	0
Total	15

SessionOutcomes (SOs)	**(LI)**	**ClassroomInstruction (CI)**	**(SL)**
SO2.1 Draw the object and implementation of formatting and editing	**Lab** **2.1** Inserting and Formatting an object **2.2** Reflecting and skewing an object and Removing Transformation **2.3** Aligning the object **2.4** Grouping and ungrouping of object **2.5** Change the order of object.	**Unit 2.** **2.1** Describe the inserting formatting, moving, rotating , reflecting, skewing an Object, Removing Transformation **2.2** Describe the Aligning and distributing objects **2.3** Describe the grouping and ungrouping, rules for grouping objects **2.4** Describe the changing the staking order of objects **2.5** Describe the formatting of object	1

SW- 1 Suggested Sessional Work (SW):

a. **Assignment:**
   How can you lock and unlock of object?
   Class Test 1
b. **Mini Project:**
c. **Other Activities:**
   Presentation

0SE401.3 Students will learn preparing a book manuscript for publication, including combining individual chapters, formatting text, and managing page layout, add page numbers to their book manuscript, including the ability to restart page numbering for different chapters as needed.

Approximate Hours

Item	Appx Hours
Cl	6
LI	12
SW	1
SL	1
Total	20

SessionOutcomes (SOs)	**(LI)**	**ClassroomInstruction (CI)**	**(SL)**
SO3.1 Creating and compilation of chapters in a book and inserting page number **SO3.2** Implementation of Master Page	**3.1** Use of page maker to prepare the Book and Combing the Chapters. **3.2** Creating a table of contents in a book. **3.3** Design Letter pad and business card using Page Maker **3.4** Creating and editing of Master page. **3.5** Working with different layer. **3.6** Build Booklet and perform Page Numbering and editing	**Unit-3 :** **3.1** Describe the creating and saving a chapter. **3.2** Describe the combine and compilation of chapters in to book. **3.3** Describe the inserting page number in a book. **3.4** Describe the creating a Table of contents in a book. **3.5** Describe the style sheets in PageMaker. **3.6** Describe the creating and editing of Master page.	1. How to work with layer

SW- 1 Suggested Sessional Work (SW):

a. **Assignment:**
   Write the importance of Style sheet in PageMaker
b. **Mini Project:**
c. **Other Activities:**
   Presentation

0SE401.4 Student will design and create a creating, modifying, and managing tables using the Tables Editor interface, text formatting options including font styles, sizes, colors, and alignment, import external tables into Adobe software from various sources such as Excel or CSV files.

Approximate Hours

Item	Appx Hours
Cl	6
LI	10
SW	1
SL	1
Total	18

SessionOutcomes (SOs)	(LI)	ClassroomInstruction (CI)	(SL)
SO4.1 Understand the use of adobe table editor **SO4.2** Creating, editing, formatting, importing and exporting table	**4.1** To applying Creating and Editing table in adobe table **4.2** Cash Meme and Certificate making in Page Maker **4.3** Exporting and importing the table in PageMaker **4.4** Exporting table as graphics. **4.5** Set the formatting in a table	**Unit-4 :** **4.1** Describe the table editor **4.2** Describe the creating, editing and formatting a table **4.3** Describe the saving a table in adobe table editor **4.4** Describe the Exporting and importing the table in PageMaker **4.5** Describe the setting of table preference **4.6** Describe the Exporting a Table as a Graphic	1 How to create a cash memo in PageMaker

SW- 1 Suggested Sessional Work (SW):

a. **Assignment:**
   Creating and saving table in adobe table editor
   Class Test 2
b. **Mini Project:**
c. **Other Activities:**
   Presentation

0SE401.5 Knowledge of the differences between linking and embedding objects in documents, Knowledge of keyline customization options, including line weight, style, and color, Story Editor for tasks such as editing text attributes, formatting, and restructuring content.

Approximate Hours

Item	Appx Hours
Cl	7
LI	14

SW	1
SL	1
Total	23

SessionOutcomes (SOs)	**(LI)**	**ClassroomInstruction (CI)**	**(SL)**
SO5.1 Understand the OLE **SO5.2** Understand the inserting and deleting bullets and numbering, keyline	**5.1** Design newspaper and advertisement **5.2** Use of various tools to design professional logos **5.3** To applying inserting object with using link option **5.4** To applying inserting bullets and numbering in paragraph **5.5** To applying keyline in text or object **5.6** To applying Drop cap option in Paragraph **5.7** To applying story editor in PageMaker	**Unit 5:** **5.1** Describe the OLE **5.2** Describing the inserting object in PageMaker **5.3** Explain the Difference between Linking and Embedding **5.4** Describe inserting bullets and numbering. **5.5** Describe Drop cap option in PageMaker **5.6** Describe the Creating keyline in text or object **5.7** Use of story editor	**1** How to find a character or word in publication

SW- 1 Suggested Sessional Work (SW):

- **a. Assignment:**
  Explain about inserting multiple columns in PageMaker
  Class Test 3
- **b. Mini Project:**
- c. **Other Activities:**
  Presentation

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Lab Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
0SE401.1: Students will gain a foundational understanding of desktop publishing principles, terminology, and techniques, Navigate and utilize essential tools such as the basics toolbox, control palette, and color palette in PageMaker, create new documents,	6	12	1	1	20

open existing publications, and manage document settings such as margins, page size, and orientation, Users can easily manipulate text, images.					
0SE401.2: Students will learn how to insert various objects such as shapes, images, and text boxes into their publications and apply formatting options including color, size, and style, moving objects within a document and applying transformations such as rotation, reflection, skewing, and resizing to achieve desired effects.	5	12	1	1	19
0SE401.3: Students will learn preparing a book manuscript for publication, including combining individual chapters, formatting text, and managing page layout, add page numbers to their book manuscript, including the ability to restart page numbering for different chapters as needed.	6	12	1	1	20
0SE401.4: Student will design and create a creating, modifying, and managing tables using the Tables Editor interface, text formatting options including font styles, sizes, colors, and alignment, import external tables into	6	12	1	1	20
0SE401.5: Knowledge of the differences between linking and embedding objects in documents, Knowledge of keyline customization options, including line weight, style, and color, Story Editor	7	12	1	1	21
Total Hours	**30**	**60**	**05**	**05**	**100**

Suggestion for End Semester Assessment

Suggested Specification Table(For ESA)

CO	**UnitTitles**	**MarksDistribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Students will gain a foundational understanding of desktop publishing principles, terminology, and techniques, Navigate and utilize essential tools such as the basics toolbox, control palette, and color palette in PageMaker, create new documents, open existing publications, and manage document settings such as margins, page size, and orientation, Users can easily manipulate text, images.	01	01	05	07
CO-2	Students will learn how to insert various objects such as shapes, images, and text boxes into their publications and apply formatting options including color, size, and style, moving objects within a document and applying transformations such as rotation, reflection, skewing, and	01	01	08	10

	resizing to achieve desired effects.				
CO-3	Students will learn preparing a book manuscript for publication, including combining individual chapters, formatting text, and managing page layout, add page numbers to their book manuscript, including the ability to restart page numbering for different chapters as needed.	02	02	07	11
CO-4	Student will design and create a creating, modifying, and managing tables using the Tables Editor interface, text formatting options including font styles, sizes, colors, and alignment, import a	02	02	05	09
CO-5	Knowledge of the differences between linking and embedding objects in documents, Knowledge of keyline customization options, including line weight, style, and color, Story Editor for tasks such as editing text attributes, formatting, and restructuring content.	02	02	09	13
Total		08	08	34	50

Legend: **R:Remember,** **U:Understand,** **A:Apply**

TheendofsemesterassessmentforFinancial Accounting willbeheld with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wiseteachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. ImprovedLecture
2. Tutorial
3. CaseMethod
4. GroupDiscussion
5. Brainstorming

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition&Year
1	Desk Top Publishing From A to Z	Bill Grout and Osborne		

2	BPB'S DTP COURSE (DESKTOP PUBLISHING)	Satish Jain & M. Geetha lyer	HPB Publication	First Edition 2009
3	ADOBE PAGEMAKER 6.5	Shashank Jain & Satish Jem	BPB Publications	First Edition 2001
4	DESKTOP PUBLISHING ON PC	MC. Sharma	DPR Publications	First Edition 1997
5	Lecture note provided by Dept. of Basic Science AKS University, Satna .			

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Cos,POs and PSO Mapping

Course Code: 0SE401

Course Title: Desktop Publishing with Advance Pagemaker

	Description	Program Outcomes												Program Specific Outcome			
		PO1 Knowledge	PO2 Research Aptitude	PO3 Communication	PO4 Problem Solving	PO5 Individual and Team Work	PO6 Investigation of Problems	PO7 Modern Tool usage	PO8 Science and Society	PO9 Life-Long Learning	PO10 Ethics	PO11 Project Management	PO12 Environment and sustainability	PSO1	PSO2	PSO3	PSO4

CO1	Students will gain a foundational understanding of desktop publishing principles, terminology, and techniques, Navigate and utilize essential tools such as the basics toolbox, control palette, and color palette in PageMaker, create new documents, open existing publications, and manage document settings such as margins, page size, and orientation, Users can easily manipulate text, images.	3	2	3	2	1	3	3	3	3	-	3	-	3	1	3	2

CO2	Students will learn how to insert various objects such as shapes, images, and text boxes into their publications and apply formatting options including color, size, and style, moving objects within a document and applying transformations such as rotation, reflection, skewing, and resizing to achieve desired effects.	3	2	3	3	2	2	2	2	2	-	3	-	3	2	3	2
CO2	Students will learn preparing a book manuscript for publication, including combining individual chapters, formatting text, and managing page layout, add page numbers to their book manuscript, including the ability																

	to restart page numbering for different chapters as needed.	3	3	2	3	3	2	2	2	2	-	2	3	2	3	3	3
CO4	Student will design and create a creating, modifying, and managing tables using the Tables Editor interface, text formatting options including	3	3	2	3	2	2	3	3	2	-	2	3	3	3	2	3
CO5	Knowledge of the differences between linking and embedding objects in documents, Knowledge of keyline customization options, including line weight, style, and color, Story Editor for tasks such as editing text attributes, formatting, and restructuring	3	3	3	2	2	2	3	2	3	-	3	3	3	3	3	3

	content.																	

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6,7,8,9, 10,11,12 **PSO 1,2,3,4**	**CO-1** Students will gain a foundational understanding of desktop publishing principles, terminology, and techniques, Navigate and utilize essential tools such as the basics toolbox, control palette, and color palette in PageMaker, create new documents, open existing publications, and manage document settings such as margins, page size, and orientation, Users can easily manipulate text, images.	**SO1.1** **SO1.2** **SO1.3**	**1,2,3,4,5**	**1,2,3,4,5,6**	**1**
PO 1,2,3,4,5,6,7,8,9, 10,11,12 **PSO 1,2,3,4**	**CO-2** Students will learn how to insert various objects such as shapes, images, and text boxes into their publications and apply formatting options including color, size, and style, moving objects within a document and applying transformations such as rotation, reflection, skewing, and resizing to achieve desired effects.	**SO2.1**	**1,2,3,4,5**	**1,2,3,4,5**	**1**
PO 1,2,3,4,5,6,7,8,9, 10,11,12 **PSO 1,2,3,4**	**CO-3** Students will learn preparing a book manuscript for publication, including combining individual chapters, formatting text, and managing page layout, add page numbers to their book manuscript, including the ability to restart page numbering for different chapters as needed.	**SO3.1** **SO3.2**	**1,2,3,4,5,6**	**1,2,3,4,5,6**	**1**
PO 1,2,3,4,5,6,7,8,9, 10,11,12 **PSO 1,2,3,4**	**CO-4** Student will design and create a creating, modifying, and managing tables using the Tables Editor interface, text formatting options including	**SO4.1** **SO4.2**	**1,2,3,4,5**	**1,2,3,4,5,6**	**1**
PO	**CO-5** Knowledge of the	**SO5.1**	**1,2,3,4,5,6,**	**1,2,3,4,5,6,**	**1**

1,2,3,4,5,6,7,8,9, 10,11,12 **PSO 1,2,3,4**	differences between linking and embedding objects in documents, Knowledge of keyline customization options, including line weight, style, and color, Story Editor for tasks such as editing text attributes, formatting, and restructuring content.	**SO5.2**	**7**	**7**	

Curriculum Development Team:

1. Dr. Akhilesh Wahoo, HoD, Department of Computer Science, AKS University, Satna (M.P.).
2. Mr. Brijesh Soni, Assistant Professor, Department of Computer Science, AKS University, Satna (M.P.).
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4. Mr. Vinay Shrivastava, Assistant Professor, Department of Computer Science, AKS University, Satna (M.P.).

Course Code:	**1CS401**
Course Title :	**Object Oriented Programming with JAVA**
Pre-requisite:	Students should have a basic understanding of computers, including hardware, software, and operating systems, as well as fundamental mathematical concepts. They should be familiar with programming basics such as variables, data types, control structures, and functions . Problem-solving skills and logical thinking are essential for algorithmic understanding.
Rationale:	This course in Java programming offers a comprehensive exploration of fundamental concepts and advanced techniques. In our initial unit, we delve into Object-Oriented Programming (OOPS) principles and the essential aspects of Java, including its historical context, core features, program structure, and runtime environment. Subsequent units progressively build upon this foundation. Unit two covers Java basics, focusing on variables, data types, operators, and control structures. Unit three delves into advanced programming constructs such as inheritance, polymorphism, and error handling. In unit four, we explore Java's extensive library of API packages, including multithreading, synchronization, and applet development. Throughout the course, students engage in practical exercises and projects, fostering hands-on application of theoretical concepts to real-world scenarios.

Course Outcomes:

CO1: Implement Object Oriented programming concept using basic syntaxes of controls Structures, strings and function for developing skills of logic building activity.
CO2: Identify classes, objects, members of a class and the relationships among them needed for a finding the solution to a specific problem.
CO3: Demonstrates how to achieve reusability using inheritance, interfaces and packages and describes faster application development can be achieved.
CO4: Demonstrate understanding and use of different exception handling mechanisms and concepts of multi-threading for robust faster and efficient application development.
CO5: Identify and describe common abstract user interface components to design GUI in Java using Applet & AWT along with response to events

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

SchemeofStudies:

Board ofStudy	CourseCode	CourseTitle	Scheme of studies(Hours/Week)					TotalCredits (C)
			Cl	LI	SW	SL	Total StudyHours(CI+LI+SW+SL)	
		Programming methodology & data structures	4	1	1	1	7	5

Legend: **CI:**ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.Lecture (L)andTutorial (T)and others).
LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworkshop, field or other locations using different instructional strategies)
SW: SectionalWork (includesassignment, seminar, miniprojectetc.),
SL: SelfLearning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacherto ensureoutcomeofLearning.

SchemeofAssessment:

Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment	Total Marks
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks	Seminar one (	Class Activity any one	Class Attendance (AT)	Total Marks (CA+CT+S		

				each (CT)	SA)	(CAT)		A+CAT+AT)	**(ESA)**	(PRA+ ESA)
		Object Oriented Programming with JAVA	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1:. Implement Object Oriented programming concept using basic syntaxes of control Structures, strings and function for developing skills of logic building activity.

Approximate Hours

Item	Appx Hrs.
Cl	10
LI	6
SW	1
SL	1
Total	15

Session Out comes (SOs)	(LI)	Classroom Instruction (CI)	(SL)
SO1.1. Grasp Object-Oriented Programming (OOP) principles and their benefits for software development. SO1.2 Understand Java's historical context, unique features, and its role in the Internet era. SO1.3 Differentiate Java from C and C++, recognizing its platform independence. SO1.4 Comprehend Java program structure, including tokens, statements, and JVM usage. SO1.5. Apply command-line arguments and adhere to programming style conventions in Java programming.	**LI1.**Program for demonstrating and use of variable and constant. LI1.2 Program for demonstrating and use of data types and type casting. LI1.3 Program for demonstrating and use of operator in java.	**Unit-1** 1.1. OOP Introduction: Discuss OOP basics, emphasizing encapsulation, inheritance, and polymorphism. 1.2. OOP Applications: Explore real-world applications of OOP principles. 1.3 Java Overview: Outline Java's history, key features, and platform independence. 1.4. Java vs. C/C++: Compare Java with C and C++, highlighting language differences. 1.5. Java and the Internet: Explain Java's role in web development and its integration with web browsers. 1.6 Program Structure: Break down Java program components, emphasizing tokens, statements, and methods. 1.7 JVM Overview: Introduce JVM and its significance in executing Java bytecode. 1.8 Command-Line Args: Demonstrate passing and processing command-line arguments in Java. 1.9 Hands-On Coding: Engage in practical coding exercises to reinforce concepts. 1.10 Practical Coding Exercises: Engage in hands-on coding to reinforce concepts covered in lectures.	

CO2: Identify classes, objects, members of a class and the relationships among them needed for a finding the solution to a specific problem.

Approximate Hours

Item	Appx Hours
Cl	10
LI	6
SW	1
SL	1
Total	15

Session Out comes (SOs)	**(LI)**	**Classroom Instruction (CI)**	**(SL)**
SO2.1 Java Basics Proficiency: Master core Java concepts such as constants, variables, and data types. **SO 2.2** Variable Management: Understand variable scope, initialization, and symbolic constants. **SO 2.3** Type Casting and Conversion: Acquire skills in type casting and data type conversion. **SO2.4**Operator Proficiency: Demonstrate competency in using arithmetic, relational, logical, and	**LI 2.1** Program for demonstrating variable an d constant **LI 2.2** Program for demonstrating type casting. **LI2.3** Java program for demonstrating operators.	**Unit 2.** 2.1 Introduction to Java Basics: Provide an overview of essential Java concepts, including constants, variables, and data types. 2.2 Variable Declaration and Initialization: Explain how to declare variables, assign values, and understand variable scope. 2.3 Symbolic Constants: Discuss the significance of symbolic constants for code readability and maintenance. 2.4 Type Casting: Introduce type casting and demonstrate its usage in converting data	

bitwise operators. **SO2.**5 Expression Evaluation: Apply knowledge of arithmetic expression evaluation and mathematical functions in Java.		types. 2.5 Operators Overview: Present various Java operators, including arithmetic, relational, logical, assignment, and bitwise operators. 2.6 Conditional Operators: Explain the usage of conditional operators for decision-making in Java programs. 2.7 Increment and Decrement Operators: Demonstrate the application of increment and decrement operators in Java. 2.8 Arithmetic Expressions: Discuss the evaluation of arithmetic expressions, operator precedence, and associativity. 2.9Type Conversions in Expressions: Explore type conversions in expressions and their impact on computation. 2.10 Mathematical Functions: Introduce commonly used mathematical functions and their implementation in Java programming.	

CO3: Demonstrates how to achieve reusability using inheritance, interfaces and packages and describes faster application development can be achieved.

Approximate Hours

Item	Appx Hours

Cl	15
LI	6
SW	1
SL	1
Total	20

Session Out comes (SOs)	**(LI)**	**Classroom Instruction (CI)**	**(SL)**
SO3.1 Decision Control: Master if statements, including simple if, if-else, and nested if-else constructs, along with switch statements and the ? operator for efficient decision-making in Java programs. SO3.2 Loop Handling: Understand and effectively use while, do-while, and for loops, including managing loop control flow and employing labeled loops for specific tasks. SO3.3 Object-Oriented Proficiency: Define classes, add variables and methods, create objects, and access class members proficiently in Java programming. SO3.4 Constructor and Method Understanding: Comprehend constructor types, method overloading, and static members for efficient class implementation and code organization. SO3.5. Nested Methods Utilization: Explore the concept of nested methods within classes and their application for encapsulating functionality and enhancing code	**LI3.1** Java program for demonstrating Decision Making using different types of if. **LI3.2** Java program for demonstrating Switch statement . **LI3.3**. program for demonstrating different types of loops in java.	**Unit-3 :** 3.1 Introduction to Decision Making: Provide an overview of decision-making constructs in Java, including if statements, switch statements, and the ternary conditional operator. 3.2 Simple if Statement: Explain the syntax and usage of the simple if statement for basic decision-making scenarios. 3.3 if...else Statement: Discuss how to use the if-else statement for branching execution paths based on conditions. 3.4 Nested if...else Statement: Introduce the concept of nested if-else statements and demonstrate their usage for complex decision-making. 3.5 if-else Ladder: Illustrate the if-else ladder structure for handling multiple conditions in a hierarchical manner. 3.6 The Switch Statement: Explore the switch statement as an alternative to if-else constructs for multi-way decision-making. 3.7 The ? Operator: Introduce the ternary conditional operator as a shorthand for simple if-else statements. 3.8 While Statement: Explain the while	

readability. SO3.6 Loop Jumping: Learn about jump statements within loops for control flow manipulation and optimization of loop execution. SO3.7 Enhanced Problem-Solving Skills: Apply the learned concepts to solve various programming challenges and develop efficient Java solutions.		loop syntax and demonstrate its usage for repetitive tasks with pre-test condition checking. 3.9 Do Statement: Discuss the do-while loop structure and its application for executing a block of code at least once before condition evaluation. 3.10 For Statement: Teach the syntax and functionality of the for loop for iterating over a sequence of values. 3.11 Jump Statements: Introduce break and continue statements for controlling loop execution flow and skipping or terminating loop iterations. 3.12 Labeled Loops: Discuss the concept of labeled loops and demonstrate how to use them for nested loop control. 3.13 Class Definition: Explain how to define a class in Java, including adding variables and methods. 3.14 Constructors and Methods: Teach the definition and usage of constructors, method overloading, and static members within a class. 3.15 Nested Methods: Explore the concept of nested methods within classes and demonstrate their application for code organization and readability.	

CO4: Demonstrate understanding and use of different exception handling mechanisms and concepts of multi-threading for robust faster and efficient application development.

Approximate Hours

Item	Appx Hours
Cl	15
LI	6
SW	1
SL	1
Total	23

essionOutcomes (SOs)	**(LI)**	**ClassroomInstruction (CI)**	**(SL)**

SO4.1 Inheritance Understanding: Master extending classes, overloading methods, and utilizing final variables and methods in Java inheritance. **SO4.2** Abstract Concepts: Grasp abstract classes and methods, ensuring a clear understanding of their role in class hierarchies. **SO4.3** Data Structure Familiarity: Learn about visibility control and apply arrays, strings, vectors, and wrapper classes for efficient data handling. **SO4.4** Interface Implementation: Define, extend, and implement interfaces for achieving multiple inheritance-like behavior. **SO4.5** Exception Handling Proficiency: Gain expertise in exception handling, including syntax, multiple catch statements, and custom exception creation. **SO4.6** Debugging Efficiency: Utilize exceptions for effective debugging and error resolution in Java programs. **SO4.7** Error Management Strategies: Develop comprehensive error management strategies for enhancing code robustness and reliability.	**LI4.**1Java program for demonstrating the concept of Inheritance. **LI4.2**.Program for demonstrating Method overloading in Java. **LI4.3** Java program for implementing one and two dimensional arrays.	**Unit-4 :** 4.1 Introduction to Inheritance: Provide an overview of inheritance in Java, including extending classes and inheriting their properties and behaviors. 4.2. Method Overloading: Explain the concept of method overloading and demonstrate how to create multiple methods with the same name but different parameters. 4.3 Final Variables and Methods: Discuss the use of final keywords to create immutable variables and prevent method overriding in subclasses. 4.4 Final Classes: Introduce final classes and explain how they cannot be sub classed further. 4.5. Finalize Methods: Discuss the finalize() method and its usage for performing cleanup operations before an object is garbage collected. 4.6. Abstract Methods and Classes: Explain abstract classes and methods, emphasizing their role as blueprints for concrete subclasses. 4.7. Visibility Control: Explore access modifiers like public, private, protected, and default to control visibility and access levels of class members. 4.8. Arrays: Introduce one-dimensional arrays and demonstrate how to declare, initialize, and access elements. 4.9 Strings: Explain the String class in Java and demonstrate common string manipulation techniques. 4.10 Vectors: Discuss the Vector class and its usage for dynamic arrays, including adding,	

		removing, and accessing elements. 4.11 Wrapper Classes: Introduce wrapper classes such as Integer, Double, and Boolean, and their role in converting primitive data types into objects. 4.12 Defining Interfaces: Define interfaces and explain their role in defining contracts for classes to implement. 4.13 Extending Interfaces: Demonstrate how interfaces can extend other interfaces to inherit their methods and add additional functionality. 4.14 Implementing Interfaces: Show how classes can implement interfaces to provide concrete implementations for interface methods. 4.15 Accessing Interface Variables: Explain how to access variables defined in interfaces and demonstrate their usage in implementing interface methods.	

CO5: Identify and describe common abstract user interface components to design GUI in Java using Applet & AWT along with response to events

Approximate Hours

Item	Appx Hours
Cl	10
LI	6
SW	1

SL	1
Total	15

SessionOutcomes (SOs)	**(LI)**	**ClassroomInstruction (CI)**	**(SL)**

SO5.1 Package Utilization: Master Java API packages, including system packages, naming conventions, and creating/accessing custom packages. **SO5.2** Threading Proficiency: Understand thread creation, lifecycle, synchronization, and exception handling for efficient multithreading. **SO5.3** Applet Development: Develop skills in building, deploying, and integrating Java applets into web pages. **SO5.4** Exception Handling: Learn to manage exceptions effectively within Java threads. **SO5.5** Applet Deployment Preparation: Prepare to deploy Java applets by designing web pages and integrating them into HTML files for web browser compatibility.	**LI5.1.**Program for demonstrating java API Packages **.** **LI 5.**2Program for demonstrating Thread synchronization. **LI5.3**.Program for demonstrating applet in java.	**Unit 5:** 5.1 Java API Packages: System packages overview and custom package creation. 5.2 Threading Essentials: Thread lifecycle, blocking, and stopping mechanisms. 5.3 Thread Synchronization: Implementing synchronization for thread safety. 5.4 Exception Handling in Threads: Managing exceptions in multithreaded environments. 5.5 Thread Priority and Lifecycle: Understanding thread priority and states. 5.6 Extending Thread Class: Creating custom thread classes. 5.7 Implementing Runnable Interface: Using Runnable for thread creation. 5.8 Java Applet Basics: Introduction to applets and their lifecycle. 5.9 Applet Development: Building and compiling Java applet code. 5.10 Applet Deployment: Integrating applets into web pages for browser execution.	

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Lab Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
CO1: Implement Object Oriented programming concept using basic syntaxes of controls Structures, strings and function for developing skills of logic building activity.	10	12	1	1	24
CO2: Identify classes, objects, members of a class and the relationships among them needed for a finding the solution to a specific problem.	10	12	1	1	24
CO3: Demonstrates how to achieve reusability using inheritance, interfaces and packages and describes faster application development can be achieved.	15	12	1	1	29
CO4: Demonstrate understanding and use of different exception handling mechanisms and concepts of multi-threading for robust faster and efficient application	15	12	1	1	29
CO5: Identify and describe common abstract user interface components to design GUI in Java using Applet & AWT along with response to events	10	12	1	1	24
Total Hours	60	60	05	05	130

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	UnitTitles	Marks Distribution			Total Marks
		R	U	A	
CO-1	OOPS-Object Oriented Paradigm	03	01	01	05
CO-2	Java Basics	01	01	03	05
CO-3	Decision Making	8	03	02	13
CO-4	Inheritance	2	03	8	13
CO-5	Java API Packages	01	03	10	14
Total		15	11	24	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment will be held with written examination of 50 marks

SuggestedInstructional/ImplementationStrategies:

6. ImprovedLecture
7. Tutorial
8. CaseMethod
9. GroupDiscussion
10. Brainstorming

SuggestedLearningResources:

(a) **Books**:

S. No.	Title	Author	Publisher	Edition&Year
1	Programming with Java,	E Balguruswami	Tata McGraw-Hill	-
2	Java: The Complete Reference.	Herbert Schildt	-	-
3	Java: How To Program	Paul Deitel, Harvey Deitel	-	-
4	Core Java	S. Horsttnann	-	-

CO's, PO's and PSO Mapping

Course Code –
Course Title- Object Oriented Programming with JAVA

Cos	Description	ProgramOutcomes												ProgramSpecificOutcome			
		PO1 Knowledge	PO2 ResearchAptitude	PO3 Communication	PO4 Problem Solving	PO5 Individual and Team Work	PO6 Investigation of Problems	PO7 Modern Tool usage	PO8 Science and Society	PO9 Life-Long Learning	PO10Ethics	PO11Project Management	PO12Environment and sustainability	PSO1	PSO2	PSO3	PSO4
CO1	. Implement Object Oriented programming concept using basic syntaxes of control Structures, strings and function for developing skills of logic building activity.	3	2	3	2	1	3	3	3	3	-	3	-	3	1	3	2

CO2	Identify classes, objects, members of a class and the relationships among them needed for a finding the solution to a specific problem.	3	2	3	3	2	2	2	2	2	-	3	-	3	2	3	2

CO3	Demonstrates how to achieve reusability using inheritance, interfaces and packages and describes faster application development can be achieved.	3	3	2	3	3	2	2	2	2	-	2	3	2	3	3	3

CO4	Demonstrate understanding and use of different exception handling mechanisms and concepts of multi-threading for robust faster and efficient application development.	3	3	2	3	2	2	3	3	2	-	2	3	3	3	2	3

CO5	Identify and describe common abstract user interface components to design GUI in Java using Applet & AWT along with response to events	3	3	3	2	2	2	3	2	3	-	3	3	3	3	3	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map

Pos & PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning (SL)
PO1,2,3,4,5,6,7 ,8,9,10,11,12 PSO1,2,3,4	CO1- Implement Object Oriented programming concept using basic syntaxes of controls Structures, strings and function for developing skills of logic building activity.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1,2,3,	Unit-1 1,2,3,4,5,6,7,8,9,10	
PO1,2,3,4,5,6,7 ,8,9,10,11,12 PSO1,2,3,4	CO2 Identify classes, objects, members of a class and the relationships among them needed for a finding the solution to a specific problem	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	1,2,3,	Unit-2 1,2,3,4,5,6,7,8,9,10	1
PO1,2,3,4,5,6,7,8, 9,10,11,12 PSO1,2,3,4	CO3 Demonstrates how to achieve reusability using inheritance, interfaces and packages and describes faster application development can be achieved.	SO3.1S O3.2 SO3.3 SO 3.4 SO 3.5 SO 3.6 SO 3.7	1,2,3	Unit-3 : 1,2,3,4,5,6,7,8,9,10,11,12,13, 14,15	1
PO1,2,3,4,5,6,7 ,8,9,10,11,12 PSO1,2,3,4	CO 4 Demonstrate understanding and use of different exception handling mechanisms and concepts of multi-threading for robust faster and efficient application development.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5 SO4.6 SO4.7	1,2,3	Unit-4 1,2,3,4,5,6,7,8,9,10,11,12,1 3,14,15	1

PO1,2,3,4,5,6,7 ,8,9,10,11,12 PSO 1,2,3,4	CO5 Identify and describe common abstract user interface components to design GUI in Java using Applet & AWT along with response to events	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	1,2,3,	Unit5: 1,2,3,4,5,6,7,8,9,10	

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Course Code:	1MS401
Course Title:	Advanced Calculus and partial differential equations
Pre- requisite:	Students should have basic knowledge of calculus
Rationale:	The program aims to develop advanced problem-solving and analytical skills and prepares students for careers in academia, research, industry, or other sectors that require advanced mathematical expertise.

Course Outcome :

CO1- 1MS401.1 The Student will aware of history of mathematics and hence of its Past, present and future role as part of our culture.

CO2- 1MS401.2 Calculate the limit superior, the limit inferior, and the limit of abounded sequence.

CO3- 1MS401.3 Apply the mean value theorems and Taylor's theorem.

CO4- 1MS401.4 Apply the various tests to determine convergence and absolute convergence of an infinite series of real numbers.

CO5- 1MS401.5 Formulate, classify and transform partial differential equations into canonical form.

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Program Core (PCC)	01MS401	Advanced Calculus and partial differential equations	6[5+1]	0	1	1	8	6

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.

AKS University

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Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+ AT)		
PCC	01MS 101	Calculus and differential equations.	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1- 1MS401.1 Student will aware of history of mathematics and hence of its Past, present and future role as part of our culture.

Approximate Hours

Item	AppX Hrs
Cl	18
LI	0
SW	1
SL	1
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO1.1 Student will aware of history of mathematics **SO1.2** Student will aware of contribution of Indian Mathematicians in field of Mathematics **SO1.3** Understand its Past, present and future role of Mathematics as part of our culture. **SO1.4**	-	**Unit-1.0 historical background of Calculus and partial differential equations** 1.1Historical background: 1.2Development of Indian Mathematics 1.3 A brief historical background of Calculus and partial differential equations in the context of India 1.4 A brief biography of Bodhayana. 1.5 Field structure and ordered structure of R 1.6 supremum and infimum in R 1.7 absolute value of a real number 1.8 Sequence of real numbers 1.9 Tutorial-I 1.10 Bounded and monotonic sequences 1.11 Cauchy's general principle of convergence. 1.12 Algebra of sequence 1.13 Tutorial-II 1.14 some important theorems 1.15 intervals, bounded and unbounded sets 1.16 completeness in R 1.17 Limit of a sequence . 1.18 Tutorial-III	**SL.1** Student will aware about Indian Mathematics **SL.2** Student will learn the Algebra of sequence **SL.3** Student will learn to supremum and infimum **SL.4** Student will learn to Limit of a sequence.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. The concept of Limit of a sequence
ii. Application of Calculus in real life
iii bounded and unbounded sets
iv.Cauchy's general principle of convergence.

b. Other Activities (Specify):

Quiz, Class Test.

CO2- 1MS401.2 Calculate the limit superior, the limit inferior, and the limit of abounded sequence.

Approximate Hours

Item	AppX Hrs
Cl	18
LI	0
SW	1
SL	1
Total	20

SW-2 Suggested Sessional Work (SW):
a. Assignments:
i. Convergence of positive term series
ii. Mean value theorems
iii. Geometrical interpretations of Mean value theorems
iv. Conditional Convergence of Series of real terms
V. Chain rule of differentiability

CO3- 1MS401.3 Apply the mean value theorems and Taylor's theorem.

Approximate Hours

Item	AppX Hrs
Cl	18
LI	0
SW	1
SL	1
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO3.1 Understand The concept of Limit and continuity of functions SO3.2 Understand the concept of homogeneous functions **SO3.3 U**nderstand the Maxima and Minima of functions SO3.4		**Unit 3 Limit and continuity of functions of two variables.** **3.1** definition of Limit 3.2 Change of variables 3.3 Euler's theorem on homogeneous functions 3.4 Taylor's theorem for functions of two variables 3.5 Jacobians 3.6 Maxima and Minima of functions 3.7 Lagrange's multiplier method 3.8 tutorial 1. 3.9 homogeneous functions,s. 3.10 continuity of functions. 3.11 continuity of functions of two variables 3.12 question based on continuity of functions. 3.13 numerical based on limit. 3.14 tutorial 2 3.15 question based on Maxima and Minima 3.16 definition and example for continuity of functions. 3.17 Beta and Gamma Functions 3.18 tutorial 3	**• knowledge of limit** **• to learn Limit and continuity of functions**

SW-3 Suggested Sessional Work (SW):
a. Assignments:
i. question based on Maxima and Minima of functions
ii. question based on Beta and Gamma Functions.
iii. definition and example for Limit and continuity of functions
iv Taylor's theorem for functions of two variables
v Euler's theorem on homogeneous functions

CO4- 1MS401.4 Apply the various tests to determine convergence and absolute convergence of an infinite series of real numbers.

Approximate Hours

Item	AppX Hrs
Cl	18
LI	0
SW	1
SL	1
Total	20

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Understand the partial differential equations of first order. **SO4.2** the concept3 Lagrange's solution.		**Unit4- Partial differential equations of the first order** **4.1** Introduction of partial differential equation. **4.2** definition and example Partial differential equations **4.**3 Lagrange's solution **4.**4 change of variables**.** **4.5** partial differential equation of first order **4.6** partial differential equation of higher order. **4.7** introduce the differential equation. **4.8 tutorial 1** **4.9** Some special types of equations **4.10** the equation homogeneous in X and Y **4.11** general method**.** **4.12** the concept of singular solutions 4.13 numerical based on differential equation. 4.14 Questions based on the partial differential equation of first order 4.15 tutorial 2 4.16 Geometrical meaning of differential equations. 4.17 Charpit's general method. 4.18 tutorial 3	● knowledge of the differential equations. ● to learn definition and example partial differential equation. ● question based on partial differential equation of first order

SW-4 Suggested Sessional Work (SW):
a. Assignments:
i. numerical based question on partial differential equation.
ii. Application of partial differential equation.
iii. Geometrical meaning of differential equations.
iv. Charpit's general method

CO5- 1MS401.5 Formulate, classify and transform partial differential equations into canonical form

Approximate Hour

Item	AppX Hrs
Cl	18
LI	0
SW	1
SL	1
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**

SO5.1 understand the linear differential equation. **SO5.2 the concept of homogeneous equation.** **SO5. 3 Understand The homogeneous linear ordinary Differential Equation.** **SO4. Transformation of equations.**		Unit 5 **Classification of partial differential equations of second order** 5.1 introduction of partial differential equation. 5.2 constant coefficient. 5.3 homogeneous partial Differential Equation. 5.4 definition of partial differential equation. 5. Classification of partial differential equations of second order 5.6 Homogeneous and non-homogeneous 5.7 partial differential equations of constant coefficients 5.8 tutorial 1 5.9 question based on partial differential equation of second order. 5.10 definition and example of homogeneous equation. 5.11 question based on homogeneous equation. 5.12 question based on partial differential equations of constant coefficients 5.13 method of homogeneous solution 5.14 Partial differential equations reducible to equations with constant coefficients.. 5.15 question based on the parameters. 5.16 tutorial 2 5.17 general method for Partial differential equation 5.18 tutorial 3	● to solve linear differential equations. ●to define the homogeneous equations with Constant Coefficient.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
CO1- 01MS401.1 The Student will aware of history of mathematics and hence of its Past, present and future role as part of our culture	18	1	1	20
CO2- 01MS401.2 Calculate the limit superior, the limit inferior, and the limit of abounded sequence.	18	1	1	20
CO3- 01MS401.3 Apply the mean value theorems and Taylor's theorem	18	1	1	20
01 CO4- 01MS401.4 Apply the various tests to determine convergence and absolute convergence of an infinite series of real numbers.	18	1	1	20
CO5- 01MS401.5 Formulate, classify and transform partial differential equations into canonical form	18	1	1	20
Total Hours	90	5	5	100

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Unit -1 Historical background of Calculus and partial differential equations	02	02	01	05
CO-2	Unit -2 Series of non-negative terms	02	08	05	15
CO-3	Unit -3 Limit and continuity of functions of two variables	03	07	05	15
CO-4	Unit-4 Partial differential equations of the first order	02	07	01	10
CO-5	Unit -5 Classification of partial differential equations of second order	02	02	01	05
Total		11	26	13	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks
Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies

1. Improved Lecture
2. Tutorial
3. Presentation
4. Group Discussion
5. Online sources
6. Seminar
7. Workshop

Suggested Learning Resources:

a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Differential Calculus	Corakh Prasad	Pothishala private	Allahabad 2016
2	Integral Calculus	Corakh Prasad	Pothishala private	Allahabad 2015
3	Advanced Calculus	Devi Prasad	Prentice Hall India	Learning Private Limited, 2009
4	Differential and Integral Calculus.	N. Piskunov	CBS Publishers	1996
5	Theory and problems of advance Calculus,	Murray R Spiegel	Schauma Publishing Co. New York	1974

Suggested Digital Platforms Web links: https://epgp.inflibnet.ac.in
https://www.highereducation.mp.gov.in/?page=xhz1QmpZwkylQo2b%2Fy5G7w%3D%3D
http://www.bhojvirtualuniversity.com

Suggested Equivalent online courses

https://nptel.ac.in/courses/111/104/111104125/
https://nptel.ac.in/courses/111/101/111101153/

Cos, POs and PSOs Mapping

Course Title: B.Sc. Mathematics
Course Code : 1MS401
Course Title: Advanced Calculus and partial differential equations

Course outcome	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
	Knowledge	Research Aptitude	Communication	Problem Solving	Individual and Team	Investigation of Problems	Modern Tool usage	Science and Society	Life-Long Learning	Ethics	Project Management	Environment and sustainability	The detailed functional knowledge of theoretical conceptsand experimental aspects of science	To integrate the gained knowledge with various contemporary and evolving areas in chemical sciences, physical science and mathematical science like analytical, synthetic, pharmaceutical etc	To understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomenon-based problems in chemical sciences,physical science and mathematical science.	Provide opportunities to excel in academics, research or Industry by research based innovative knowledge for sustainable development in chemical science, physical science and mathematical science

CO1-1MS401.1 **The** Student will aware of history of mathematics and hence of its Past, present and future role as part of our culture	2	3	2	2	1	2	2	2	1	1	1	1	2	1	1	3
CO2-1MS401.2 Calculate the limit superior, the limit inferior, and the limit of abounded sequence.	1	3	2	1	1	1	1	2	1	2	3	1	3	1	1	2

CO3-1MS401.3 Apply the mean value theorems and Taylor's theorem	2	3	2	2	3	1	3	2	1	1	3	1	2	1	2	2
CO4-1MS401.4 Apply the various tests to determine convergence and absolute convergence of an infinite series of real numbers.	2	3	2	2	1	1	3	2	2	1	3	1	2	1	2	2
CO5-1MS401.5 Formulate, classify and transform partial differential equations into canonical form	2	3	2	2	1	1	3	2	1	1	3	1	2	1	2	3

Legend: 1 – Low, 2 – Medium, 3 – High

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Semester-I

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction (CI)	Self Learn (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO1- 01MS401.1 Student will aware of history of mathematics and hence of its Past, present and future role as part of our culture	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1. Historical background of Calculus and partial differential equations 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10 1.11 1.12 1.13 1.14 1.15 1.16 1.17 1.18	SL1.1 SL1.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO2- 01MS40101.2** Calculate the limit superior, the limit inferior, and the limit of abounded sequence	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-2 Series of non-negative terms. 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10 2.11 2.12 2.13 2.14 2.15 2.16 2.17 2.18	SL2.1 SL2.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO3- 01MS401.3** Apply the mean value theorems and Taylor's theorem	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-3 Limit and continuity of functions of two variables 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8,3.9,3.10 3.11 3.12 3.13 3.14 3.15 3.16 3.17 3.18	SL3.1 SL3.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO4- 01MS401.4** Apply the various tests to determine convergence and absolute convergence of an infinite series of real .	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-4 Partial differential equations of the first order 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8,4.9,4.10 4.11 4.12 4.13 4.14 4.15 4.16 4.17 4.18	SL4.1 SL4.2

PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO5- 01MS401.5** Formulate, classify and transform partial differential equations into canonical form	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-5 Classification of partial differential equations of second order: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8,5.9,5.10 5.11 5.12 5.13 5.14 5.15 5.16 5.17 5.18	SL5.1 SL5.2

Curriculum Development Team

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CourseCode: 1PH401

CourseTitle: **Electricity, Magnetism and Electromagnetic theory**

Pre-requisite: To understand the basics of electrostatics.

Rationale: Understanding the concepts of electric and magnetic fields with its applications.

Course Outcomes:

Course Outcomes	**1PH401.1**Understand the basic concepts of electrostatics and their applications. **1PH401.2** Understand the basic concepts of electrostatics and their applications. **1PH401.3** Apply various network theorems and their applications in electronics, electrical circuit analysis and electrical machines. **1PH401.4** To explain charged particle dynamics and radiation from localized time varying electromagnetic sources. To understand the construction and working of various charged particle accelerators. **1PH401.5** Understand the concept of electromagnetic waves and its propagation through different media and interfaces and understanding reflection and refraction from a plane surface.TouseofMaxwellequationsinanalyzingtheelectromagneticfieldduetovtimevarying chargeandcurrentdistribution.

Scheme of Studies:

Board of Study	**Course Code**	**Course Title**	**Scheme of studies (Hours/Week)**					**Total Credits (C)**
			Cl	**LI**	**SW**	**SL**	**Total Study Hours (CI+LI+SW+SL)**	
DCC	1PH401	Electricity, Magnetism and Electromagnetic theory	4	4	1	1	10	6

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Legend: **CI:** Classroom Instruction (Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Board ofStudy	Course Code	CourseTitle	**Scheme of Assessment (Marks)**							
			Progressive Assessment(PRA)						**End Semester Assessment**	**Total Marks**
			Class/HomeAssignment5 number 3markseach (CA)	ClassTest2 (2bestoutof3) 10markseach (CT)	Seminarone (SA)	Class Activityanyone (CAT)	ClassAttendance (AT)	TotalMarks (CA+CT+SA+CAT+AT)	**(ESA)**	(PRA+ESA)
DCC	1PH401	Electricity, Magnetism and Electromagnetictheory	15	20	5	5	5	50	50	100

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Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1PH401.1 Understand the basic concepts of electrostatics and their applications.

Approximate Hours

Cl	12
LI	12
SW	02
SL	01
Total	27

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO1.1 Understanding the behavior of charged particles and the forces they exert on each other. Significance in describing the relationship between electric flux and the enclosed charge in a closed surface. **SO1.2**Gauss theorem and its applications of Gauss theorem. **SO1.3** Understanding the conservative nature of electrostatic field. Exploring Laplace andpoisons equations. **SO1.4** Concept of dielectrics and deep understanding for polar and non-polar molecules. Polarization of molecules. **SO1.5** Derivation of Clausius-Mossotti relation and Langevin-Debye formula.	1.1 Verification of Thevenin's theorem. 1.2 Verification of Norton's theorem.	1.1 An overview of thermal and hydroelectric power plants inMadhya Pradesh. 1.2 Electrostatic field; Electric fluxElectric fieldGauss's theorem ofelectrostatics; Applications of Gauss theorem. 1.3 Electricfield due to infinite long charged wire; Uniformly chargedspherical shell and solid sphere; Charged plate 1.4 Conservative nature of electrostatic field; Laplace and poisons equations 1.5 Uniqueness theorem. 1.6 Dielectrics; Polar and non-polar molecules; Parallel plate capacitor with a dielectric. 1.7 Electrical susceptibility and	Basics of electrostatics

		dielectric constant; Polarization and Polarization vector**(P).** 1.8 Displacement vector (D); Intensity of Electric field(E); Relationship between D, E and P. 1.9 Gauss's law in dielectrics; Clausius-Mossotti relation 1.10 Langevin-Debye formula; 1.11 Ferroelectric materials; Hysteresis loop for ferroelectrics. 1.12 Paraelectric materials; Hysteresis loop for ferroelectrics	

SW-1Suggested Seasonal Work(SW):

a. Assignments:

1. Hysteresis loop.
2. Laplace and Poisson's equation.

1PH401.2 Understand the basic concepts of electrostatics and their applications.

Approximate Hours

Item	AppX Hrs
Cl	12
LI	12
SW	2
SL	1
Total	27

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO2.1 To understand the magnetic force experienced by a charged particle moving through a magnetic field. Factors affecting the magnitude and direction of forces. **SO2.2** Biot-Savart's Law, particularly in scenarios involving various types of current-carrying geometries.to apply Ampere's Law to calculate the magnetic field for symmetric current distributions. **SO2.3** Magnetic permeability as the property of a material that describes its ability to support the formation of a magnetic field within itself when subjected to an external magnetic field. **SO2.4** Comprehend and define magnetic field strength (H) as the measure of the magnetic field force applied to a material.Explore the concept of permeability (μ) and understand its role in the relationship between B, H, and M. **SO2.5** Concept of magnetic materials and their types, Hysteresis loop and B-H curve.	2.1 To draw the B-H curve and determination of Hysteresis loss **2.2** Verification of Maximum power transfer theorem.	2.1To draw the B-H curve and determination of Hysteresis loss 2.2 Lorentz force equation and magnetic field B; Bio-Savart's law; Calculation of magnetic intensity H for solenoid and anchor ring. 2.3 Ampere's circuital law and its applications for solenoid and Toroid; 2.4 Basic law of magnetostatics in differentialform **V.B=O, VXB=μoJ;** Free and bound currents 2.5 Magnetization and magnetization vector **M;** Magneticpermeability and susceptibility. 2.6 Derivation of **VXM=Jb** for a non-uniformly magnetized substance. 2.7 Relationship between **B, H** and **M.** 2.8 Diamagnetic, Paramagnetic and Ferromagnetic substances; B-H Curve and Hysteresis loss. 2.9 General idea about AC and DC motors, Motor winding. 2.10 Understanding of basic concepts of magnetic field. 2.11 Comprehend and define	Understanding of basic concepts of magnetic field.

		magnetic field strength (H) 2.12 the measure of the magnetic field force applied to a material	

SW-2 Suggested Seasonal Work(SW):

a. Assignments:

1. Prove Maxwell's four equations.
2. Relationship between B, H and M.

1PH401.3 Apply various network theorems and their applications in electronics, electrical circuit analysis and electrical machines.

Approximate Hours

Item	AppXHrs
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO3.1 Understanding of Thevenin's theorem, Norton's theorem, Millman's theorem and maximum power transfer theorem. **SO3.2** Understanding and defining the transient current as the temporary current that flows in a circuit during the establishment or disruption of a steady-state condition for various circuits like LR, RC, LCR. **SO3.3**Understand and define alternating current as an electric current that periodically reverses direction, typically in a sinusoidal waveform.Learning how to express AC quantities, such as voltage and current, using complex numbers and phasors, understanding the concept of magnitude and phase angle. **SO3.4**Analyzing the impedance	3.1 Verification of Superposition theorem. 3.2 Determination of voltage, frequency and phase difference using CRO. 3.3 Measurement of unknown resistance using Kelvin's bridge. Determination of self-inductance by Anderson bridge. 3.4 To study the charging	**Unit-3: Current Electricity** 3.1Network theorems: Concept of ideal current and voltage sources; Thevenin's theorem. 3.2 Norton's theorem; Millman's theorem; Maximum power transfer theorem. 3.3 Transient current: Growth and decay of current in LRcircuit. 3.4 Charging and discharging of a capacitor throughresistor, measurement of high resistance by leakage. 3.5 Charging and discharging of a condenser through an inductance and resistance. 3.6 Alternating currents: Complex number and theirapplications in alternating current circuits (RL, RC andLC); Series LCR	In-depth understanding of current voltage relationship.

(Z) in RL, RC, and LC circuits, understanding the relationship between resistance, inductive reactance (XL), and capacitive reactance (XC) as complex quantities. **SO3.5** Defining power factorin an AC circuit, indicating the efficiency of power transfer. Understanding various bridges like Maxwell's bridge; Owen's bridge. Anderson's bridge; Kelvin's bridge.	and discharging of a condenser through a resistor.	(acceptor) and parallel LCR (rejector) circuits. 3.7 Power factor, A.C. bridges: Maxwell's bridge; Owen's bridge. 3.8 Anderson's bridge; Kelvin's bridge.	

SW-3 Suggested Seasonal Work (SW):

Assignments:
1. Norton's theorem.
2. Charging and discharging in a LCR circuit.
3. Maxwell's bridge, Owen's bridge and Anderson's bridge.

1PH401.4 To explain charged particle dynamics and radiation from localized time varying electromagnetic ources.

To understand the construction and working of various charged particle accelerators..

ApproximateHours

Item	Approx. Hrs
Cl	12
LI	12
SW	2
SL	1
Total	27

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO4.1 Explain how charged particles move in an electric field, experiencing a force in the direction of the field lines. **SO4.2** Exploring a cyclotron as a type of particle accelerator designed to accelerate charged	4.1Determination of voltage, frequency and phase difference using CRO.	**Unit-4:Motion of charged particles in electric and magnetic field** 4.1 Motion of charged particles in electric and magnetic field. 4.2 Construction and working	Concept of electromagnetic field.

particles, typically protons or electrons, in a circular path using a combination of electric and magnetic fields. A betatron as a type of circular accelerator that uses a changing magnetic field to induce an electric field for particle acceleration. **SO4.3**Introduced Thomson's method as an experimental techniqueby J.J. Thomson to determine the specific charge of electrons and ballistic galvanometer and cathode ray oscilloscope (CRO). **SO4.4**Understanding ofelectromagnetic induction which includes Faraday's laws and Len's law. **SO4.5**Understanding the phenomena of self induction and mutual induction and how the energy stored in a magnetic field.		principle of Cyclotron and Betatron. 4.3 Thomson's method for the determination of specific charge (e⁄m) of electron. 4.4 Ballistic galvanometer: Torque on a current loop; Current and charge sensitivity. 4.5 Electromagnetic damping; Logarithmic damping; CDR. 4.6 Introduction to CRO: Block Diagram of CRO; Applications of CRO. 4.7 Study of Waveform,Measurement of Voltage, Cuτent, Frequencyand Phase Difference. 4.8 Electromagnetic induction: Faraday's law; Lenz's law 4.9 Selfand mutual inductance; Reciprocity theorem. 4.10 Self-mutualinductanceof coil; Mutual inductance of two coils; Energy stored inmagnetic field.	
	4.2 Study of sensitivity of CRO.		

SW-4SuggestedSessionalWork(SW):

a. Assignments:

1. Concept of electromagnetic induction and laws associated with it.

2. Construction and working of CRO, Cyclotron and Betatron.

3. Phenomena of self induction and mutual induction.

1PH401.5 Understand the concept of electromagnetic waves and its propagation through different media and interfaces and understanding reflection and refraction froma plane surface.TouseofMaxwellequationsinanalyzingtheelectromagneticfieldduetovtimevaryingchargeandcurrentdistribution.

Item	Approx. Hrs
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO5.1 Understand the connection between the equation of continuity and Kirchhoff's current law, recognizing that the total current into a junction equals the total current out. **SO5.2** Understanding Maxwell's uations, a set of four fundamental uations that describe the behavior of ctric and magnetic fields in space, nducting medium. **SO5.3** Deriving the wave equations for electric and magnetic fields from Maxwell's equations, recognizing the interdependence of electric and magnetic fields in propagating electromagnetic waves. **SO5.4**Understanding the mechanisms	5.1 Study of sensitivity of CRO. 5.2 Measurement of self-inductance using Maxwell's bridge.	**Unit 5: Electrodynamics** 5.1Equation of Continuity for current; Maxwell's displacement current. 5.2 Derivation of Maxwell's equations; Poynting theorem. 5.3 Electromagnetic wave equations; Plane electromagnetic wave in vacuum. 5.4 Electromagnetic wave equations dielectric media, Reflection and refraction at a plane boundary of dielectric. 5.5 Polarization by reflection and	Understanding of electric and magnetic field equations.

leading to polarization by reflection, including the interaction of light with surfaces. Expressing reflectance and transmittance in terms of the incident angle, polarization, and the refractive indices of the media involved using Fresnel's equations. **SO5.5**Explaining the factors influencing skip distance, including the frequency of the transmitted signal, the angle of incidenceand the ionospheric conditions.		Fresnel's equation, Brewster's Law. 5.6 Electromagnetic Waves in conducting medium. 5.7 Reflection and refraction of Electromagnetic wave by the ionosphere. 5.8 Secant law, Skip distance and maximum usable frequency.	

SW-5SuggestedSessionalWork(SW):

a. Assignments:
1. Brewster's law.
2. Poynting theorem.
3. Equation of continuity.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Totalhour (Cl+SW+Sl)
1PH401.1 Understand the basic concepts of electrostatics and their applications.	12	12	02	1	27
1PH401.2 Understand the basic concepts of electrostatics and their applications.	12	12	02	1	27
1PH401.3 Apply various network theorems and theirapplications in electronics, electrical circuitanalysis and electrical machines.	12	12	02	1	27

1PH401.4 Toexplainchargedparticle dynamics and radiation from localized time varying electromagnetic sources. To understand the construction and working of various charged particle accelerators.	12	12	02	1	27
1PH401.5 Understand the concept of electromagnetic waves and its propagation through different media and interfaces and understanding reflection and refraction from a plane surface. To use of Maxwell equations in analyzing the electromagnetic field due to time varying charge and current distribution.	12	12	02	1	27
Total Hours	**60**	60	**10**	**5**	**135**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Electrostatics	04	04	02	10
CO-2	Magneto statics	04	05	02	11
CO-3	Current electricity	02	03	04	09
CO-4	Motion of charged particles in electric and magnetic field	05	04	02	11
CO-5	Electrodynamics	03	04	02	09
Total		18	20	12	50

Legend: R:Remember, U:Understand, A:Apply

Suggested Learning Resources:

Text and Reference Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Electricity, Magnetism & Electromagnetic Theory	Mahajan S. and Choudhury	Tata McGraw	2012
2	Electricity and Magnetism, 3rd Edn	Griffiths D.J	Benjamin Cummings	1998
3	Electricity and magnetism	Tayal D. C	Himalaya Publishing Co.	1988
4	Electricity and magnetism	Murugesan	S. Chand & Co.	2019
5	Feynman Lectures Vol.2	Feynman R. P., Leighton R.B., Sands M	Pearson Education	2008
6	Electromagnetic field theory.	Kshetrimayun R. S.	Cengage Learning	2012
5	Notes Provided by University			

Cos, Pos and PSOs Mapping

Course Title: 4 B.Sc.

Course Code: 1PH401

Course Title: Electricity, Magnetism & Electromagnetic Theory

Course Outcomes	**Program Outcomes**												**ProgramSpecificOutcome**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
	Engineering knowledge	**Problem analysis**	**Design/ developmentof solutions**	**Conduct investigationsof complex problems**	**Modern tool usage**	**Theengineer andsociety**	**Environment and sustainability:**	**Ethics**	**Individualandteamwork:**	**Communication:**	**Projectmanagement and finance:**	**Life-longlearning**	**Identify,formulate,andsolvePhysicsproblems**	**Designandconductexperiments, aswellastoanalyseandinterpretdata**	**Apply knowledge of Physics in a different stream of science and to communicate effectively**	**Ability to use the techniques, skills, and modern physical tools in real world application**
1PH401.1 Understand the basic concepts of electrostatics and their applications.	**1**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**

1PH401.2 Understand the basic concepts of electrostatics and their applications.	1	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1
1PH401.3 Apply various network theorems and theirapplications in electronics, electrical circuitanalysis and electrical machines.	2	2	1	1	1	2	2	2	1	2	1	2	1	1	2	2
1PH401.4 Toexplaincharge dparticle dynamicsandradiationfrom localized timevaryingelectromagnetic sources. To understand the construction and working of various charged particle accelerators.	3	2	2	2	3	2	3	2	2	1	2	3	3	3	3	2
1PH401.5 Understand the concept of electromagneticwaves anditspropagationthroughdi fferentmediaandinterfaces and understanding reflection and refraction froma plane surface.TouseofMaxwelleq uationsinanalyzingtheelec tromagneticfieldduetotimev aryingchargeandcurrentdistr	-	-	-	1	1	3	3	3	1	1	2	2	3	3	1	3

ibution.																

Legend:1–Low,2–Medium,3– High

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Course Curriculum Map:

Pos & PSOs No.	Cos No .&Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	**1PH401.1** Understand the basic concepts of electrostatics and their applications.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5 SO1.6 SO1.7 SO1.8 SO1.9 SO1.10	1.1,1.2	Unit-1 Electrostatics 1.1,1.2,1.3,1.4,1.5,1.6,1.7, 1.8, 1.9, 1.10	As mentioned in Page number 2to6
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	**1PH401.2**Understand the basic concepts of electrostatics and their applications.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5 SO2.6 SO2.7 SO2.8	2.1,2.2	Unit-2Electrodynamics 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	**1PH401.3** To describe the nature of electromagnetic wave and its propagation through different media and interfaces.	SO3.1 SO3.2 (2) SO3.3 SO3.4 SO3.5 SO3.6 SO3.7 SO3.8	3.1,3.2,3.4	Unit-3:Maxwell equations 3.1,3.2 (2),3.3,3.4,3.5,3.6,3.7,3.8	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	**1PH401.4** To be able to analyzes radiation systems in which the electric dipole, magnetic dipole or electric quadruple dominate.	SO4.1 SO4.2 SO4.3 SO4.4	4.1,4.2	Unit-4: Electromagnetic Fields	

		SO4.5 SO4.6 SO4.7 SO4.8 SOI4.9 SO4.10		4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10
PO 1,2,3,4,5,6	**1PH401.5** Understanding of the covariant formulation ofelectrodynamicsandtheconceptofretardedtimeforchargesundergoingacceleration.Toexplainchargedparticle dynamics and radiation from localized time varying electromagnetic sources.	SO5.1 SO5.2(2) SO5.3 SO5.4 SO5.5 SO5.6 SO5.7 SO5.8	5.1,5.2	Unit5:Plasma Physics 5.1,5.2(2),5.3,5.4,5.5,5.6,5.7,5.8

Curriculum Development Team

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AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

COURSE NAME: Transition elements, Chemi – energetic,Phase Equilibria
COURSE CODE: 1CH401

Course Code	Course Title	L	T	P	Total Credits
1CH401	**Transition elements, Chemi – energetic,Phase Equilibria**	3	1	2	6

Pre-requisite: Students must have fundamental knowledge of mathematics, valence shell electron pair repulsion theory and basic concepts of periodic table

Rationale: The students studying analytical chemistry should possess foundational understanding about basic mathematics, valence shell electron pair repulsion theory, and different concentration terms to understand the basic principle of chromatography and spectroscopic analysis.

CourseOutcomes:

After the completion ofthiscourse, thelearner willable to

1CH401.1: Explainthe electronic configuration,oxidation states and magnetic behavior of d and f-block elements

1CH401.2: Describe the metal ligand bonding on the basis of VBT,CFTand LFT

1CH401.3:Discuss aboutthefirst,secondandthirdlawofthermodynamics and their applications

1CH401.4:Describe the various types of reference electrodes,electrochemical series,electrode potential and Nernst equation

1CH401.5: Apply their knowledge to explain the phase diagram of one and two component Systems

Transition elements, Chemi – energetic,Phase Equilibria

(Paper-2)

CLO: **-** By the end of this course students must have had the subject chemistry in class =@ or equivalent

1. Cheinisti¯yz.of d & f-block Elements, Basic Concepts of Coordination Chemistry
2. Siereochemistry of Transition Metal Complexes.
3. Laws of Thermodynamics..

4. Concept of Phase Equilibrium with reference to Solid Solution, Liquid-Liquid Mixtures, Partially Miscible Liquids.
5. Basic Concepts of Electrochemistry.

UNIT-1

Chemistryofd-&f-blockelements

ChemistryofTransitionelements:First, Second andThirdTransitionseries.Generalgrouptrendswithspecialreferenceto-ElectronicConfiguration,CoordinationGeometry,Colour,VariableValency,Spectral,MagneticandCatalyticProperties,Abilityto formComplexes.

ChemistryofInnerTransitionelements: LanthanidesandActinides,GeneralgrouptrendswithspecialreferencetoElectronicConfiguration,OxidationStates,Colour,SpectralandMagneticProperties.LanthanideContraction.SeparationofLanthanides(Ion-exchangemethodonly).Transuranicelements:GeneralIntroduction.

UNIT-2

CoordinationChemistry „-,

MetalLigandBondinginTransitionMetalComplexes

TypesofligandsCoordinationnumberOxidationstate,EAN,ValenceBondTheory(VBT):PostulatesandapplicationsforTetrahedral,SquareplanarandOctahedrahedralcomplexes.LimitationsofVBT.CrystalFieldTheory(CFT),PostulatesandapplicationofCrystalfieldtheory,splittingofd-orbitals:..Crystalfieldstabilisationenergy(CFSE),Factors'affectingthecrystalfieldparameters..Jahn-Tellertheorem.LigandfieldandMolecularOrbital(MO)Theory

Isomerism in coordination compounds:

Structuralisomerism-Ionization,Linkage,Coordination-LigandIsomerism.

Stereoisomerism:

Geometrical isomerism and Optical isomerism:

UNIT-3

Thermodynamics

First law of Thermodynamics.

Conceptofheat(Q),work(W),internalenergy(U),Statementoffirstlaw,Enthalpy(H),Relationbetweenheatcapacities.CalculationsofQ,W,internalenergychangeandenthalpychangeunderisothermalandadiabatic conditionsforReversible,IrreversibleandFree(idealandvanderWaals)expansionsofgases.JouleThomsoneffectanditstheory,Inversiontemperature.

Second Law of Thermodynamics.

Carnotcycle,Statementofthesecondlawofthermodynamics.'ConceptofEntropy,Calculationofentropychangefor,Reversibleandirreversibleprocesses,Conceptofresidualentropy,FreeEnergyFunctions:GibbsandHelmholtzeneizy..VariOonofentropy(S),Gibbsfreeenergy(G),workfunction(A)With'temperature(T) volume(V)&pressure(P).Freeenergychangeandspontaneity,Gibbs-Helmholtzequation.

Third Law of Thermodynamics : Statement of third law,Calculation of absolute entropy of substance

UNIT-4

Electrochemistry

Electrical Conduction in metals and in electrolyte solutions. Specific equivalent, and molar conductivity. Measurement of equivalent conductance Effect of dilution on conductivity. KohlialiSchlaw and its applications. Weakand 'Strong electrolytes: Theory of strong electrolytes, DebyeHuckel On Sager (DHO) theory and equation. Transport numbers 'Determination of transport numbers by Hitter Method and Moving boundary method. 'Nernst equation, Derivation and application of Nernst equation, Electrode

Reference electrodes

Standard hydrogen electrode,Quinhydrone electrode, Glass electrode, Calomel electrode.

Electrochemical series and its applications, Electrochemical cells

UNIT-5

Phaseequilibrium

Concept of phases. Components and degrees of freedom. Thermodynamic derivation of Gibbs Phase Rule for reactive and non reactive systems. Clausius-Clapeyron equation and its applications to Solid- Liquid, Liquid-Vapourand Solid-Vapour equilibria. Phase diagram for one component systems with applications-Water and Sulphur.Phase diagrams for systems of solid-liquid equilibria in volving-Eutectic, Congruent and In congruentmelting points.WaterandSulfursystem,Ag-PbandMg-Znsystem,NaC1-H20system.

Bi**nary solutions:** Raoult'sLaw, Ideal and Non-ideal or Azeotropic mixtures, Immiscible liquids, Steamdistillation.

SUGGESTEDWEBSOURCES:

1. https://nptel.ac.in/course.html
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5
3. https://swayam.gov.in/explorer?category=Chemistry

MODEOFTRANSACTION:Lecture,demonstration,E-tutoring,discussion,assignments,quizzes, case study, power point; **LMS/ICT Tools:** Digital Classrooms, DLMS, ZOOM, G-Suite,MSPower-Point, Online Resources

SchemeofStudies:

Board ofStudy	CourseCode	CourseTitle	Scheme ofstudies (Hours/Week)						Total CreditsI
			Cl	**T**	**LI**	**SW**	**SL**	**Total Study Hours(CI+LI+SW+SL)**	
ProgramCore(PCC)	**1CH401**	**Transition elements, Chemi – energetic,Phase Equilibria**	4	0	2	1	1	8	6

Legend: CI: ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)andothers),
LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworkshop,fieldorotherlocationsusingdifferentinstructionalstrategies)
SW: SessionalWork(includesassignment,seminar,miniprojectetc.),
SL: SelfLearning
C: Credits.

Note: SW&SLhastobeplannedandperformedunderthecontinuousguidanceandfeedbackofteacherto ensure outcome ofLearning.

SchemeofAssessment: Theory

Board ofStudy	CourseCode	CourseTitle	SchemeofAssessment(Marks)						
			ProgressiveAssessment(RA)					**EndSemesterAssessment (ESA)**	**TotalMarks** (PRA+ESA)
			Class/HomeAssignment5number 3 markseach	Class Test2 (2bestoutof3) 10	Seminarone + Class activity	ClassAttendance (AT)	TotalMarks (CA+CT+SA+AT)		
DCC	1CH401	**Transition elements, Chemi – energetic,Phase Equilibria**	15	20	10	5	50	50	100

Course-Curriculum Detailing:
This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (Sos), culminating in the overall achievement of Course Outcomes (Cos) upon the course's conclusion.

Unit-1 (1CH401.1):

Chemistryofd-&f-blockelements

ChemistryofTransitionelements:First, Second andThirdTransitionseries.Generalgrouptrendswithspecialreferenceto-ElectronicConfiguration,CoordinationGeometry,Colour,VariableValency,Spectral,MagneticandCatalyticProperties,Abilityto formComplexes.

ChemistryofInnerTransitionelements: LanthanidesandActinides,GeneralgrouptrendswithspecialreferencetoElectronicConfiguration,OxidationStates,Colour,SpectralandMagneticProperties.LanthanideContraction.SeparationofLanthanides(Ion-exchangemethodonly).Transuranicelements:GeneralIntroduction.

formulae.

Activity	Appx Hrs
Cl	12
LI	6
SW	2
SL	1
Total	21

Session Outcomes (SOs)	LI	CI	SL
After the completion of topics students will be able to SO1.1 understand the concept of d block elements SO1.2 Restate the concept of f-block elements SO1.3 Overview of Oxidation States and magnetic properties SO1.4 Discuss about the Lanthanide and Actinide contraction SO1.5 Explain complex formation by metal-ligand bonding	Synthesis of inorganic complexes • Preparation of potassium tri oxalate ferrate(III) • Preparation of tetra ammine copper (II) sulphate • Preparation of tetraammine carbonate Cobalt(III)nitrate	**Unit-1:Chemistry of d- & f-block elements** 1.1Chemistry of Transition elements: 1.2First, Second and Third Transition series. 1.3General group trends with special reference to- Electronic Configuration Coordination Geometry, 1.4Colour, Variable Valency, 1.5Spectral, Magnetic and Catalytic Properties, 1.6Ability to form Complexes. 1,7Chemistry of Inner Transition elements: 1.8Lanthanides and Actinides, 1.9General group trends with special reference to Electronic Configuration, 1.10 Oxidation States, Colour, Spectral and Magnetic Properties. 1.11Lanthanide Contraction. Separation of Lanthanides (Ion-exchange method	• Basic idea about d-block elements • Properties of f-block elements

		only). 1.12Transuranic elements: General Introduction	

SW-1SuggestedSessionalWork(SW):
Assignments: properties of 4d and 5d Transition metals
Mini Project: Software's for drawing structures and molecular formulae.
Other Activities (Specify):Basic idea about periodic table
Unit-2(1CH401.2):

CoordinationChemistry „-,

MetalLigandBondinginTransitionMetalComplexes

TypesofligandsCoordinationnumberOxidationstate,EAN,ValenceBondTheory(VBT).PostulatesandapplicationsforTetrahedral,SquareplanarandOctahedrahedralcomplexes.LimitationsofVBT.CrystalFieldTheory(CFT),PostulatesandapplicationofCrystalfieldtheory,splittingofd-orbitals:..Crystalfieldstabilisationenergy(CFSE),Factors'affectingthecrystalfieldparameters..Jahn-Tellertheorem.LigandfieldandMolecularOrbital(MO)Theory

Isomerism in coordination compounds:

Structuralisomerism-Ionization,Linkage,Coordination-LigandIsomerism.

Stereoisomerism:

Geometrical isomerism and Optical isomerism:

Activity	AppX Hrs
Cl	13
LI	6
SW	2
SL	1
Total	22

Session Outcomes (SOs)	Laboratory Instruction	Class room Instruction (CI)	Self Learning (SL)

	(LI)		
After the completion of topics students will be able to **SO2.1**Restate the concept of ligand and types of ligand **SO2.2**Explain the Postulates of valence bond theory **SO2.3 Di**scuss splitting of d-orbitals **SO2.4**Discuss CFSE and pairing energy **SO2.5O**verview of ligand field theory	Synthesis of inorganic complexes • Preparation of Nickel(II)dmg • Preparation of copper (II)acetylacetonate • Preparation of Iron(III) acetylacetonate • • Determination of carbonate and hydroxide present in mixtur • Determination of carbonate and bicarbonate present in a mixture.	**UNIT- 2** **Coordination Chemistry** 2.1Metal Ligand Bonding in Transition Metal Complexes 2.2Types of ligands 2.3Coordination numberOxidation state, 2.4 EAN(Effective atomic number) 2.5Valence Bond Theory (VBT): Postulates and applications 2.6Limitations of VBT. 2.7Crystal Field Theory (CFT) 2.8 Postulates and application of Crystal field theory, 2.9splitting of d-orbitals:.. Crystal field stabilisation energy (CFSE) 2.10 Factors 'affecting the crystal field parameters.. 2.11 Jahn-Teller theorem. Ligand field and Molecular Orbital (MO) Theory **2.12**Isomerism in coordination compounds:	• Factors affecting CFSE • Isomerism in co-ordination compounds

SW-2 Suggested Sessional Work (SW):

Assignments: Presentation of experimental data and results, from the point of view of Metal-Ligand bonding

Mini Project: Synthesis of inorganic complexes and their applications

Other Activities (Specify): Determination of hybridization and geometry of some metal complexes

Unit-3 (1CH401.3):

Thermodynamics

First law of Thermodynamics.

Conceptofheat(Q),work(W),internalenergy(U),Statementoffirstlaw,Enthalpy(H),Relationbetweenheatcapacities.CalculationsofQ,W,internalenergychangeandenthalpychangeunderisothermalandadia baticconditionsforReversible,IrreversibleandFree(idealandvanderWaals)expansionsofgases.JouleThomsoneffectanditstheory,Inversiontemperature.

SecondLawofThermodynamics.

Carnotcycle,Statementofthesecondlawofthermodynamics.'ConceptofEntropy,Calculationofentropychangefor,Reversibleandirreversibleprocesses,Conceptofresidualentropy,FreeEnergyFunctions:GibbsandHelmholtzeneizy..VariOonofentropy(S),Gibbsfreeenergy(G),workfunction(A)With'temperature(T) volume(V)&pressure(P).Freeenergychangeandspontaneity,Gibbs-Helmholtzequation.

ThirdLawofThermodynamics: Statementofthirdlaw,Calculationofabsoluteentropyofsubstance

Activity	AppX Hrs
Cl	11
LI	4
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)

After the completion of topics students will be able to **SO3.1** Overview of enthalpy. Entropy and free energy **SO3.2**Discuss basic concept of thermodynamics **SO3.3**Explain Laws of Thermodynamics **SO3.4 E**xplain conceptually the state function and path function **SO3.5**Describe Carnot cycle and efficiency of engine	Determination of enthalpy of following: • Determination of free alkali present in different soaps/detergents • Neutralization of hydrochloric acid with sodium hydroxide • Ionization of ethnic acid • Hydration of salts • Determination of enthalpy (endothermic and exothermic)of aqueous solution of salts	**UNIT-3Thermodynamics** 1.1First law of Thermodynamics. 1.2Concept of heat (Q), work (W), internal energy (U), 1.3Statement of first law, Enthalpy (H), Relation between heat capacities. 1.4Calculationsof Q, W, internal energy change and enthalpy change under isothermal and adiabaticconditions 1.5 for Reversible, Irreversible and Free (ideal and van der Waals) expansions of gases 1.6.Joule Thomson effect and its theory, Inversion temperature. 1.7Second Law of Thermodynamics. 1.8Carnot cycle, Statement of the second law of thermodynamics. 1.9'Concept of Entropy, Calculation of entropy change for ,Reversible and irreversible processes, 1.10Gibbs and Helmholtz energy..VariOon of entropy (S), Gibbs free energy (G), work	• Gibbs free energy • Van't Hoff factors

		function (A) With' temperature (T)volume (V) & pressure (P). Free energy changeand spontaneity, 1.11 Gibbs-Helmholtz equation. 1.12Third Law of Thermodynamics	

SW-3 Suggested Sessional Work (SW):

Assignments: Concept of enthalpy,entropy and free energy

Mini Project:Thermodynamics of Ramjet

Other Activities (Specify): Numerical Problems on thermodynamics

Unit-4 (1CH401.4): Electrochemistry

Electrical Conduction in metals and in electrolyte solutions. Specifie equivalent, and molar conductivity. Measurement of equivalent conductance Effect of dilution on conductivity. KohlialiSchlaw and its applications. Wea-kand 'Strongelectrolytes: Theory of strong electrolytes, Debye Huckel On Sager (DHO) theory and equation. Transport numbers 'Determination of transport numbers by Hitter Method and Moving boundary method. 'Nernst equation, Derivation and application of Nernst equation, Electrode

Reference electrodes

Standard hydrogen electrode, Qu in hydrone electrode,Glass electrode, Calomelel ectrode.

Electro chemical series and its applications, Electrochemical cells

Activity	AppX Hrs
Cl	13

LI	6
SW	2
SL	1
Total	21

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
After the completion of topics students will be able to **SO4.1**understand basics of Electrochemistry **SO4.2**Overview of strong ,weak electrolyte and cell notation **SO4.3** Disuss effect of dilution on conductivity **SO4.4**Explain the concept of reference electrodes **SO4.5 Di**scuss the concept of various cell	Qualitative Analysis • Identification by determination of the Rf values of the given organic / inorganic compounds by paper/ thin layer chromatography. • Systematic identification of organic compound by qualitative analysis	**Unit-4 (2CH101.4):** **Electrochemistry** 4.1 Electrical Conduction in metals and in electrolyte solutions. 4.2Specifie,,equivalent, and molar conductivity. Measurement of equivalent conductance 4.3 Effect of dilution on conductivity. 4.4KohlialiSch law and its applications .4.5Wea¯k and 'Strong electrolytes, Debye Huckel On Sager (DHO) theory and equation. 4.6Transport numbers' Determination of transport numbers by Hittorf Method and Moving boundary method. 4.7'Nernst equation, Derivation and 4.8application of Nernst equation 4.9**Referenceelectrodes**Standardhydrogenelectrode, 4.10Quinhydrone electrode, Glass electrode, Calomel electrode. 4.11Electrochemical series and its applications, 4.12Electrochemical cells	DebyeHuckelOnSager(DHO)theory andequation. measurementofequivalentconductance

SW-4 Suggested Sessional Work (SW)

Assignment: Application of electrochemical series
Mini Project: Synthesis of green corrosion inhibitors
Other Activities (Specify): Mechanism of Rusting

Unit-5 (1CH401.5):
Phaseequilibrium

Concept of phases. Components and degrees of freedom. Thermodynamic derivation of Gibbs Phase Rule for reactive and non reactive systems. Clausius-Clapeyron equation and its applications to Solid- Liquid, Liquid-Vapourand Solid-Vapour equilibria. Phase diagram for one component systems with applications-Water and Sulphur.Phase diagrams for systems of solid-liquid equilibria in volving-Eutectic, Congruent and In congruentmelting points.WaterandSulfursystem,Ag-PbandMg-Znsystem,NaC1-H20system.

Bi**nary solutions:** Raoult'sLaw, Ideal and Non-ideal or Azeotropic mixtures, Immiscible liquids, Steamdistillation.

Activity	AppX Hrs
Cl	11
LI	6
SW	2
SL	1
Total	20

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)

After the completion of topics students will be able to **SO5.**1 Understand Basics of water and Sulphur systems **SO5.2**Overview of vaporization and Sublimation curve **SO5.3 A**pply the concept of Phase to evaluate the degree of freedom and triple point **SO5.**4 Idea about ideal and non ideal solution **SO5.5** Explain about the esthetic and congruent point	.Phase equilibria: • Verification of Lambert-Beer Law • Determination of concentration of colored compounds (e.g. CuSO4, KMnO4) a)Construction of the phase diagram using cooling curves or ignition tube method: 1)Simple eutectic and 2)Congruently melting systems b)Distribution of acetic/benzoic acid between water and cyclohexane c)Purification/Separation of compounds by fractional distillation/Steam distillation	**Unit-5Phase equilibrium** 5.1 Concept ofphasesComponents and degrees of freedom 5.2Thermodynamic derivation of Gibbs Phase Rule for reactive and nonreactive systems. 5.3 Clausius-Clapeyron equation an Liquid-Vapour and Solid-Vapour equilibria. 5.4Phase diagram for one component systems 5.5 Water and Sulfur system, 5.6Ag-Pb and 5.7 Mg-Zn system, 5.8 NaC1-H_2O system. 5.9Binary solutions: Raoult's Law, 5.10Ideal and Non-ideal solutions .11Azeotropic mixtures, 5.12Immiscible liquids, Steam distillation.	• Applications of one component systems • Positive and negative deviation

SW-5 Suggested Sessional Work (SW):
Assignments: Applications of two component Systems

Mini Project: Application of Phase diagrams in metallurgy and ceramics
Other Activities (Specify): Numerical Problems on Raoult's Law

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
1CH401.1: Explainthe electronic configuration,oxidation states and magnetic behavior of d and f-block elements	12	12	02	01	27
1CH401.2: Describe the metal ligand bonding on the basis of VBT,CFTand LFT	12	12	02	01	27
1CH401.3:Discuss aboutthefirst,secondandthirdlawofthermodynamics and their applications	11	12	02	01	27
1CH401.4:Describe the various types of reference electrodes,electrochemical series,electrode potential and Nernst equation	13	12	02	01	27
1CH401.5: Apply their knowledge to explain the phase diagram of one and two component Systems.	11	12	02	01	27
Total Hours	60	60	10	05	135

Suggestion for End Semester Assessment

SuggestedSpecificationTable(ForESA)

CO	UnitTitles	MarksDistribution			TotalMarks
		R	**U**	**A**	
CO-1	**Chemistryofd-&f-blockelements**	03	01	01	05
CO-2	**CoordinationChemistry**	02	06	02	10

CO-3	**Thermodynamics**	03	04	03	10
CO-4	**Electrochemistry**	-02	08	05	15
CO-5	**Phaseequilibrium**	03	02	05	10
Total		13	21	16	50

Legend: R:Remember, U:Understand, A:Apply

The written examination of 50 marks will be held at theendof semesterfor Inorganic Chemistry

Note.DetailedAssessmentrubricneedtobepreparedbythecoursewiseteachersforabovetasks. Teacherscanalsodesigndifferenttasksasperrequirement,forendsemesterassessment.

SuggestedInstructional/ImplementationStrategies:

1. ImprovedLecture
2. Tutorial
3. CaseMethod
4. GroupDiscussion
5. RolePlay
6. Visitto NCL, CSIR laboratories
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT, Blog,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
9. Brainstorming

SuggestedLearningResources:

(a) Books:

S. No.	**Title**	**Author**	**Publisher**
1	Organic Chemistry, Sultan Chand and Sons. Delhi.	Soni PL,	Sultan Chand and Sons, . Delhi
2	Chemistry	Srivastava, S. S. Gehlot. A.S.	Ratan Prakashan Temple. Indore.

3	Inorganic Chemicals	Sing, DR, Saxena, G, Singh, B.	Shivlal Aggarwal & Company, Agra
4	Bioinorganic Chemistry	AK Das	Prentice-Hall
5	Inorganic chemistry	Gary L. Miessler	Pearson
6	Inorganic chemistry	VK Jaiswal	Shri Balaji
7	Elementary Organic Spectroscopy	Sharma Y.R.	S Chand, 2013
8	Elements Physical Chemistry	Peter Atkins	7Th Edition 2017
9	Textbook of Physical Chemistry	Glasstone, S	Macmillan, 1951.
10	Advanced Physical Chemistry	Bahl. A. & Bahal. B.S.	S. Chand. 2010

SuggestedWebSources:

1. https://celqusb.files.wordpress.com/2017/12/inorganic-chemistry-g-l-miessler-2014.pdf
2. https://www.slideshare.net/MANISHSAHU106/inert-and-labile-complexes
3. https://swayam.gov.in/explorer?category=Chemistry

ModeofDelivery:Lecture,demonstration,E-tutoring,discussion,assignments,quizzes, case study, power point;

LMS/ICT Tools: Digital Classrooms, DLMS, ZOOM, G-Suite,MSPower-Point, Online Resources.

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Course Title: Transition elements, Chemi – energetic,Phase Equilibria **Course Code: 1CH401**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
	Knowledge	**Research Aptitude**	**Communication**	**Problem Solving**	**Individual and Team**	Investigation of	**Modern Tool usage**	**Science and Society**	**Life-Long Learning**	**Ethics**	**Project Manageme**	**Environment and sustainabili**	**The detailed functional knowledge**	**To integrate the gained knowledge with**	**understand, analyze, plan and implement qualitative**	**Provide opportunities to excel in academics, research or Industry by**
CO1: Explainthe electronic configuration,oxidation states and magnetic behavior of d and f-block elements.	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**
CO2: Describe the metal ligand bonding on the basis of VBT,CFTand LFT	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
CO3: Discuss aboutthefirst,secondandthirdlawofthermodynamics and their applications.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO4: Describe the various types of	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**

reference electrodes,electrochemical series,electrode potential and Nernst equation																
CO5: Apply their knowledge to explain the phase diagram of one and two component Systems	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: **1–Low,** **2–Medium,** **3–High**

C0urse Curriculum Map:

POs &PSOsNo.	COs No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO-1:explain basic concept of straight line equation, logarithmic relation, differentiation and integration and run the software's to plot the graphs and draw the structure of different molecules.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1. **Chemistryofd-&f-blockelements** 1.1,1.2 ,1.3,1.4,1.5,1. 6,1.7	• Basic idea about d-block elements • Properties of f-block elements
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO2:describe the presentation of experimental data and analyze the results in terms of significant figure by applying the concept of concentration terms, error, sampling, precision, accuracy	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2 **CoordinationChemistry** 2.1,2.2,2.3,2. 4,2.5,2.6, 2.7, 2.8,2.9	• Factors affecting CFSE • Isomerism in co-ordination compounds
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO3:explain thermodynamic derivation of law of chemical equilibrium by applying the concept of Gibbs free energy and chemical potential	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3 : **Thermodynamics** 3.1, 3.2,3.3,3.4,3.5,3.6,3. 7	• Gibbs free energy • Van't Hoff factors
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO4:**d**iscuss principle of chromatography and analyze different components of a mixture quantitatively by applying chromatographic principle.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4 : **Electrochemistry** 4.1, 4.2,4.3,4. 4,4.5,4.6, 4.7	Debye HuckelOnSager (DHO)theoryandequation. measurementofequivalentconductance

PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO5:discuss basic concept of spectroscopy and analyze unknown component qualitatively & quantitatively and also identify the functional groups of a molecule on the basis of their stretching and bending vibrations	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit 5: **Phaseequilibrium** 5.1,5.2,5.3,5.4 ,5.5,5.6,5.7	• Applications of one component systems • Positive and negative deviation

Curriculum Development Team:

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Course Code: **2GO401**

Course Title: Sedimentary Rocks and Stratigraphy of India

Pre-requisite: To study this course, a student must have some basic and fundamental knowledge of the subject of Geologyin the class certificate and earlier semesters.

Rationale: The students studying Bachelor of Sciences (Geology) Course should possess foundational understanding of sedimentary rock units, sedimentary textures and stratigraphy.They must have knowledge of economic importance of sedimentary rocks. They should be able to identify various sedimentary rock types in lab as well as in fields.

Course Outcomes

2GO401.1: Describe the Sedimentary Rocks.

2GO401.2: Demonstrate theSedimentary Texture - Structure and Fossils.

2GO401.3: Analyse the concept of Stratigraphy.

2GO401.4: Explain the Phanerozoic Stratigraphy of India.

2GO401.5 Discuss Deccan Traps, Cenozoic Rocks of Assam and the Siwalik Group.

Scheme of Studies:

Board of Study	**Course Code**	**Course Title**	**Scheme of studies(Hours/Week)**					**Total Credits**
			Cl	**LI**	**SW**	**SL**	**Total Study Hours(CI+LI+SW +SL)**	**(C)**
Program Core (PCC)	2GO401.	Sedimentary Rocks and Stratigraphy of India	3	2	1	1	5	4

Legend:

CI: Classroom Instruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory, workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment

Theory

Board of Study	Course Code	Cours e Title	**Scheme of Assessment (Marks)**
Board of Study	Course Code	Cours e Title	**Scheme of Assessment (Marks)**

			Progressive Assessment (PRA)						End Semester Assessment	Total Marks
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	(ESA)	(PRA + ESA)
PCC	**2GO401**	Sedimentary Rocks and Stratigraphy of India	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

2GO401.1: Describe the Sedimentary Rocks.

Approximate Hours

Item	Approx. Hrs
Cl	9
LI	4
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)

SO1.1 Describe the classification and uses of sedimentary rocks. **SO1.2** Demonstrate the environments of sediment deposition **SO1.3** Interpret the presence of heavy minerals in sedimentary rocks. **SO1.4**Explain the sedimentary provinces and facies. **SO1.5** Describe the origin and transportation of sediments.	1.1 Megascopic, Microscopic Study and distribution of Sandstone rocks in India 1.2 Megascopic, Microscopic Study and distribution of Shale rocks in India	**Unit 1: Sedimentary Rocks** 1.1 Geological Knowledge of Ancient India 1.2 Identification, Classification and Uses of Rocks 1.3 Origin and Transportation of Sediments 1.4 Environments of Sediments Deposition 1.5 Concepts of Lithification and Diagenesis 1.6 Concepts of Sedimentary Basin 1.7 Sedimentary provinces and Facies 1.8 Heavy Minerals and their significance in Sedimentary Study	i. Study of Geology of India ii. Classification of Sedimentary Rocks

SW-1 Suggested Sessional Work (SW):

a. **Assignments:**

1) Origin and transportation of sediments.
2) Concept of lithification and diagenesis.

b. **Mini Project:**

Power point presentation on sedimentary basins.

c. **Other Activities (Specify)**

Debate on geological knowledge of ancient India.

2GO401.2: Demonstrate theSedimentary Texture - Structure and Fossils.

Approximate Hours

Item	Approx. Hrs
Cl	9
LI	4
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 Describe theTextures in Sedimentary Rocks **SO2.2** Explain the Fossils and their preservations **SO2.3** Analyse the	2.1 Megascopic, Microscopic Study and distribution of Clay rocks in India 2.2 Megascopic, Microscopic Study and distribution of Limestone rocks in India	**Unit 2:** Sedimentary Texture - Structure and Fossils 2.1 Structures in Sedimentary Rocks 2.2 Textures of Sedimentary Rocks	I. Discuss Index Fossils II. Structures in Sedimentary Rocks

uses and importance of fossils. **SO2.4** Discuss the Structural features in sedimentary rocks. **SO2.5** Evaluate the recognition of top and bottom of beds.		2.3 Identification of Beddings 2.4 Recognition of Top and Bottom of Beds 2.5 Fossils and their essential Conditions 2.6 Modes of Fossilization 2.7 Geological Uses and Importance of Fossils 2.8 Index Fossils	

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Uses and Importance of Fossils
ii. Strural features in sedimentary rocks

b. Mini Project:

Power point presentation on fossils, their modes of formation and the importance thereof.

c. Other Activities (Specify)

Identification of beddings and bedding planes in sedimentary rocks.

2GO401. 3: Analyse the concept of Stratigraphy.

Approximate Hours

Item	Approx. Hrs

Cl	9
LI	4
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 Explain the concept of stratigraphy. **SO3.2 Assess** the basic principle of stratigraphic correlation. **SO3.3** Discuss the basic concepts of lithostratigraphic units. **SO3.4** Analyse the stratigraphy and geographical distribution of Vindhyan Supergroup **SO3.5** Assess the stratigraphy and geographical distribution of Dharwar Supergroup.	3.1 Megascopic ,Microscopic Study and distribution of Dolomite rocks in India 3.2 Megascopic, Microscopic Study and distribution of Conglomerates rocks in India	**Unit 3:** Introduction to Stratigraphy 3.1 Basic concepts of Lithostratigraphic Units 3.2 Basic concepts of Biostratigraphic Units 3.3 Basic concepts of Chronostratigraphic Units 3.4 Basic concepts of Magnetostratigraphic Units 3.5 Basic Principles of Stratigraphic Correlation 3.6 Stratigraphy, geographical distribution and economic importance of Dharwar Supergroup 3.7 Stratigraphy, geographical distribution and economic importance of Cuddapah Supergroup	i. Basic concepts of biostratigeaphical units ii. Stratigrapgy of Cuddapah Supergroup.

		3.8 Stratigraphy, geographical distribution and economic importance of Vindhyan Supergroup	

SW-3 Suggested Sessional Work (SW):

a. Assignments:

I. Principles of stratigraphic correlations
II. Stratigraphy and geographical distribution of Vindhyan Supergroup

b. Mini Project:

Study of basic concepts of magnetostratigraphic units.

c. Other Activities (Specify):

Class seminar on stratigraphy of India

2GO401.4: Explain the Phanerozoic Stratigraphy of India.

Approximate Hours

Item	Approx. Hrs
Cl	9
LI	4
SW	4
SL	2
Total	19

Session Outcomes (SOs)	Laboratory Instruction	Classroom Instruction (CI)	Self Learning

	(LI)		(SL)
SO4.1 Discussthe stratigraphy and geographical distribution of Gondwana rocks. **SO4.2** Relate the Stratigraphic Distribution, and Lithology of Jurassic of Kuchha **SO4.3** Evaluate thePhanerozoic Stratigraphy of India. **SO4.4**Stratigraphic Distribution, and Lithology of Triassic of Spiti. **SO4.5** Evaluate the stratigraphy and lithology of Bagh and Lameta group.	4.1 Megascopic, Microscopic Study and distribution of Brecias rocks in India 4.2 Identification of rocks based on their distinct characteristics and arranging them in their stratigraphic order.	**UNIT 4** : Phanerozoic Stratigraphy of India 4.1 Stratigraphic Distribution, and Lithology of Gondwana Supergroup 4.2 Stratigraphic Distribution, and Lithology of Triassic of Spiti 4.3 Stratigraphic Distribution, and Lithology of Jurassic of Kuchha 4.4 Stratigraphic Distribution, and Lithology of Cretaceous of Tiruchirappali 4.5 Stratigraphic Distribution, and Lithology of Bagh Group and Lameta Group	1) Study the stratigraphy and lithology of cretaceous rocks of Tirruchirapalli. 3) Study of Gondwana Formations

SW-4 Suggested Sessional Work (SW):

A. Assignments:

I. Gondwana Supergroup
II. Vindhyan Supergroup

B . Mini Project:

Power point presentation on Jurassic rock formations in India

C . Other Activities (Specify)

Model study of Gondwana Group.

2GO401.5 Discuss Deccan Traps, Cenozoic Rocks of Assam and the Siwalik Group.

Approximate Hours

Item	Approx. Hrs
Cl	9
LI	4
SW	2
SL	1
Total	16

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**

SO5.1 Describe the Cenozoic rocks of Siwalik Group **SO5.2** Explain stratigraphy and distribution of Deccan Traps. **SO5.3** Analyse the stratigraphy and economic importance of tertiary rocks of Assam. **SO5.4** Evaluate the major stratigraphic boundary problems in precambrian - cambrian boundary. **SO5.5** Evaluate the Cretaceous Tertiary Boundary.	5.1 Distribution of important stratigraphic units in the outline map of India.	**UNIT 5:** Deccan Traps, Cenozoic Rocks of Assam and Siwalik Group 5.1 Stratigraphy, geographic distribution and age of the Deccan Traps. 5.2 Stratigraphy, lithology, Fossil content and economic importance of Tertiary of Assam. 5.3 Stratigraphy, lithology, Fossil content and economic importance of Siwalik Group. 5.4 Major stratigraphy boundary problems in Precambrian - Cambrian Boundary 5.5 Cretaceous - Tertiary (K- Pg) Boundary	**A.** Cenozoic rocks of Assam **B.** Study of Cretaceous tertiary boundary

SW-5 Suggested Sessional Work (SW):

a. Assignments:

I. Stratigraphy of tertiary rocks of Assam.

II. Stratigraphy and distribution of Deccan Traps.

b. Mini Project:

Power point presentation on Tertiary Rocks of Assam.

c. Other Activities(Specify):

Class presentation / seminar on Siwalik Group.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
2GO401.1: Describe the Sedimentary Rocks.	9	4	2	1	16

2GO401.2: Demonstrate theSedimentary Texture - Structure and Fossils. **2GO401.3:** Analyse the concept of Stratigraphy.	9	4	2	1	16
2GO401.4: Explain the Phanerozoic Stratigraphy of India.	9	4	4	2	19
2GO401.5 Discuss Deccan Traps, Cenozoic Rocks of Assam and the Siwalik Group.	9	2	2	1	14
Total Hours	45	20	12	7	81

Suggestion for End Semester Assessment

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Sedimentary Rocks.	03	01	01	05
CO-2	theSedimentary Texture - Structure and Fossils.	02	06	02	10
CO-3	the concept of Stratigraphy	03	07	05	15
CO-4	the Phanerozoic Stratigraphy of India.	-	10	05	15
CO-5	Deccan Traps, Cenozoic Rocks of Assam and the Siwalik Group.	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U:Understand, A:Apply

The end of semester assessment for Igneous and Metamorphic Petrology will be held with written examination of 50 marks.

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to geological sites
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Whatsapp,

Mobile,Onlinesources)

9. Brainstorming

Suggested Learning Resources:

(a) **Books**:

S. No.	Title	Author	Publisher	Edition&Year
1	Sedimentary Rocks	Pettijohn, Francis , J.	CBS, India	2 nd Edition. 2018
2	The Principle of Petrology	Tyrrell, G. W.	B I Publication, India	
3	Introduction to Sedimentology	Sengupta, S.	CBS Publication, India	2 nd Edition. 2018
4	Fundamentals of Historical Geology and Stratigraphy of India	Ravindra Kumar	New Age Int. Pvt ltd.India	2020
5	Geology of India	Vidyanathan, R. and Ramakrishnan, M.	Geological Society of India Publication	2 nd Edition 2010

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

COs, Pos and PSOs Mapping

Course Code: ***2GO401***

Course Title: Sedimentary Rocks and Stratigraphy of India

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Knowledge.	Research aptitude.	Communication.	Problem solving.	Individual and team work.	Investigation of Problem.	Modern tool usage	Science and Society.	Life-long learning	Ethics	Project management and finance:	Environment and sustainability.	The detailed functional knowledge of Theoretical concepts and experimental concepts of geology.	Ability Word skills and advanced GIS, statistics, databases, spreadsheets, digital drawing through online workbooks and workshops	Develop a research design, which has an appropriate problem related to earth sciences but may incorporate some scientific methods,	Provide an excellent preparation for a career in professional practice in industrial or environmental Earth Sciences, research in Geosciences and
CO.1 Describe the Sedimentary Rocks	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**

CO.2 Demonstrate theSedimentary Texture - Structure and Fossils.	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
CO.3 Analyse the concept of Stratigraphy	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO.4 Explain the Phanerozoic Stratigraphy of India.	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO.5 Discuss Deccan Traps, Cenozoic Rocks of Assam and the Siwalik Group.	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend:1–Low,2–Medium,3–Hig

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,67,8,9,10 ,11,12 PSO1,2,3,4	**CO.1** Describe the Sedimentary Rocks	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1 1.2	Unit-1.0 1.1,1.2,1.3,1.4,1.5,1.6 ,1.7,1.8,1.9 Tutorial 1.1, 1.2, 1.3	As mention in page number 2 to 6
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO.2** Demonstrate theSedimentary Texture - Structure and Fossils. .	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1 2.2	Unit-2 2.1,2.2,2.3,2.4,2.5,2.6 ,2.7,2.8,2.9 Tutorial 2.1, 2.2, 2.3	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO.3**Analyse the concept of Stratigraphy	SO3 .1 SO3 .2 SO3.3 SO3.4 SO3.5	3.1 3.2	Unit-3 : 3.1,3.2,3.3,3.4,3.5,3.6 ,3.7,3.8,3.9 Tutorial 3.1, 3.2, 3.3	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO.4**Explain the Phanerozoic Stratigraphy of India.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1 4.2	Unit-4: 4.1,4.2,4.3,4.4,4.5,4.6 ,4.7,4.8,4.9 Tutorial 4.1, 4.2, 4.3	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO.5**Discuss Deccan Traps, Cenozoic Rocks of Assam and the Siwalik Group.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1 5.2	Unit5: 5.1,5.2,5.3,5.4,5.5,5. 6,5.7,5.8,5.9 5.1, 5.2, 5.3	

Curriculum Team:

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B.Sc. (Vth semester)

Course Code: **0SE501**

Course Title: **Development of Entrepreneurship**

Pre-requisite: Student should have basic knowledge of Entrepreneurship and also delineate the evolution and development of the concept of the term entrepreneur.

Rationale: Its all about the Start-up and New enterprise!'
The students studying Entrepreneurship development under the Computer science engineering should possess to develop the knowledge and skills to manage the enterprise affairs of individuals, communities, and businesses based on IT .
Students will develop the knowledge and skills necessary to establish and maintain Enterprise, based on internet and technology, Manage financial affairs, Act with integrity and Contribute to the wider community.
Entrepreneurship development gives students the tools to make real life business decisions in a constantly changing and uncertain world
And enhances business literacy.

Course Outcomes:

CO-0SE501.1: Acquire the knowledge of Entrepreneurship and different theories of Entrepreneurship, challenges and process of Entrepreneurship.

CO-0SE501.2: Acquire the basic concept of Entrepreneurial mind set and creativity within no vativeide as related to technology.

CO-0SE501.3: Exposed to various methods of Opportunity analysis which includes opportunity sighting, opportunity evaluation process and different business models.

CO-0SE501.4: Familiarize and understand Various techniques of pitching, various sources of funds, Types of invest or sand understanding of the three financial statements: Profit and loss account, Balance sheet, and cash flow statement.

CO-0SE501.5: Acquire the concept of Collaboration its types, Networking and it's types and Intellectual property rights

Scheme of Studies:

Board of Study	Course Code	CourseTitle	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	

SEC	0SE501	Entrepreneurship development	4	0	2	1	6	4

Legend: **CI:** Class room Instruction (Includes different in structional strategies i.e. Lecture (L)and Tutorial(T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Seasonal Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning

Scheme of Assessment:

Theory

Boardof Study	Couse Code	CourseTitle	**Scheme of Assessment(Marks)**							
			Progressive Assessment(PRA)						**EndSemesterAsses (ESA)**	**Total (PR**
			Class/HomeAssignment5number	ClassTest2 (2bestout of3)	Seminarone	Class Activityany one	ClassAttendance	TotalMarks		
SEC	0SE501	Entrepreneurship develop	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and sessionlevels,whichstudentsareanticipatedtoaccomplishthroughvariousmodesofinstruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and SelfLearning(SL).Asthecourseprogresses,studentsshouldshowcasetheirmasteryofSession Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion

Topic Covered:

Unit1: Introduction of Entrepreneurship

Theories of Entrepreneurship: Theory of Achievement Motivation, Theory of Entrepreneur as a risk taker, Theory of Creative destruction; Entrepreneurship Categories: by chance, need, choice, force; Myths, challenges and process of Entrepreneurship, Definition of Startups and types of Internet based startups.

Unit2:Creativity and innovating

Difference between Scientist, Entrepreneur, and Manager; Characteristics of Entrepreneur; Entrepreneurial Mindset and its enablers, difference between idea and opportunity, Link between creativity and innovation, character of creative climate with cases of world most creative companies, types of innovation, link between technology and innovation.

Unit3: Opportunity Analysis

Opportunity sighting: Market Driven, People Driven; Opportunity Evaluation Process, Approaches to ideation, Ideation techniques, Idea to Opportunity Mapping. Business Model – Functions and Factors of Business Model

Unit 4: Sources of funds and Types of Financial statements

IntroductiontoPitching,typesofpitch,Aspectsoffunds,typesofcapital,conceptofbreak-even, sources of funds, types and nature of investors, understanding of the three financial statements: profitandlossaccount,balancesheet,cashflowstatement,IntroductiontoBusinessPlanitstypes and different sections.

Unit 5: Collaboration

Why Collaborate, types and approaches of collaboration; Networking: Why Network: places of networking, stages of networking, good networking practices; Distinction between data, information, intelligence and knowledge, Components of Knowledge; Intellectual Property: Its life cycle, its types and IPRights

CO.1: Acquire the knowledge of Entrepreneurship and different theories of Entrepreneurship, challenges and process of Entrepreneurship.

Approximate Hours

Item	
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	(LI)	Class room Instruction (CI)	(SL)
SO1.1 UnderstandtheConcept and nature of Entrepreneurship **SO1.2** Understand Various Entrepreneurship theories **SO1.3** UnderstandChallenges and Process of Entrepreneurship **SO1.4** UnderstandStart-upand internet based start-up **SO1.5** UnderstandMythsrelated to entrepreneurship and those Forces which affects it		**Unit-1IntroductionofEntrepreneurship** Concept of Entrepreneurship Evolution of Entrepreneurship theories Theory of Achievement motivation Theory of Entrepreneur as a risk taker Theory of Creative Destruction Entrepreneurship categories: by Chance, Need, Choice, Force, and Myths Challenges and Process of Entrepreneurship Startup and its types Internet based start-up Entrepreneur as a risk taker Entrepreneur application	1. Identifyfeatures and functions of Entrepreneurship 2. Comperative studybetweenold and new start-up

SW-1SuggestedSessionalWork (SW):

a. Assignments: Different between entrepreneur and entrepreneur

b. Mini Project : Identification of function performed by an entrepreneur

c. OtherActivities(Specify): Distinguishwithexamplesbetweenanentrepreneurandmanager

CO.2: Acquire the basic concept of Entrepreneurial mindset and creativity with innovative ideas related to technology.

Approximate Hours

Item	Appx Hours
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	(LI)	Class room Instruction (CI)	(SL)
SO2.1 ConceptMeaning & terminology of creativity **SO2.2**Understanding About the character of creative climate **O2.3**Preparation of Entrepreneurial mindset and its enablers **SO2.4**Understanding the Difference Between scientist, Entrepreneur and manager	.	**Unit2Creativityandinnovatin** Concept of creativity and innovation Difference between Scientist, Entrepreneur, and Manager Characteristics of Entrepreneur Entrepreneurial Mind set and its enablers, difference between idea and opportunity, Link between creativity and innovation, character of creative climate with cases of world most creative companies, types of innovation, link between technology and innovation.	1. Terminology Of Entrepreneurial mindset and it's enablers 2. How creativity and innovation link

SW-2SuggestedSessionalWork (SW):

a. Assignments: Differentiation between creativity and innovation

b. Mini Project: write new innovation in the field of IT sector

c. OtherActivities(Specify): Visitanysuccessfulentrepreneurinnovativeidea

CO.3: Exposed to various methods of Opportunity analysis which includes opportunity sighting, opportunity evaluation process and different business models.

Approximate Hours

Item	Appx Hours
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	(LI)	Class room Instruction (CI)	(SL)

SO3.1 Meaningandconceptof Opportunity sightings (Market and people driven) **SO3.2**Practicalproblemrelated	.	**Unit3:Opportunity Analysis** Opportunity sighting: Market Driven, People Driven;	1.How to get idea and after that how to Utilize opportunity

To Opportunity analysis **SO3.3** Understanding the Opportunity Evaluation process **SO3.4**Understandingabout Ideation and ideation techniques **SO3.5** Preparation of Opportunity mapping and Business models		Opportunity Evaluation Process, Approach estoideation, Ideation techniques, Idea to Opportunity Mapping. Business Model Functions of business models Factors of Business Model	2. Concept of Ideation and it's techniques

SW-3SuggestedSessionalWork (SW):

a. Assignments: JustifytheNeedforandsignificanceofopportunityidentificationandselection

b. Mini Project: Understand by project identification with examples

c. Other Activities (Specify):visittoany Entrepreneur.

CO.4: Familiarize and understand Various techniques of pitching, various sources of funds, Types of investors and understanding of the three financial statements: Profit and loss account, Balance sheet, and cash flow statement.

Approximate Hours

Item	Appx Hours
Cl	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	**(LI)**	**Class room Instruction (CI)**	**(SL)**
SO4.1 Understanding about The concept and types of pitching		**Unit4: Sources of funds and types of Financial statements**	1.System of Pitching and it's techniques
SO4.2 Preparation of Financial statements		Introduction to Pitching, types of pitch, Aspects of funds, types of capital,	

SO4.3 Understanding about the Types of capital and break even analysis **SO4.4**Understanding about The Source of funds and Types of investors **SO4.5**Preparationof Business plan its types and different sections		concept of break-even, sources of funds, Types and nature of investors, 4.6Understandingofthethreefinancialstatements: Profit and loss account, 4.7Balancesheet,cashflowstatement, 4.8Introduction toBusinessPlan 4.9Typesanddifferentsectionsofbusiness plan.	2.Interintoabank and ask about the process how to get funds

SW-4SuggestedSessionalWork (SW):

a. **Assignments:** Write different ounces of funds near you.

b. **Mini Project:** Collect the list of those sources which are easily available and those which are difficult.

c. **Other Activities(Specify):** Bank loan procedure.

CO.5: Acquire the concept of Collaboration its types, Networking and its types and Intellectual property rights.

Approximate Hours

Item	AppxHours
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	(LI)	Class room Instruction (CI)	(SL)
SO5.1 Understand about the concept of collaboration and it's types with approaches **SO5.2** Understand about Networking and its stages		**Unit 5: Collaboration** Introduction of Collaboration, Types and approaches of collaboration; Networking : Why Network:	**1.**Comparision between data Information and

SO5.3 Understand about Intellectual property rights and its types **SO5.4** Understanding the Different between data, Information and intelligence **SO5.5**Understanding how Collaboration effects an organization		Places of networking, stages of networking, Good networking practices; 5.7 Distinction between data, information, intelligence and knowledge, 5.8ComponentsofKnowledge; 5.9 Intellectual Property: Its lifecycle, its types and IP Rights	intelligence **2.** How to collaborate one Organization with another

SW-5SuggestedSessionalWork (SW):

a. Assignments: Collaboration and its importance in an organization

b. Mini Project: Prepare are port on the business or companies Collaboration

c. Other Activities(Specify): Power Point Presentation of Networking.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Totalhour (Cl+SW+Sl)
CO.1: Acquire the knowledge of Entrepreneurship and different theories of Entrepreneurship, challenges and process of Entrepreneurship	12	2	1	15
CO.2: Acquire the basic concept of Entrepreneurial mindset and creativity with innovative ideas related to technology.	12	2	1	15
CO.3: Exposed to various methods of Opportunity analysis which includes opportunity sighting, opportunity evaluation process and different business models.	12	2	1	15

CO.4: Familiarize and understand Various techniques of pitching, various sources of funds, Types of investors and understanding of the three financial statements: Profit and loss account, Balance sheet, and cash flow statement.	12	2	1	15
CO.5: AcquiretheconceptofCollaborationit'stypes, Networking and it's types and Intellectual property rights.	12	2	1	15
Total Hours	60	10	05	75

Suggestion for End Semester Assessment

Suggested Specification Table(For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Acquire the knowledge of Entrepreneurship and Different theories of Entrepreneurship, challenges and process of Entrepreneurship	01	01	03	05
CO-2	Acquire the basic concept of Entrepreneurial mind set and creativity within novativeide as related to technology.	01	01	03	05
CO-3	Exposed to various methods of Opportunity analysis which includes opportunity sighting, opportunity evaluation process and different business models.	-	03	10	13
CO-4	Familiarize and understand Various techniques of pitching, various sources of funds, Types of investors and understanding of the three financial statements: Profit and loss account, Balance sheet, and cash flow statement.	-	03	10	13
CO-5	Acquire the concept of Collaboration its types, Networking and its types and Intellectual property rights.	01	03	10	14
Total		03	12	36	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Financial Accounting will be held with written examination of 50 marks

Note .Detailed Assess men rubric need to be prepared by the course wise teachers for above tasks. Teacherscanalsodesigndifferenttasksasperrequirement,forendsemester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Brainstorming

Suggested Learning Resources:

(a)Books:

S. No.	Title	Author	Publisher	Edition& Year
1	Entrepreneurship development	Dr.S.S.khanka	*S. Chand*	
2	Entrepreneurshipof smallscalerindustries	Deshpande,M.U.	DeepandDeep	
3	Entrepreneurship theoryandpractice	RajShankar		
4	Lecturenoteprovidedby Dept.ofCommerceAKSUniversity,Satna.			

Cos, POs and PSOs Mapping

Course Code : 0SE501
Course Title: Entrepreneurship development

CourseOutcomes	ProgramOutcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PSO1	PSO2	
	Engineeringknowledge	Solvingtheproblems	Design/development ofsolutions	Conduct studiesof differentproblems	Utilisation ofmoderntools	Engineeringandsociety	Environmentandsustainability	Decisionmaking	Individualandteamwork	Projectmanagementandfinance	Paraphrasethefield ofECommerceand digitalplatforms	Articuareaocorposectoropera	
CO.1: Acquire the knowledge ofEntrepreneurship and differenttheories of Entrepreneurship,challenges and process ofEntrepreneurship	2	2	1	1	1	1	2	1	1	**1**	**2**		
CO.2: Acquire the basicconcept of Entrepreneurialmindset and creativity withinnovative ideas	2	2	**1**	**1**	**1**	**1**	2	1	**1**	**1**	**2**		

related totechnology.													
CO.3:Exposed to variousmethods of Opportunity analysiswhich includes opportunitysighting, opportunity evaluationprocess and different businessmodels.	2	2	**1**	**2**	**1**	**1**	2	1	**2**	**1**	**2**		
CO.4:Familiarize an dunderstand Varioustechniquesof pitching, various sources offunds, Types of investors andunderstanding of the threefinancial statements: Profit andlossaccount,Bala ncesheet,and cashflow statement.	2	2	**1**	**2**	**1**	**1**	2	1	**1**	**1**	**2**		

CO.5: Acquire the concept ofCollaboration it's types,Net workingandit'stypes and Intellectualpropertyrights.	2	2	**1**	**1**	**1**	**1**	2	1	**1**	**1**	**1**	

Legend: 1 – Slight (Low), 2 – Medium, 3–High

POs&PSOsNo.	COsNo.&Titles	SOs No.	(LI)	Classroom
PO1,2,3,4,5,6 7,8,9,10, PSO1,2,3,4,5	CO-1: Acquire the knowledge of Entrepreneurship and different theories of Entrepreneurship,challengesandprocessof Entrepreneurship	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit1.Intr Entreprene 1.1,1.2,1.3, 1.4
PO1,2,3,4,5,6 7,8,9,10, PSO1,2,3,4,5	CO 2 : Acquire the basic concept of Entrepreneurial mindsetandcreativitywithinnovativeideasrelated to technology.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2 Cre innovation 2.1, 2.2, 2.3 2.8,2.4
PO1,2,3,4,5,6 7,8,9,10, PSO1,2,3,4,5	**CO.3:**Exposed to various methods of Opportunity analysis which includes opportunity sighting, opportunityevaluationprocessanddifferentbusiness models.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3:Opp 3.1,3.2,3.3,3 3.4
PO1,2,3,4,5,6 7,8,9,10, PSO1,2,3,4,5	**CO.4:**FamiliarizeandunderstandVarioustechniques of pitching, various sources of funds, Types of investors and understanding of the three financial statements: Profit and loss account, Balance sheet, and cash flow statement.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4:sou Type stat 4.1,4.2,4.3,4 4.4
PO1,2,3,4,5,6 7,8,9,10, PSO1,2,3,4,5	**CO.5:**AcquiretheconceptofCollaborationit'stypes, Networking and it's types and Intellectual property rights.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit5:Coll 5.1,5.2,5.3,5 5.4

Curriculum Development Team:

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AKS University
Faculty of Basic Science
Curriculum of B. Sc. (Honours / By Research) Program
(Revised as on 01 August 2023)

Course Code: 1CS501

Course Title : Operating system (Theory)

Pre-requisite: Student should have basic knowledge of Operating system such as windows linux and their features .Student should aware of the component of a computer such as Input devices Output devices and central processing unit.

Rationale: Students who engage with these topics can expect to emerge with a comprehensive understanding of operating systems, including their historical evolution, key functions, and various types. They will develop effective process management skills, capable of evaluating scheduling algorithms and addressing deadlock situations. Proficiency in memory management, encompassing concepts like address binding, swapping, and fragmentation, will be achieved. Additionally, students will gain practical skills in Linux, covering architecture, file systems, and command-line usage, facilitating a comparative analysis with Windows. The unit on basic commands equips students with practical command-line skills and an introduction to shell programming, fostering a holistic grasp of operating system concepts and practical competencies essential for roles in computer science and information technology.

Course Outcomes:

CO-1CS501.1: Describe the importance of computer system resources and the role of operating system in their management policies and algorithms
CO-1CS501.2: Understand various process management concepts and can compare various scheduling techniques, synchronization, and deadlocks.
CO-1CS501.3: Identify the best suited memory management technique for any process and Describe various file operations, file allocation methods and disk space management.
CO-1CS501.4: Students will gain practical skills in system management and an appreciation for the importance of the Linux kernel and open-source principles.
CO-1CS501.5: Learn to operate the Linux system, along with its administration and Shell programming.

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours(CI+LI+SW+SL)	
	1CS501	Operating System	4	4	1	1	10	6

Legend: **CI:** Class room Instruction(Includes different instructional strategies i.e. Lecture(L) and Tutorial (T) and others).
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work(includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks (PRA+ ESA)**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
DCC	1CS501	Operating system	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1: Describe the importance of computer system resources and the role of operating system in their management policies and algorithms.

Approximate Hours

Item	Appx Hrs.
Cl	12

LI	6
SW	1
SL	1
Total	20

Session Outcomes (SOs)	**(LI)**	**Class room Instruction (CI)**	**(SL)**
SO1.1 Understanding Operating System Fundamentals. **SO1.**2 Proficiency in Basic OS Functions: **SO1.**3Categorizing Types of Operating Systems: **SO1.4** Application of Operating Systems in Diverse Platforms: **SO1.5**. Analysis of Process Control and Real-time Systems:	LI1.1 Familiarize students with the Linux environment LI1.2. Understand the file system structure and the role of the Linux kernel LI1.3. Gain hands-on experience with Linux installation and system management.	**Unit-1.0 MS Windows** 1.1. History and Evolution of Operating Systems. 1.2. Basic Functions of an Operating System. 1.3. Types of Operating Systems - Overview 1.4. Multiprogramming Systems. 1.5. Batch Processing Systems. 1.6. Time Sharing Systems. 1.7. Operating Systems for Personal Computers 1.8 Operating Systems for Workstations and Hand-held Devices. 1.9. Process Control Systems. 1.10 Real-Time Systems. 1.11 User Interface and Interaction 1.12 Security and Protection Mechanisms.	

CO2: Understand various process management concepts and can compare various scheduling techniques, synchronization, and deadlocks

Approximate Hours

Item	Appx Hours
Cl	12
LI	6
SW	1
SL	1
Total	20

SessionOutcomes (SOs)	**(LI)**	**Class room Instruction (CI)**	**(SL)**

SO2.1 Introduction to Process Management Process Concepts. **SO2.2** Process States & Process Control Block **SO2.3** Process Scheduling **SO2.4** Scheduling Criteria and Algorithms **SO2.5** Priority, Multiple-Processor, Real-Time Scheduling **SO2.6** Multilevel Queue and Multilevel Feedback Queue Scheduling **SO2.7**. Deadlocks and Deadlock Handling Approaches.	LI2.1 Learn essential disk management commands and compare CLI and GUI operating systems. LI2.2. Compare Linux and Windows, and understand the significance of open-source software. **LI2.3.**Fundamental commands for navigating the file system and basic file operations.	**Unit 2. Process Management Concepts** 2.1. Introduction to Process Management. 2.2. Process States and Process Control Block. 2.3. Process Scheduling Overview. 2.4. Scheduling Algorithms - FCFS, SJF 2.5. Scheduling Algorithms - SRTN, RR 2.6. Scheduling Algorithms - Priority, Multiple-Processor 2.7. Real-Time Scheduling 2.8.Multilevel Queue and Multilevel Feedback Queue Scheduling 2.9. Introduction to Deadlocks and characterization 2.10.Necessary and Sufficient Conditions for Deadlock 2.11. Deadlock Handling Approaches - Prevention 2.12. Deadlock Handling Approaches – Avoidance, Detection, and Recovery.	

CO3: Identify the best suited memory management technique for any process.

Approximate Hours

Item	Appx Hours
Cl	12
LI	6
SW	1
SL	1
Total	20

Session Out comes (SOs)	(LI)	Class room Instruction (CI)	(SL)
SO3.1 Memory Management and Address Binding and Logical versus Physical Address Space SO3.2 Swapping and Allocation Strategies SO3.3 Fragmentation and Compaction	**LI 3.**1. Learn commands for comparing and editing file content. **LI3.**2. Understand searching file content and locating files in different	**Unit-3 : Memory Management** 3.1 Students will understand the significance of memory management in operating systems, including its role in optimizing system performance and resource utilization. 3.2. Participants will learn about address binding, exploring concepts such as compile time, load time, and run time binding, and their impact on the execution of programs. 3.3. Students will differentiate between logical	

SO3.4 Paging and Segmentation SO3.5 Virtual Memory and Demand Paging SO3.6 Page Replacement Algorithms and File Management SO3.7 Disk Management	directories. **LI3.**3Implement and utilize general-purpose utilities in Linux(calendar, date, and calculator commands)	and physical address spaces, understanding how memory addresses are managed at the application and hardware levels. 3.4. Participants will delve into the concept of swapping, its role in moving processes between main memory and secondary storage, and its impact on system performance. 3.5. Students will explore contiguous and non-contiguous memory allocation methods, understanding how processes are assigned memory blocks and the implications of each approach. 3.6. Participants will understand the concept of fragmentation, both internal and external, and its effects on memory utilization and system efficiency. 3.7. Students will learn about memory compaction as a technique to alleviate fragmentation, exploring how it helps in optimizing memory usage. 3.8 Participants will be introduced to paging as a non-contiguous memory allocation method, understanding how it enhances flexibility and reduces fragmentation. 3.9. Students will explore memory segmentation, understanding how it allows for logical division of memory space and facilitates the execution of complex programs. Participants will understand the concept of virtual memory, its role in extending available memory, and the benefits it brings to system performance. 3.10. Students will delve into demand paging, understanding how it optimizes the use of physical memory by bringing in only the necessary pages as demanded by the executing program. Participants will analyze the performance implications of demand paging, exploring factors such as page faults, page replacement, and overall system efficiency 3.11. Students will explore various page replacement algorithms, including FIFO, LRU, and Optimal, understanding their advantages, disadvantages, and impact on system performance. 3.12. Participants will understand the fundamental concepts of a file system, including file attributes, operations, and types, and their role in organizing and managing data. Students will explore the functions and types of file systems, including sequential, direct, and other access methods, gaining insights into their applications and advantages.	

CO4: Students will gain practical skills in system management and an appreciation for the importance of the Linux kernel and open-source principles

Approximate Hours

Item	Appx Hours
Cl	12
LI	6
SW	1
SL	1
Total	20

Session Out comes (SOs)	(LI)	Class room Instruction (CI)	(SL)
SO4.1 Introduction to Linux **SO4.2** History and Features of Linux **SO4.3** Advantages of Linux **SO4.4** Hardware Requirements for Installation **SO4.5** Linux Architecture and File System **SO4.6** Linux Standard Directories and Kernel **SO4.7** Installing Linux and System Processes	**LI4.**1. Explore various text editors and understand different modes.(vi, joc, vim, gedit, atom, nano) **LI4.**3.Learn how to access help and documentation(help, and man commands) **LI54**3. Gain proficiency in managing multiple processes(kill and ps commands)	**Unit-4 : Linux Introduction** 4.1. Provide an overview of Linux, its significance in the computing world, and its open-source nature. 4.2 Explore the history of Linux, from its inception to its evolution, highlighting key features that distinguish it from other operating systems. 4.3. Discuss the advantages of using Linux, such as stability, security, cost-effectiveness, and flexibility. 4.4. Outline the hardware specifications necessary for a successful Linux installation, covering aspects like CPU, RAM, and storage. 4.5.Dive into the architecture of Linux, explaining the kernel-space and user-space components and their interactions. 4.6. Explore the standard directory structure in Linux, explaining the purpose of each directory and its contents.	

		4.7. Break down the Linux file system, elucidating key elements like boot block, super block, inode table, and data blocks. 4.8. Provide an in-depth understanding of the Linux kernel, its role in the operating system, and how it interacts with hardware. 4.9. Demonstrate the process of partitioning a hard drive to prepare it for Linux installation, emphasizing best practices. 4.10. Walk through the steps of installing Linux, covering the installation options, partitioning, and post-installation configurations. Explain the sequence of events during the startup and shut-down processes in a Linux system. 4.11 Introduce the concepts of init and run levels in Linux, elucidating their roles in managing system processes. Discuss processes in Linux, the purpose of swap partitions, and how to use the fdisk tool for disk partitioning. 4.12. Teach students how to monitor disk usage and check free space on Linux systems using commands like df and du. Difference between CLI OS & GUI OS, Windows vs. Linux, Importance of Linux Kernel, Files and Directories, Concept of Open Source Software.	

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CO5: Learn to operate the Linux system, along with its administration and Shell programming

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Item	Appx Hours
Cl	12
LI	6
SW	1
SL	1
Total	20

Session Out comes (SOs)	(LI)	Class room Instruction (CI)	(SL)

SO5.1 Basic Commands for File and Directory Operations **SO5.2** Text Editing and File Manipulation **SO5.3** File Search and Retrieval **SO5.4** General Purpose Utilities commands **SO5.5** Text Editors and Modes **SO5.6** Help and Process Management **SO5.7** User and Group Management, Shell Programming Basics	**LI5.**1. Learn to manage user accounts and groups.(Explore group management commands: chgrp, chown, groupadd, groupdel.) **LI5.**2Understand the basics of shell programming(Practice debugging scripts using echo, read, and operators) **LI5.**3. Dive into advanced shell programming concepts.(Practice advanced commands like head, tail, grep, sort, piping, yank, kill, chgrp, chown, groupadd)	**Unit 5:** 5.1. Displaying Current Directory. Listing Files and Directories 5.2. Creating, Removing, Renaming, Copying, and Moving Files or Directories 5.3. Comparing and Editing File Content. 5.4. Displaying File Content: tr, head, tail, last, grep, sort, Piping, Searching File Content 5.5. General Purpose Utilities: Calendar, Date, Calculator, Basic Arithmetic Expressions. 5.6Compression and Extraction of File/Directory 5.7 Text Editors: vi, joc, vim, gedit, atom, nano etc 5.8Help Commands: what is, --help, man command, Managing Multiple Processes: Pipes, tee, Redirecting Input/Output 5.9. Changing Process Priority with nice, Cron Commands, kill, ps 5.10 Managing User Accounts: Sudo, useradd, usermod, userdel, passwd 5.11 Group Management: Primary & Secondary Group, chgrp, chown, groupadd, groupdel 5.12Shell Programming: Types of Shells, Shell Meta Characters, Shell Scripts	

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Class Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)

CO1: Describe the importance of computer system resources and the role of operating system in their management policies and algorithms.	12	6	1	1	17
CO2: Understand various process management concepts and can compare various scheduling techniques, synchronization, and deadlocks	12	6	1	1	17
CO3: Identify the best suited memory management technique for any process.	12	6	1	1	17
CO4: Students will gain practical skills in system management and an appreciation for the importance of the Linux kernel and open-source principles	12	6	1	1	17
CO5:Learn to operate the Linux system, along with its administration and Shell programming	12	6	1	1	17
Total Hours	60	30	05	05	100

Suggestion for End Semester Assessment

Suggested Specification Table(For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	**Introduction to Operating System**	01	01	03	05
CO-2	**Process Management**	01	01	03	05
CO-3	**Memory Management**	2	03	08	13
CO-4	**LINUX Introduction**	8	03	2	13
CO-5	**Basic Commands**	01	03	10	14
Total		03	12	36	50

Legend: R:Remember, U:Understand, A:Apply
The end of semester assessment for Financial Accounting will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion

5. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition&Year
1	Operating Systems Concepts	A Silberschatz, P.B. Galvin, G. Gagne	John Wiley Publications.	
2	Modern Operating Systems	A.S. Tanenbaum	Pearson Education	
3	Linux	Sumitabh Das	TMH	
4	Operating Systems: A Modern Perspective	G. Nutt	Pearson Education	

Cos, POs and PSOs Mapping

Course code: 1CS501
Course Title: Operating system (Theory)

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO 5	PO 6	P O7	PO 8	PO 9	PO1 0	PO1 1	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
	Kno w ledg e	Rese arch Apti tude	Com muni c ation	Prob l em Solvi n g	Ind ivi dua l and Tea m Wo rk	Inve stig a tion of Pro b lem s	Mo der n To ol usa ge	Scie nce and Soci et y	Life - Lon g Lea rni ng	Ethi cs	Proje ct Man age ment	Envi ron ment and susta ina bilit y	The detail ed functi onal know ledge of theor etical conce pts and exper iment al aspec ts of chemi	To integr ate the gaine d knowl edge with vario us conte mpor ary and evolvi ng areas in	understa nd, analyze, plan and impleme nt qualitati ve as well as quantita tive analytica l synthetic and phenome non -based proble	Provide opportu nitie s to excel in academi cs, research or Industr y by research based innovati ve knowled ge for sustaina ble develop

													stry	**chemical sciences like analytical, synthetic, pharmaceutical etc.**	**ms in chemical sciences.**	**ment in chemical science**
CO1: Describe the importance of computer system resources and the role of operating system in their management policies and algorithms. .	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**
CO2: Understand various process management concepts and can compare various scheduling techniques, synchronization, and deadlocks	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**

CO3: Identify the best suited memory management technique for any process.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO4: Students will gain practical skills in system management and an appreciation for the importance of the Linux kernel and open-source principles	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO5:Learn to operate the Linux system, along with its administration and Shell programming	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

]Legend: 1 – Slight (Low), 2 – Medium, 3–High

AKS University
Faculty of Basic Science
Curriculum of B. Sc. (Honours / By Research) Program
(Revised as on 01 August 2023)

Course Curriculum Map

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO:1,2,3,4,5,6,7,8,9,10,11,12 PSO:1,2,3,4,5	**CO1:** Describe the importance of computer system resources and the role of operating system in their management policies and algorithms	**SO1.1 SO1.2 SO1.3 SO1.4 SO1.5**	**1.1 1.2**	Unit 1 1.1,1.2,1.3,1.4,1.5,1.6,1.7, 1.8,1.9,1.10, 1.11, 1.12	**As mentioned in page number 2 to 10**
PO:1,2,3,4,5,6,7,8,9,10,11,12 PSO:1,2,3,4,5	**CO2:** Understand various process management concepts and can compare various scheduling techniques, synchronization, and deadlocks	**SO2.1 SO2.2 SO2.3 SO2.4 SO2.5**	**2.1 2.2**	Unit 2 2.1,2.2,2.3,2.4,2.5,2.6, 2.7,	
PO:1,2,3,4,5,6,7,8,9,10,11,12 PSO:1,2,3,4,5	**CO3:** Identify the best suited memory management technique for any process.	**SO3.1 SO3.2 SO3.3 SO3.4 SO3.5**	**3.1 3.2**	Unit 3 3.1, 3.2,3.3,3.4,3.5,3.6,3.7. 3.8,3.9,3.11	
PO:1,2,3,4,5,6,7,8,9,10,11,12 PSO:1,2,3,4,5	**CO4:** Students will gain practical skills in system management and an appreciation for the importance of the Linux	**SO4.1 SO4.2 SO4.3 SO4.4 SO4.5**	**4.1 4.2**	Unit 4 4.1, 4.2,4.3,4.4,4.5,4.6,4.7.4.8.4.9,4.10,4.11	

	kernel and open-source principles				
PO:1,2,3,4,5,6,7,8,9 ,10,11,12 PSO:1,2,3,4,5	**CO5**: Learn to operate the Linux system, along with its administration and Shell programming	**SO5.1 SO5.2 SO5.3 SO5.4 SO5.5**	**5.1 5.2**	Unit 5.1, 5.2,5.3,5.4,5.5,5.6,5.7.5. 8.5.9,5.10,5.11	

Curriculum Development Team:

1. Dr. Akhilesh Wahoo, HoD, Department of Computer Science, AKS University, Satna (M.P.).
2. Mr. Brijesh Soni, Assistant Professor, Department of Computer Science, AKS University, Satna (M.P.).
3. Mr. Rahul Majhi, Assistant Professor, Department of Computer Science, AKS University, Satna (M.P.).
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Course Code: 2CS501

Course Title : PHP & MYSQL

Pre-requisite: Student should have basic knowledge of hypertext and basic computer.

Rationale: Study of this subject will develop different skills in students to create and manage the websites. Concepts like Html, CSS and JavaScript will helpful to develop front end design of website. And knowledge of PHP will help students to develop back-end design.

Course Outcomes:

On successful completion of this course, the students will be able to:

l. Have knowledge of HTML, its essential tags, Attributes, Text styles, Links to External Documents and different sections of a HTML page.
2. Develop skills to generate HTML and CSS page and have knowledge of Java Script assisted style sheets.
3. Have knowledge of PHP, PHP Syntax, Comments, Variables and Constants, Embedding PHP in HTML pre-defined and used defined.
4. Develop skills to generate Static and dynamic application designing, Google form designing.

Scheme of Studies:

Legend: **CI:**Class room Instruction(Includes different instructional strategies i.e. Lecture(L) and Tutorial (T) and others),
LI: Laboratory Instruction(Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credit

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA+ ESA)
			Assignment 5 number 3 marks each	(2 best out of 3) 10 marks each	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		

PE	PE006	Web Engineering	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1: Have knowledge of HTML, its essential tags, Attributes, Text styles, Links to External Documents and different sections of a HTML page.

Approximate Hours

Item	AppX Hrs
Cl	08
LI	6
SW	2
SL	1
Total	17

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 Understand and basics of HTML **SO1.2**Understanding various tags used with HTML **SO1.3**Understanding types of List in Html. **SO1.4**Understanding	1 Design web pages for your college containing a description of the courses, departments,faculties, library, etc, use href, list tags. 2 Create your class timetable using the table tag. 3 Create user Student feedback form (use textbox, text area, checkbox, radio button, select box, etc.)	**Unit-1.0 Topics Basics of Internet and Web** **1.1** ntroduction to HTML **1.2** ssential Tags **1.3** ags and Attributes **1.4** ext Styles and Text An-arguments, Text, Effects Events **1.4** coupling tools, Form elements **1.5 Table layout and presentation** **1.6** Use of different input types . **1.7 List types** **1.8various tags: Canvas, DIV and SPAN** **1.9** **Introduction to basic client-side technologies**	1. Learning various concepts related with internet.

different input types **SO1.**5 Understand client server architecture . .			

SW-1 Suggested Sessional Work(SW):

a. **Assignments:**

i. Explain basic terminologies used with HTML.

ii. Explain various types of tags.

b. **Mini Project:**

CO2: Develop skills to generate HTML and CSS page and have knowledge of Java Script assisted style sheets (JSSS).

Approximate Hours

Item	AppX Hrs
Cl	7
LI	0
SW	2
SL	1
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 To Understand the concept of web server. **SO2.2** To learn about Cascading Style Sheet. **SO2.3** To implement VB Script and Java Script. **SO2.4** To understand Document Object Model. **SO2.**5 To learn about JRE (JavaScript Runtime Environment).	4 Create a web page using the frame. Divide the page into two parts with 5 Create your resume using HTML tags also experiment with colors, text, links, size, and also other tags you studied. 6 Create a web page by making use of the following tags: Head, Body, Bgcolor. 7 Write a HTML program to implement different types of CSS.	Unit-2 **Web Client and Web Sever** 2.1 Cascading Style Sheet-Introduction 2.2 types of CSS and its static and dynamic applications 2.3 . JavaScript- Basics of JavaScript technology 2.4 Control statements. 2.5 Document Object Model. 2.6 Events, functions, Array . 2.7 JRE (JavaScript Runtime Environment) and its applications. 2.8Embedding JavaScript in HTML and CSS run time data communications	i. Try to Implement VB Script and Java Script

SW-2 Suggested Sessional Work(SW):

a. Assignments:

i. Explain client-side scripting VBScript and JavaScript.

ii. Explain web database connectivity using DBC and ODBC.

b. **Mini Project:**

Create an user interface.

CO3 : Have knowledge of PHP, PHP Syntax, Comments, Variables and Constants, Embedding PHP in HTML pre-defined and used defined.

Approximate Hours

Item	AppX Hrs
Cl	10
LI	6
SW	2
SL	1
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 Learning server-side scripting language PHP. **SO3.2**Will learn PHP Syntax, Comments Tags and Attributes . **SO3.3** Learn CSS and JavaScript run time data communications . **SO3.4**Creating forms using HTML. **SO3.**5 Implement front end to back end any data base communication .	Acquaintance with elements, tags and basic structure of HTML files. 2.Practicing basic and advanced text for formatting. 3. Practice use of image, video and sound in HTML documents. 4. Designing of web pages- Document layout, list, tables. 5. Practicing Hyperlink of web pages, working with frames. 6. Working with forms and controls. 7. Working with background, text, font, list properties	**Unit-3 :PHP** 3.1 Introduction to server-side scripting language PHP. 3.2 ata types in PHP 3.3 HP Syntax, Comments Tags and Attributes 3.4 ariables and Constants 3.5 mbedding PHP in HTML 3.6 SS and JavaScript run time data communications 3.7 re-defined and used defined Functions 3.8 trings functions and Array 3.9 RUD 3.10 ront end to back end any data base communication	1. Learning various attributes of HTML tags. 2. Learning online HTML editors.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Explain basic PHP tags and their properties.
ii. Create an HTML page that contains a CSS.

b. Mini Project:

iii. Create an admission form using HTML tags& CSS.

c. Other Activities (Specify):

Use of latest editors for web development like. VSCode, Notepad++ etc.

CO4: Have knowledge of basic PHP.

Approximate Hours

Item	9
Cl	6
LI	2
SW	2
SL	2
Total	21

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO4.1 Understanding functions of PHP . **SO4.2**Learn variable scope **SO4.3**Learn string handling operations. **SO4.4**Learn Accessing Data from regular expressions. **SO4.**Understand working	11 Create a web form using php for login page. 12 Create a simple xml document with following details: Rollno, Sname, Contact, Email & Address. 13 Write a simple PHP script to perform crud operations. 14 Create a web form using php for	**Unit-4:** 4.1 Introduction to PHP 4.2 MVC Architecture and PHP applications 4.3 PHP: - Introduction, PHP Fundamentals 4.4 PHP Syntax, string handling operations. 4.5 J Query Introduction, J Query Syntax 4.6 J query selectors,	i. Learn Accessing Data from regular expressions i. Learn PHP and Javascript

of client side and server side of PHP.	enquiry details.	Events 4.7 working with client side and server side of PHP.	

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Write down the features of PHP.
ii. Explain client side and server side of PHP.

a. **Mini Project:**
i. Design a web page And use PHP.

b. Other Activities(Specify):
Implementing CSS in your previously created web page.

CO5: Develop skills to generate Static and dynamic application designing, Google form designing.

Approximate Hours

Item	AppX Hrs
Cl	8
LI	4
SW	2
SL	2
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)

SO5.1 Learn Static and dynamic application designing. **SO5.2**Implementing session and cookies. **SO5.3**Learn file and directory open, close etc operations. **SO5.4** Implementing template customization and develop dynamic applications **SO5.**5 Learn file handling with PHP.	15 Customize a template using PHP 4. Create a MySQL data base and connect with PHP. 5. Write PHP script for storing and retrieving user information from my SQL table. a. Write a HTML page which takes Name, Address, Email and Mobile number from user (register PHP). b. Store this data in MySQL data base. c. Next page displays all user in HTML table using PHP (display PHP). 5. Write a PHP program to print first ten Fibonacci numbers.	**Unit-5** 4.1 Static and dynamic application designing 4.2 Google form designing. 4.3 customer review panel 4.4 Introduction to super global variables. 4.5 MVC (Model View Temp) with PHP 4.6 template customization and develop dynamic applications	1. Learn PHP as server side scripting. 2. Use PHP to connect any database.

SW-5 Suggested Sessional Work(SW):

a. **Assignments**

i. Write a PHP program to print first ten Fibonacci numbers.

ii. Create HTML page with java script which takes integer number as a input and tells whether the number is divisible by 4 or not.

b. **Mini Project:**

i. Using HTML, CSS, Javascript, PHP, MySQL, design and authentication module of a web page.

c. **Other Activities(Specify):**

Create form validation using PHP.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Laboratory	Self Learning (Sl)	Total hour (Cl+SW+Sl)
CO1: Have knowledge of HTML, its essential tags, Attributes, Text styles, Links to External Documents and different sections of a HTML page.	9	1	6	1	17
CO2: Develop skills to generate HTML and CSS page and have knowledge of Java Script assisted style sheets (JSSS).	9	2	6	1	18
CO3: Have knowledge of PHP, PHP Syntax, Comments, Variables and Constants, Embedding PHP in HTML pre-defined and used defined.	9	2	6	1	18
CO4 : Have knowledge of functions of PHP Fundamentals of PHP,	9	2	6	2	19
CO5 : Develop skills to generate Static and dynamic application designing, Google form designing, file handling of PHP	9	2	6	2	19
Total Hours	45	9	30	7	91

Suggestion for End Semester Assessment

Suggested Specification Table(ForESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Have knowledge of HTML, it's essential tags, Attributes, Text styles, Links to	02	01	01	04

	External Documents and different sections of a HTML page.				
CO-2	Develop skills to generate HTML and CSS page and have knowledge of Java Script assisted style sheets (JSSS).	02	06	02	10
CO-3	Have knowledge of PHP, PHP Syntax, Comments, Variables and Constants, Embedding PHP in HTML pre-defined and used defined.	03	07	05	15
CO-4	Have knowledge of functions of PHP Fundamentals of PHP,	02	10	05	17
CO-5	Develop skills to generate Static and dynamic application designing, Google form designing, file handling of PHP	03	02	02	07
Total		12	26	15	53

Legend: R:Remember, U:Understand, A:Apply

The end of semester assessment for Web Technology will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

6. Improved Lecture
7. Tutorial
8. Case Method
9. Group Discussion
10. Role-play
11. Visit to cement plant
12. Demonstration
13. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,WhatsApp,Mobile,Onlinesources)
14. Brainstorming

Suggested Learning Resources:

(b) **Books**:

S. No.	Title	Author	Publisher	Edition &Year
1	Beginning PHP5, Apache, and MySQL Web Development	Elizabeth Naramore, Jason Gerner, Yann Le Scouarnec, Jeremy Stolz	Glass Wrox Publication	2005

2	Beginning HTML, XHTML, CSS, and JavaScript 2010	Jon Duckett	Wiley Publishing	2010
3	Web Technologies, Black Book, Dream Tech Press 2010	Kogent	Learning Solutions Inc Dream Tech Press	2010
4	HTML, XHTML and CSS Bible	Bryan Pfaffenberger, Steven M. Schafer, Chuck White	**John Wiley & Sons**	2004

CO, PO and PSO Mapping

Course Code: 2CS501

Course Title: PHP & MYSQL

PO NO.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Program Outcomes	**Engineering knowledge**	**Problem Analysis**	**Design/development of solutions**	**Conduct studies of difficult problems**	**Utilization of modern tools**	**Engineers and society**	**Environment and sustainability**	**Ethics**	**Individual and team work**	**Communication**	**Project management and finance**	**Life-long learning**
CO1: Have knowledge of HTML, its essential tags, Attributes, Text styles, Links to External Documents and different sections of a HTML	2	2	3	3	3	1	1	3	1	1	1	3

page.												
CO2: Develop skills to generate HTML and CSS page and have knowledge of Java Script assisted style sheets (JSSS).	1	3	2	3	2	2	2	2	1	1	1	3
CO3 : Have knowledge of PHP, PHP Syntax, Comments, Variables and Constants, Embedding PHP in HTML pre-defined and used defined	2	2	2	3	3	2	1	2	1	1	1	3
CO4: Have knowledge of basic PHP	1	2	3	2	3	2	1	3	1	2	1	3
CO5: Develop skills to generate Static and dynamic application designing, Google form designing.	1	2	2	2	3	2	1	3	1	1	1	3

Course Curriculum Map

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO:1,2,3,4,5,6,7,8,9,10,11,12 **PSO:1,2,3,4,5**	**CO1:** Describe the importance of computer system resources and the role of operating system in their management policies and algorithms	**SO1.1** **SO1.2** **SO1.3** **SO1.4** **SO1.5**	**1.1** **1.2**	Unit 1 1.1,1.2,1.3,1.4,1.5,1.6,1.7, 1.8,1.9,1.10, 1.11, 1.12	**As mentioned in page number 2 to 10**
PO:1,2,3,4,5,6,7,8,9,10,11,12 **PSO:1,2,3,4,5**	**CO2:** Understand various process management concepts and can compare various scheduling techniques, synchronization, and deadlocks	**SO2.1** **SO2.2** **SO2.3** **SO2.4** **SO2.5**	**2.1** **2.2**	Unit 2 2.1,2.2,2.3,2.4,2.5,2.6, 2.7,	

PO:1,2,3,4,5,6,7,8,9 ,10,11,12 PSO:1,2,3,4,5	**CO3:** Identify the best suited memory management technique for any process.	**SO3.1 SO3.2 SO3.3 SO3.4 SO3.5**	**3.1 3.2**	Unit 3 3.1, 3.2,3.3,3.4,3.5,3.6,3.7. 3.8,3.9,3.11	
PO:1,2,3,4,5,6,7,8,9 ,10,11,12 PSO:1,2,3,4,5	**CO4:** Students will gain practical skills in system management and an appreciation for the importance of the Linux kernel and open-source principles	**SO4.1 SO4.2 SO4.3 SO4.4 SO4.5**	**4.1 4.2**	Unit 4 4.1, 4.2,4.3,4.4,4.5,4.6,4.7.4. 8.4.9,4.10,4.11	
PO:1,2,3,4,5,6,7,8,9 ,10,11,12 PSO:1,2,3,4,5	**CO5**: Learn to operate the Linux system, along with its administra tion and Shell programmi ng	**SO5.1 SO5.2 SO5.3 SO5.4 SO5.5**	**5.1 5.2**	Unit 5.1, 5.2,5.3,5.4,5.5,5.6,5.7.5. 8.5.9,5.10,5.11	

Curriculum Development Team:

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Course Code:	**1MS501**
Course Title :	**Numerical Methods and scientific computation**
Pre- requisite:	Students should have basic knowledge of and deep understanding of the theory of the Numerical Methods and scientific computation.
Rationale:	The program aims to develop advanced problem-solving and analytical skills and prepares students for careers in academia, research, industry, or other sectors that require advanced mathematical expertise.

CO1-1MS501.1 Understand the importance of Understand the importance of Interpolation for equal and unequal interval

CO2-1MS501.2 Determine the Method for Solving Algebraic and Transcendental Equation
CO3-1MS501.3 Demonstrate an understanding of the theory of the Numerical Differentiation and Numerical Integration

CO4-1MS501.4 Define and recognize the method to solve system of linear equation

CO5-1MS501.5 Students will create the concept of a Numerical solution of ordinary differential equations

Scheme of Studies:

Board of Study	**Course Code**	**Course Title**	**Scheme of studies (Hours/Week)**					**Total Credits (C)**
			Cl	**LI**	**SW**	**SL**	**Total Study Hours (CI+LI+SW+SL)**	
Program Core (PCC)	1MS501	Numerical Methods and scientific computation	6	0	1	1	8	6

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA + ESA)
			Class/Home Assignment 5 number 3 marks each	Class Test 2 (2 best out of 3) 10 marks	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+ AT)		

			(CA)	each (CT)						
DCC	**1MS501**	Numerical Methods and scientific computation	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1-1MS501.1 Understand the importance of Interpolation for equal and unequal interval

Approximate Hours

Item	AppX Hrs
Cl	19
LI	0
SW	1
SL	1
Total	21

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Understand the concept of Interpolation **SO1.2** Understand the Finite differences operators **SO1.3** Understand the Gregory-Newton Forward Difference Interpolation. **SO1.4** Understand the Interpolation. Langrange Interpolation		**Unit-1.0** 1.1 Introduction 1.2 Lagranges interpolation formula for unequal interval 1.3 Remainder term in lagranges interpolation formula 1.4 Finitedifferences 1.5 Difference Backward Operators, 1.6 Difference table 1.7 The identity operator I 1.8 The shifting operator E 1.9 Differences formulae 1.10 Fundamental theorem of the difference calculus 1.11 Central and average	**SL1.1**Properties and some more relationships of operators.

		operator 1.12 Relation between operators 1.13 Method for Interpolation 1.14 Missing term technique 1.15 Gregory-Newton Forward Difference Interpolation, 1.16 Gregory-Newton Backward Difference 1.17 Interpolation with Unequal intervals 1.18 Langrange Interpolationformula 1.19 Newton 's devide difference formula	

SW-1 Suggested Sessional Work (SW):

a. **Assignments:**

Lagrange's interpolation, Newton forward interpolation, Newton Backward interpolation. Newton divided differences formula

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO2-1MS501.2 Determine the Method for Solving Algebraic and Transcendental Equation

Approximate Hours

Item	AppX Hrs
Cl	10
LI	0
SW	1
SL	2
Total	13

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO2.1 Understand the concept Solving Algebraic and Transcendental Equation		**Unit2.0** 2.1Method for Solving Algebraic and Transcendental Equation	**SL.1**Define errors with types **SL.2**Rate of convergence of Newton Raphson and Regula falsi method

SO2.2 Understand the Ramanujan method SO2.3 Understand the Newton-Raphson Method SO2.4 Understand the Regula falsi method		2.2Procedure to apply Ramanujan method 2.3 Ramanujan method 2.4 Bisection method 2.5 Regula falsi method 2.6 Secant method 2.7 Newton-Raphson Method 2.8 Rate of convergence of Newton Raphson 2.9 Rate of convergence Regula falsi method 2.10 Rate of convergence Secant method	

SW-2 Suggested Sessional Work (SW):

a. Assignments:

Newton Raphson method, Bisection method, secant method, Absolute, Relative and percentage errors, Regula falsi method

b. Mini Project:

Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):

Quiz, Class Test.

CO3-1MS501.3 Demonstrate an understanding of the Numerical Differentiation and Numerical Integration

Approximate Hours

Item	AppX Hrs
Cl	13
LI	0
SW	1
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO3.1 1Newton's forward Difference formula for derivative SO3.2 Understand the Newton's Backward Forward Difference formula for derivative		**Unit-3.0** 3.1Newton's forward Difference formula for derivative, 3.2 Newton's BackwardForward Difference formula for derivative, 3.3 Stirlings formula for derivative. 3.4 Numerical integration	**SL.1**Properties of cotes number

SO3.3 Understand the Numerical integration SO3.4Understand the Newton-cotes formulae Trapezoidal rule, Simpsons rule		3.5 Open type and closed typeQuadrature formulas 3.6 Newton-cotes formulae 3.7 A general quadrature formula 3.8 Derivation of Trapezoidal rule 3.9 Gaussian quadrature formula 3.10 Simpsons 1/3 rule, 3.11 Simpsons 3/8 rule, 3.12 Weddle's rule . 3.13Truncation error in Trapezoidal rule,simpsons rule .	

SW-3 Suggested Sessional Work (SW):

a. **Assignments:**
Simpson's 1/3 rule, Simpson's 3/8 rule, Weddle rule, Trapezoidal rule

b. **Mini Project:**
Oral presentation, Poster presentation, Power Point Presentation.

c. **Other Activities (Specify):**
Quiz, Class Test.

CO4-1MS501.4 Define and recognize the method to solve system of linear equation

Approximate Hours

Item	AppX Hrs
Cl	13
LI	0
SW	1
SL	2
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Understand Solve system of Linear Equation: SO4.2 Understand the Gauss elimination SO4.3Understand LU decomposition		**Unit-4.0** 4.1 Method to Solve system of Linear EquationIntroduction 4.2 Direct method for solving system of linear equation, 4.3 Gauss elimination procedure 4.4 Examples on Gauss	**SL.1** Some problems on Eigen value and eigen vectors **SL.2** problems on Interpolation

SO4.4 understand and problems solving on Jacobi Method SO4.5understand and problems solving on Gauss-Seidal Method.		elimination 4.5 Gauss Jordan method procedure 4.6 Gauss Jordan method -Examples 4.7Procedure of LU decomposition, 4.8 Examples of LU decomposition, 4.9 Cholesky decomposition method. 4.10 Iterative method : introduction and procedure 4.11 Procedure of Jacobi Method, and Gauss-Seidal Method. 4.12Examples on Jacobi Method, 4.13Examples on Gauss-Seidal Method.	

SW-4 Suggested Sessional Work (SW):

a. **Assignments:**

Jacobi Method, Triangularization Method , Gauss Seidel method , Factorization Method

b. Mini Project:

Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):

Quiz, Class Test.

CO5-1MS501.5 Students will create the concept of a Numerical solution of ordinary differential equations

Approximate Hours

Item	Appx Hrs
Cl	14
LI	0
SW	1
SL	1
Total	16

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**

SO5.1 Understand the concept numerical solution of Ordinary Differential Equations **SO5.2** Understand the Single Step methods **SO5.3** Understand Taylor's series Method **SO5.4** Understand Predictor and Corrector method		**Unit-5.0** 5.1Introduction 5.2Ordinary Differential Equations: Introduction 5.3Single Step methods: 5.4Picard Method 5.5Taylor's series Method, 5.6 Euler method 5.7 Runge's method 5.8 Milne method 5.9 Single step method -Procedure 5.10Runge-Kutta Method. 5.11Multistep method:-Procedure 5.12Predictor-corrector Method, 5.13Modified Euler Method, 5.14Milne-Simpson's Method.	**SL.1** Distinguish between an initial value problem and boundary value problem

SW-3 Suggested Sessional Work (SW):

a. Assignments

Runge - Kutta method, Picard method, Milne' Simpson method**.**

b. Mini Project:

Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):

Quiz, Class Test.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
CO1-1MS501.1 Understand the importance of Understand the importance of Interpolation for equal and unequal interval	19	1	1	21
CO2-1MS501.2 Determine the Method for Solving Algebraic and Transcendental Equation	10	1	2	13
CO3-1MS501.3 Demonstrate an understanding of the theory of the Numerical Differentiation and	10	1	1	12

Numerical Integration				
CO4-1MS501.4 Define and recognize the method to solve system of linear equation	13	1	2	16
CO5-1MS501.5 Students will create the concept of a Numerical solution of ordinary differential equations	14	1	1	16
Total Hours	66	5	7	78

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**					**Total Marks**
		R	**U**	**A**			
CO-1	Understand the importance of Understand the importance of Interpolation for equal and unequal interval	03	01	01			05
CO-2	Determine the Method for Solving Algebraic and Transcendental Equation	02	06	02			10
CO-3	Demonstrate an understanding of the theory of the Numerical Differentiation and Numerical Integration	03	07	05			15
CO-4	Define and recognize the method to solve system of linear equation	-	10	05			15
CO-5	Students will create the concept of a Numerical solution of ordinary differential equations	03	02		-		05
Total		11	26		13		50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies

1. Improved Lecture
2. Tutorial
3. Presentation
4. Group Discussion
5. Online sources
6 Seminar
7. Workshop

Suggested Learning Resources:

a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Numerical method and scientific computation	Dr.H.K. Pathak	Shree shiksha sahitya prakashan	2023-24
2	Numerical methods fore scientific and engineering computations	M.K.Jain,S.R.K. Iyenger.		
3	Numerical Analysis	G.Shankar Rao	New age international publishers ,new-Hydrabad.	2006

Cos,POs and PSOs Mapping

Course Title: B.Sc. Mathematics
Course Code : 1MS501
Course Title: Numerical Methods and scientific computation

Course Outcome	PO 1	PO 2	PO3	PO 4	PO5	PO 6	PO7	PO8	PO 9	PO10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
	Knowledge	Research	Communication	Problem Solving	Individual and Team	Investigation of Problems	Modern Tool usage	Science and Society	Life-Long Learning	Ethics	Project Management	Environment and	Thedetailed functional knowledge	To	To	Provide opportunities to excel in academics,
CO1-1MS501.1 Understand the importance of Understand the importance of Interpolation for equal and unequal interval	2	3	1	2	1	2	1	1	1	1	1	1	2	2	1	

CO2-1MS501.2 Determine the Method for Solving Algebraic and Transcendental Equation	2	3	1	1	1	1	1	1	1	1	1	1	2	2	2	
CO3-1MS501.3 Demonstrate an understanding of the theory of the Numerical Differentiation and Numerical Integration	3	3	1	2	1	1	3	2	2	1	2	2	1	2	3	
CO4-1MS501.4 Define and recognize the method	3	2	1	2	2	2	3	2	1	1	1	2	2	1	1	

to solve system of linear equation															
CO5-1MS501.5 Students will create the concept of a Numerical solution of ordinary differential equations	3	2	3	1	2	1	2	3	1	1	1	1	1	1	1	

Legend: 1 – Low, 2 – Medium, 3 – High

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Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO1-1MS501.1** Understand the importance of Understand the importance of Interpolation for equal and unequal interval	SO1.1 SO1.2 SO1.3 SO1.4		Unit-1.0 Interpolationfor equal and unequal interval1.1,1.2,1.3,1.4,1.5,1.6. 1.7,1.8,1.9,1.10,1.11,1.12,1.13 ,1.14,1.15,1.16,1.17,1.18,1.19	SL1.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO2-1MS501.2** Determine the Method for Solving Algebraic and Transcendental Equation	SO2.1 SO2.2 SO2.3 So2.4		Unit-2 Method for Solving Algebraic and Transcendental Equation:2.1, 2.2, 2.3, 2.4,2.5,2.6,2.7,2.8,2.9,2.10	SL2.1 SL2.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO3-1MS501.3** Demonstrate an understanding of the theory of the Numerical Differentiation and Numerical Integration	SO3.1 SO3.2 SO3.3 SO3.4		Unit-3Numerical Differentiation and Numerical Integration 3.1, 3.2, 3.3, 3.4, 3.5 ,3.6,3.7,3.8,3.9,3.10,3.11,3.12, 3.13	SL3.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO4-1MS501.4** Define and recognize the method to solve system of linear equation	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4 system of linear equation 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8,4.9,4.10,4.11,4.12	SL4.1 SL4.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO5-1MS501.5** Students will create the concept of a Numerical solution of ordinary differential	SO5.1 SO5.2 SO5.3 SO5.4		Unit-5Numerical solution of ordinary differential equations 5.1, 5.2, 5.3, 5.4, 5.5, 5.6 ,5.7,5.8,5.9,5.10,5.11,5.12,5.1 3,5.14	SL5.1

	equations				

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Curriculum Development Team

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Course Code: **2MS501**

Course Title : Elements of Discrete Mathematics

Pre-requisite: Understanding of basic concepts such as Binary number, Graph, Matrix

Rationale: Understand sets and perform operations and algebra on sets. Determine properties of relations, identify equivalence and partial order relations, sketch relations. Identify functions and determine their properties. Define graphs, digraphs and trees, and identify their main properties.

CO1-2MS501.1 Student will aware of history of indian logic of mathematics and hence of its Past, present and future role as part of our culture.

CO2-2MS501.2 Understand the concepts of the propositions, truth table, predicates and quantifiers, relation ,partition etc. and Understand the concepts of Hass diagram and lattices .

CO3-2MS501.3 Apply the knowledge of Boolean algebra, Logical circuits, Karnaugh Map. and their applications .

CO4-2MS501.4 Understand the concepts of Graph, and its applications in study of shortest path algorithms.

CO5-2MS501.5 Understand the concepts of application of tree and matrix Representation of graph using adjacency and incidence matrices.

SchemeofStudies:

Board ofStudy	**CourseCode**	**CourseTitle**			**Scheme of studies(Hours/Week)**			**TotalCredits (C)**
			Cl	**LI**	**SW**	**SL**	**Total StudyHours(CI+LI+SW+SL)**	
Program Core (PCC)	**2MS501**	Discrete Elements of Mathematics	4	0	1	1	6	4

Legend:

CI: ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)andothers),

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LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworkshop, field or other locations using different instructional strategies)

SW: Sessional Work(includes assignment, seminar, mini projectetc.),
SL: SelfLearning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA + ESA)
			Class/Home Assignment 5 number (3 marks each) (CA)	Class Test 2 (2 best out of3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+AT)		
PCC	**2MS501**	Discrete Elements of Mathematics	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1-2MS501.1 Student will aware of history of indian logic of mathematics and hence of its Past, present and future role as part of our culture .

Approximate Hours

Item	AppXHrs
Cl	08
LI	0
SW	2
SL	1
Total	11

SessionOutcomes (SOs)	**LaboratoryInstruction (LI)**	**ClassroomInstruction (CI)**	**SelfLearning (SL)**
SO1.1 Student will aware of history of indian logic of mathematics **SO1.2**To know about Indian Logic origins, Nyaya Jain logic and Buddhist logic		**Unit-1. Indian Logic** **1.1** Indian Logic **1.2** origins **1.3** The school Vaisheshika **1.4** Catuskoti **1.5** Nyaya Jain logic and Buddhist logic **1.6** Navya –Nyaya **1.7** Influence of indian logic on modern logic **1.8** Boolean logic and Indian thoughts	**SL.1** History of mathematics **SL.2** Contribution of Indian Mathematics

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SW-1 SuggestedSessionalWork(SW):

a. Assignments:-

i. Knowledge of Indian logic
ii. Nyaya Jain logic and Buddhist logic
iii. Navya –Nyaya
iv. Influence of indian logic on modern logic
v. Boolean logic and Indian thoughts
vi. Hasse diagram
vii. Lattices

b. Other Activities

Quiz , Oral presentation

CO2-2MS501.2 Understand the concepts of the propositions, truth table, predicates and quantifiers, relation ,partition etc. and Understand the concepts of Hass diagram and lattices .

Approximate Hours

Item	AppXHrs
Cl	16
LI	0
SW	2
SL	1
Total	19

SessionOutcomes (SOs)	**LaboratoryInstruction (LI)**	**ClassroomInstruction (CI)**	**SelfLearning (SL)**

SO2.1 To Understand the concept of Relation. **SO2.2** To Understand the application of equivalence classes **SO2.3** To understand the concept of Partition in Maths. **SO2.4** To understand the application of Lattics **SO2.5** To understand the application of Hasse diagram		**Unit-2** : **Relations** **2.1** Relations **2.2** Binary Relations **2.3** inverse Relations **2.4** composite Relations **2.5** equivalence Relations **2.6** Equivalence classes **2.7** Properties of Equivalence classes **2.8** Tutorial-1 **2.9** Partition of a set **2.10** Partial order relation **2.11** Partially ordered sets **2.12** Totally ordered sets **2.13** Hasse diagram **2.14** Examples on Hasse diagram **2.15** Lattices: Definition and examples **2.16** Dual, bounded ,distributive and complemented lattice.	1.About set theory. 2. Understand the concept of Relations with example .

SW-2 SuggestedSessionalWork(SW):

a. Assignments:
(1) Inductive definition of sets
(2) The definition of relation with example and their types
(3) Partition

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class test

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CO3-2MS501.3 Apply the knowledge of Boolean algebra, Logical circuits, Karnaugh Map. and their applications .

Approximate Hours

Item	AppXHrs
Cl	15
LI	0
SW	2
SL	1
Total	18

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**SelfLearning (SL)**
SO3.1 To know about Binary operation. **SO3.2** To Understand the Operation on sets under the properties of Boolean Algebra **SO3.3** **To** learn about Boolean functions. **SO3.4** To understand the difference between SOP and POS **SO3.5** To understand the concept of Karnaugh Map .	.	**Unit-3 Boolean Algebra** **3.1** Boolean Algebra **3.2** Properties of Boolean Algebra **3.3** Theorems on Boolean Algebra **3.4** Demorgan's law **3.5** Switching circuits **3.6** Applications of Switching circuits **3.7** Logic gates **3.8** Logic circuits **3.9** Boolean functions **3.10** Disjunctive normal forms **3.11** Conjunctive normal forms **3.12** Bool's expansion theorem **3.13** Minimize the Boolean function using Karnaugh Map for Two Variables. **3.14** Minimize the Boolean function using Karnaugh Map for Three Variables. **3.15** Minimize the Boolean function using Karnaugh Map for Four Variables.	1. Practice on DNF and CNF 2. Logical connectives operation on Boolean function.

SW-3 SuggestedSessionalWork(SW):

a. **Assignments:-**

(1) Kannaugh MAp
(2) DNF
(3) CNF
(4) Demorgan’s Law
(5) Theorems on Boolean Algebra

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO4-2MS501.4 Understand the concepts of Graph, and its applications in study of shortest path algorithms.

Approximate Hours

Item	AppXHrs
Cl	9
LI	0
SW	2
SL	1
Total	12

SessionOutcomes (SOs)	**LaboratoryInstruction (LI)**	**ClassroomInstruction (CI)**	**SelfLearning (SL)**

SO4.1 Understanding the elements of graph theory **SO4.2** Understanding the Application of Graph **SO4.** Dijkastra's Algorithm to find the shortest paths **So4.4** Understand the application of Euler graph and Hamiltonian graph		**Unit-4 Graph** **4.1**Graph : Definition **4.2** Types of graph **4.3** Subgraph **4.4** Walk, Path and circuit **4.5** Connected and disconnected graphs **4.6** Euler graph 4.7 Hamiltonian graph 4.8 Dijkastra's Algorithm for shortest paths in weighted graph: working Rule 4.9 Dijkastra's Algorithm: Examples	(1) o Learn about. Eular graph. (2) earn about Hamiltonian graph (3) o Learn the Graph and Types of graph with examples.

SW-4 Suggested Sessional Work(SW):

a. **Assignments:**
   (1) The definition and example of Graph
   (2) construction of trees , Spanning trees with example.
   (3) The theorem based on the trees.
   (4) The Representation of relation by graphs.

b. MiniProject:
   Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):

CO5-2MS501.5 Understand the concepts of application of tree and matrix Representation of graph using adjacency and incidence matrices.

Item	AppXHrs
Cl	12

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LI	0
SW	2
SL	1
Total	15

SessionOutcomes (SOs)	**LaboratoryInstruction (LI)**	**ClassroomInstruction (CI)**	**SelfLearning (SL)**
SO5.1 To Understanding the properties of Tree. **SO5.2** **To** learn about Types of Tree **SO5.3** To Understand the calculate rank and Nullity of graph **SO5.4** To Understand the concept of cut-set		**Unit -5 Tree** **5.1** Tree **5.2** Properties of Tree **5.3** Rooted ,Binary and Decision tree **5.4** spanning tree **5.5** Rank and nullity of graph **5.6** Kruskal's Algorithm **5.7** Cut set and its properties **5.8** Fundamental circuit and Cut–set **5.9** Planer graphs **5.10** Kurtowaski's two graphs Matrix representation of graphs Incidence Circuit Cut –Set Path. **5.11** Matrix representation of graphs Adjacency Circuit Cut –Set Path. **5.12** Theorems on Tree	1. To learn about Tree and Types of Tree. 2.To know the matrix representation

SW-5 Suggested Sessional Work(SW):

a. Assignments:-

Tree,Properties of tree,Theorems on tree, Matrix representation of graphs,Cut set, Adjacency and Incidence matrix, Kruskal's Algorithm

b. Mini Project:
Dessertation, Oral presentation

c. **OtherActivities(Specify):**
Quiz,Classtest

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
CO1-5MS303.1 Student will aware of history of indian logic of mathematics and hence of its Past, present and future role as part of our culture.	08	2	1	11
CO2-5MS303.2 Understand the concepts of the propositions, truth table, predicates and quantifiers, relation ,partition etc. and Understand the concepts of Hass diagram and lattices	16	2	1	19
CO3-5MS303 .3 Apply the knowledge of Boolean algebra, Logical circuits, Karnaugh Map. and their applications	15	2	1	18
CO4-5MS303 .4 Understand the concepts of Graph, and its applications in study of shortest path algorithms.	09	2	1	12
CO5-5MS303 .5 Understand the concepts of application of tree and matrix Representation of graph using adjacency and incidence matrices	12	2	1	15
Total Hours	60	10	5	75

Suggestion for End Semester Assessment

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Suggested Specification Table (ForESA)

CO	UnitTitles	MarksDistribution			Total Marks
		R	U	A	
CO-1	Indian Logic	03	02	00	05
CO-2	Relation	04	04	02	10
CO-3	Boolean Algebra	05	05	05	15
CO-4	Graph	05	04	03	12
CO-5	Tree	04	02	02	08
Total		21	17	12	50

Legend: R:Remember, U:Understand, A:Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

SuggestedInstructional/ImplementationStrategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, WhatsApp, Mobile, Online sources)

Suggested Learning Resource

a) Books:

S. No.	Title	Author	Publisher	Edition & Year

1	Discrete Mathematics structures with application to computer science	J.P. Tremblay and R. Manohar	MacGraw Hill Education,	1st edition ,2017
2	Discrete structures	S.B.Singh	Khanna book publishing	2019 3rd edition
3	Discretes tructure	Satinder Bal gupta and C.P.Gandhi	laxmi publications,	2010
4.	Elments of discrete mathematics	C.L.Lui	MacGraw Hill Education ,	4th edition 2017
4	Graph Theory with Applications to Engineering and Computer	Narsingh Deo	Science Prentice Hall India Learning Private Limited	1979

Reference Books:
1. Seymour Lipschutz and Mark Lipson Discrete Mathematics (Schaums Outline),
McGraw Hill Education, 3rd edition, 2017.
2 .Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, Pearson Education Pt. Ltd. Indian Reprint 2003. Suggested Digital
Web links:
1.https://www.eshiksha.mp.gov.in/mpdhe Suggested Equivalent online courses:
2.https://nptel.ac.in/courses/111106086 https://ugemooc inflibnet ac in/index.php/courses/view ug/311

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Cos, POs and PSOs Mapping

Course Title: B.Sc.
Course Code : 2MS501
Course Title: Elements of Discrete Mathematics

	-															
Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Knowledge	Research Apt	Communication	Problem Solving	Individual and Team Work	Investigation of Proble	Modern Tool usage	Science and Society	Life-Long Learning	Ethics	Project Management	Environment and sust	Thedetailed functional knowledge of	To integrate the gained kno	To understand, analyze, plan	Provide opportunities to excel in

		itude				ms						ain ability	theoretical conceptsand experimental aspects of science.	wledge with various contemporary and evolving areas in chemical sciences, physical science and mathematical science like anal	and implement qualitative as well as quantitative analytical synthetic and phenome non-based problems in chemical sciences ,phy	academics, research or Industry by research based innovative knowledge for sustainable development in chemical science, physical science and mathematical science

														ytical, synthetic, pharmaceutical etc	sical science and mathematical science.	
CO1-.1 05MS501.1 Student will aware of history of indian logic of mathematics and hence of its Past, present and future role as part of our culture .	2	3	1	2	1	2	2	2	1	1	1	1	2	1	1	3
CO2- 05MS501.2 Understand the concepts of the propositions , truth table, predicates	1	3	2	1	1	1	1	1	1	2	3	1	3	1	1	2

and quantifiers, relation, partition etc. and Understand the concepts of Hass diagram and lattices																
CO3-05MS501 .3 Apply the knowledge of Boolean algebra, Logical circuits, Karnaugh Map. and their applications .	2	3	2	2	1	1	3	2	1	1	3	1	2	1	2	2
CO4-05MS501 .4 Understand the concepts of Graph, and its applications in study of	2	3	2	2	1	1	3	2	1	1	3	1	2	1	2	2

shortest path algorithms.																
CO5-05MS501 .5 Understand the concepts of application of tree and matrix Representation of graph using adjacency and incidence matrices.	2	3	2	2	1	1	3	2	1	1	3	1	2	1	2	3

Legend: 1 – Low, 2 – Medium, 3 – High

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Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO1-.1 05MS501.1** Student will aware of history of indian logic of mathematics and hence of its Past, present and future role as part of our culture .	SO1.1 SO1.2		Unit-1.0 Group 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8, 1.9,1.10	SL1.1 SL1.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO2-05MS501.2** Understand the concepts of the propositions, truth table, predicates and quantifiers, relation, partition etc. and Understand the concepts of Hass diagram and lattices	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2 Ring 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	SL2.1 SL2.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO3-05MS501 .3** Apply the knowledge of Boolean algebra, Logical circuits, Karnaugh Map. and their applications .	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	SL3.1 SL3.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO4-05MS501 .4** Understand the concepts of Graph, and its applications in study of shortest path algorithms.	SO4.1 SO4.2 SO4.3 SO4.4		Unit-4 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	SL4.1 SL4.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO5-05MS501 .5** Understand the concepts of application of tree and matrix Representation of graph using adjacency and incidence matrices.	SO5.1 SO5.2 SO5.3 SO5.3		Unit-5 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	SL5.1 SL5.2

AKS University
Faculty of Basic Science
Department of Mathematics
Curriculum & Syllabus of B.Sc. Mathematics program
Semester-I

Curriculum Development Team

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AKS University
Faculty of Basic Science
Department of Mathematics
Curriculum & Syllabus of B.Sc. Mathematics program
Semester-I

CourseCode:	**1PH501**
CourseTitle:	**Quantum, Atomic and Molecular Physics**
Pre-requisite:	To study this course, a student must have had Physics as a subject in Diploma.
Rationale:	The students studying cement technology should possess foundational understanding about historical binding materials employed in construction. This encompasses familiarity with the inventionand evolution of Portland cement. Additionally, students ought to acquire fundamental insights into various cement types, their applications, as well as the Indian regulatory authorities responsible for supervising production standards and quality of cement.

CourseOutcomes:

1PH501.1: The students will be able to know Quantum technology in India: National Mission onQuantum Technologies & Applications (NM-QTA).

1PH501.2: The students will be able to know the quantum mechanics and its applications.

1PH501.3:The students will be able to explain the atomic structures and X-rays.

1PH501.4:The students will be able to analyse the atomic and molecular spectra such as electronic, rotational and vibrational.

1PH501.5: The students will be able to identify the various materials using Raman spectroscopic techniques.

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Department of Mathematics
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Semester-I

SchemeofStudies:

Boardo f Study	Cours e Code	CourseTitle	Schemeofstudies(Hours/Week)					TotalCred its (C)
			Cl	LI	SW	SL	TotalStudyHour s (CI+LI+SW+SL)	
Program Core (DCC)	1PH501	Quantum, Atomic and Molecular Physics	4	4	1	1	10	6

Legend: **CI:**ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)andothers),
LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworkshop, field or other locations using different instructional strategies)
SW: SessionalWork(includesassignment,seminar,miniprojectetc.),
SL: SelfLearning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

SchemeofAssessment:

Theory

Board ofSt udy	Cou seC ode	CourseTi tle	SchemeofAssessment(Marks)							
			ProgressiveAssessment(PRA)						EndSeme sterAsses sment	Tota l Mark s
			Class/H omeAssi gnment5 number 3mar ksea ch (CA)	ClassT est2 (2bestout of3) 10mar kseach (CT)	Semi naro ne (SA)	Class Activ ityan yone (CAT)	ClassAttend ance (AT)	TotalMarks (CA+CT+SA+C AT+AT)	(ESA)	(PR A+ ES A)

DCC	1PH501	Quantum, Atomic and Molecular Physics	15	20	5	5	5	50	50	100

Course-CurriculumDetailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1PH501.1: The students will be able to know Quantum technology in India: National Mission on Quantum Technologies & Applications (NM-QTA).

ApproximateHours

Item	AppXHrs
Cl	12
LI	12
SW	1
SL	1
Total	26

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO1.1 UnderstandQuantum technology in India **SO1.2** Learn about particle nature of wave: Limitations of Classical Mechanics **SO1.3**Learn aboutwave nature of particle: De-Broglie hypothesis **SO1.4**To understand Heisenberg's uncertainty principle with	. 1.1 Determination of Planck's constant. 1.2 Determination of e/m using Thomson's method.	**Quantum Mechanics-I** 1.1 Quantum technology in India 1.2 National Mission on Quantum Technologies & Applications (NM-QTA) 1.3 Particle nature of wave 1.4 Limitations of Classical	1. Photoelectric effect, Compton effect, Heisenberg uncertainty principle, Schrodinger equation.

application **SO1.**5To understand the Schrodinger wave equation .		Mechanics, Blackbody radiation 1.5 Photoelectric effect; Plank's radiation law; Compton effect 1.6 Wave nature of particle: De-Broglie hypothesis;experimental verification of De-Broglie hypothesis 1.7 concept of wave packet; concept of phase and group velocities 1.8 Heisenberg's uncertainty principle, experiments for the verification of uncertainty principle 1.9 Different forms of uncertainty principle 1.10 The Schrodinger wave equation: Schrodinger's time dependent and time independent equation 1.11 Physicalinterpretation of wave function; Probability Current Density 1.12 Equation of Continuity and its physicalsignificance, Normalisation of the wave function.	

SW-1SuggestedSessionalWork(SW):

a. **Assignments:**

Write about The Schrodinger wave equation: Schrodinger's timedependent and time independent equation

b. **OtherActivities(Specify):**
Present any one topic of this unit by power point presentation in front of departmental student and faculty.

1PH501.2: The students will be able to know the quantum mechanics and its applications.

ApproximateHours

Item	AppXHrs
Cl	12
LI	12
SW	1
SL	1
Total	26

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO2.1 ToUnderstandtheoperators in quantum mechanics **SO2.2** To learn about Expectation value and Ehrenfest Theorem **SO2.3**Tounderstandabout application of Schrodinger equation **SO2.4**TounderstandtheTunnel effect in barrier penetration (α-decay) **SO2.**5 To learn about One dimensional Harmonic Oscillator and concept of zero-point energy	. 2.1 Determination of e by Millikan's Method 2.2 Study of spectra of hydrogen and deuterium	Unit-2**Quantum Mechanics-II** 2.1 Operators in quantum mechanics: Eigen functions andEigenvalues 2.2 Hermitian operator; Position and Momentumoperator 2.3 Total energy (Hamiltonian) operator 2.4 Expectation value; Concept of parity; Parity operator; 2.5 Ehrenfest Theorem 2.6 Application of Schrodinger equation: Free particle 2.7 Particle in one-dimensional box1.8 Rectangular potential	1. Eigenfunction, Hermitian operator, HarmonicOscillato r

		barrier 2.9 Tunnel effect 2.10 Applications of tunnel effect in barrier penetration 2.11 One dimensional Harmonic Oscillator 2.12 Concept of zero-point energy	

SW-2 SuggestedSessionalWork(SW):

a. **Assignments:**

Explain One dimensional HarmonicOscillator .

b. OtherActivities(Specify):
Present any one topic of this unit by power point presentation in front of departmental student and faculty.

1PH501.3:The students will be able to explain the atomic structures and X-rays.

ApproximateHours

Item	AppXHrs
Cl	12
LI	12
SW	1
SL	1
Total	26

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO3.1 Brief review of Bohr and Sommerfeld model of atom **SO3.2**Learn about Vector atom model and Concepts of quantization **SO3.3**To understand spectroscopic notations of energy States **SO3.4**Discuss about Spin Orbit	. 3.1 Absorption spectrum of iodine vapour. 3.2 Study of alkali or alkaline earth spectra using concave grating	**Atomic structure:** 3.1 Brief review of Bohr and Sommerfeld model of atom 3.2 Electron orbits, Energy levels and spectra 3.3 Vector atom model	1. Electron orbits. Exclusion principle, Spin Orbit Interaction.

interaction and selection rules **SO3.**5Learn about Fine structure of Sodium D line: Spectral terms of two electron atoms.		3.4 Concepts of space quantization 3.5 Electron spin and Stern-Gerlach experiment 3.6 One and two valence electron systems 3.7 Pauli's exclusion principle and electron configuration 3.8 Spectroscopic notations of energy States,Multiplicity of energy level state 3.9 Spin Orbit interaction; Selection rules 3.10 Spectra of alkalineatom 3.11 Fine structure of Sodium D line: Spectral terms of two electron atoms; L-S and j-j coupling 3.12 Spectra ofHelium atom: Franck-Hertz experiment	

SW-3SuggestedSessionalWork(SW):

a. **Assignments:**

   Explain Spectroscopic notations of energy States, Multiplicity of energy level state.

b. **OtherActivities(Specify):**
   Present any one topic of this unit by power point presentation in front of departmental student and faculty.

1PH501.4:The students will be able to analyse the atomic and molecular spectra such as electronic, rotational and vibrational

ApproximateHours

Item	AppXHrs
Cl	12
LI	12
SW	1

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SL	1
Total	26

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO4.1 Evaluation of Zeeman effect: Early Discoveries and developments **SO4.2** Experimental arrangement of Zeeman effect **SO4.3** Understanding theNature and production of X-rays **SO4.4**L e a r n a b o u t Duan and Hunts rule and X-ray emission spectra **SO4.5**T o u n d e r s t a n d Auger effect andDoublet structure of X-ray	. 4.1 Study of Zeeman Effect for determination of Lande g-factor 4.2 Study of Raman spectrum using laser as an excitation source	**Unit-4 : Zeeman effect and X-Ray Spectroscopy:** 4.1 Zeeman effect: Early Discoveries and developments 4.2 Experimental arrangement; 4.3 Normal and AnomalousZeeman effect; 4.4 Zeeman shift, Stark effect 4.5 Nature and production of X-rays 4.6 Discrete and continuous X-ray spectra 4.7 Characteristics X- ray spectrum 4.8 Duane and Hunts rule 4.9 X-ray emission spectra 4.10 Moseley's law and its application 4.11 Auger effect; Doublet structure of X-ray spectra 4.12 X-ray absorption spectra	1. Zeeman effect, X - Ray, Doublet structure.

SW-4SuggestedSessionalWork(SW):

a. **Assignments:**

Explain Auger effect; Doublet structure of X-ray spectra.

b. **OtherActivities(Specify):**
Present any one topic of this unit by power point presentation in front of departmental student and

faculty.

1PH501.5: The students will be able to identify the various materials using Raman spectroscopic techniques.

Item	AppXHrs
Cl	12
LI	12
SW	1
SL	1
Total	26

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO5.1 To Learn about Molecular Spectroscopy and its type. **SO5.2** Determination of intermolecular distance of Diatomic molecules **SO5.3** Electronic Spectra of Diatomic molecules **SO5.4**Overview of Raman Spectroscopy **SO5.**5Applications of Raman effect	5.1 Calculation of energy states of Hydrogen and Deuterium 5.2 To determine the operating voltage, slope k of the plateau and dead time of a G.M. Counter	**Unit 5: Molecular Physics:** 5.1 Molecular Spectroscopy 5.2 Various types of spectra 5.3 Quantization ofVibrational and Rotational energies 5.4 PureRotational Spectra 5.5 Determination of intermoleculardistance ofDiatomic molecules 5.6 Pure vibrational Spectraof Diatomic molecules 5.7 Electronic Spectra of Diatomicmolecules 5.8 Raman Spectroscopy 5.9 Raman effect: Stokes and anti-stokes lines; Experimental setup of Raman effect 5.10 Classical theory of Raman effect; Quantum theory ofRaman	1. Molecular Spectroscopy, Vibrational Spectra, Raman effect, Electronic Spectra.

		effect 5.11 Applications of Raman effect: Electronicspectrum; Born-Oppenheimer approximation 5.12 FranckCondon principle; Fluorescence and Phosphorescence	

SW-5SuggestedSessionalWork(SW):

a. **Assignments:**

Explain Classical theory of Raman effect and Quantum theory of Raman effect .

b. **OtherActivities(Specify):**
Present any one topic of this unit by power point presentation in front of departmental student and faculty.

BriefofHourssuggestedfortheCourseOutcome

CourseOutcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Totalhour (Cl+SW+Sl)
1PH501.1: The students will be able to know Quantum technology in India: National Mission on Quantum Technologies & Applications (NM-QTA).	12	12	1	1	26
1PH501.2: The students will be able to know the quantum mechanics and its applications.	12	12	1	1	26
1PH501.3:The students will be able to explain the atomic structures and X-rays.	12	12	1	1	26
1PH501.4:The students will be able to analyse the atomic and molecular spectra such as electronic, rotational and vibrational.	12	12	1	1	26
1PH501.5: The students will be able to identify the various materials using Raman spectroscopic techniques.	12	12	1	1	26

Total Hours	60	60	5	5	130

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Quantum Mechanics-I	03	04	03	10
CO-2	Quantum Mechanics-II	03	04	03	10
CO-3	Atomic structure	03	04	03	10
CO-4	Zeeman effect and X-Ray Spectroscopy	03	04	03	10
CO-5	Molecular Physics	03	04	03	10
Total		15	20	15	50

Legend: R:Remember, U:Understand, A:Apply

The end of semester assessment for Quantum, Atomic and Molecular Physics will be held with written examination of 50 marks

Note.DetailedAssessmentrubricneedtobepreparedbythecoursewiseteachersforabovetasks. Teacherscanalsodesigndifferenttasksasperrequirement,forendsemesterassessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a)Books:

S. No.	Title	Author	Publisher	Edition& Year
1	Concept of Modern Physics	A. Beiser	McGraw Hill	
2	Modern Physics	J.B. Rajam	S. Chand	
3	Introduction to Modern Physics	H.S. Mani, G.K. Mehra	East West Press	1989
4	Introduction to Quantum Mechanics	D. J. Griffiths	Cambridge University Press	
5	HolcimTrainingManual			
6	FLSTraining Manual			
7	Lecturenoteprovidedby Dept.ofCementTechnology,AKSUniversity,Satna.			

Cos, POs and PSOs Mapping

Course Title: B.Sc.

Course Code : PH501
Course Title: Quantum, Atomic and Molecular Physics

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO8	PO 9	PO10	PO1 1	PO1 2	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/ developmentof solutions	Conduct investigationsof complex problems	Modern toolusage	Theengineerandsociety	Environment and sustainability:	Ethics	Individualandteamwork:	Communication:	Projectmanagement and finance:	Life-longlearning	Theabilitytoapply technical &engineeringknowledgeforproductionquality cement	Abilityto understandthe day toplantoperational problemsof cementmanufacture	Abilityto understandthelatestcement manufacturing technology.	Abilityto usetheresearchbasedinnovative knowledgeforSDGs
CO.1: The students will be able to know Quantum technology in India: National Mission on Quantum Technologies & Applications (NM-QTA).	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1
CO.2: The students will be able to know the quantum mechanics and its applications.	1	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1

CO.3: The students will be able to explain the atomic structures and X-rays.	2	2	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO.4: The students will be able to analyse the atomic and molecular spectra such as electronic,rotational and vibrational.	3	2	2	2	3	2	3	2	2	1	2	3	3	3	3	2
CO.5: The students will be able to identify the various materials using Raman spectroscopic techniques.	-	-	-	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3– High

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CourseCurriculumMap:

POs& PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction (LI)	Class room Instruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO.1: The students will be able to know Quantum technology in India: National Mission on Quantum Technologies & Applications (NM-QTA).	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0Quantum Mechanics-I 1.1,1.2,1.3,1.4,1.5,1.6, 1.7	Asmention edin pagenumber 2to6
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO.2: The students will be able to know the quantum mechanics and its applications.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2Quantum Mechanics-II 2.1,2.2,2.3,2.4,2.5,2.6, 2.7, 2.8,2.9,2.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO.3: The students will be able to explain the atomic structures and X-rays.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3Atomic structure 3.1, 3.2,3.3,3.4,3.5,3.6,3.7, 3.8	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO.4: The students will be able to analyse the atomic and molecular spectra such as electronic, rotational and vibrational.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4 Zeeman effect and X-Ray Spectroscopy 4.1, 4.2,4.3,4.4,4.5,4.6,4.7, 4.8,4.9,4.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO.5: The students will be able to identify the various materials using Raman spectroscopic techniques.	SO5.1 SO5.2 SO5.3 SO5.4		Unit-5Molecular Physics 5.1,5.2,5.3,5.4,5.5	

		SO5.5			

Curriculum Development Team

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CourseCode: **2PH501**

CourseTitle: **Nuclear and Particle Physics**

Pre-requisite: To study this course, a student must have had Physics as a subject in Diploma.

Rationale: Nuclear physics is the study of the structure of nuclei—their formation, stability, and decay. It aims to understand the fundamental nuclear forces in nature, their symmetries, and the resulting complex interactions between protons and neutrons in nuclei and among quarks inside hadrons, including the proton.

CourseOutcomes:

2PH501.1: Understand the structure of nucleus and nuclear energy.

2PH501.2: Understand the nuclear model and two body interaction processes.

2PH501.3: Develop the understanding for fission and fusionprocesses and nuclear power generation.

2PH501.4: Understand the different forms of nuclear counter and detectors.

2PH501.5: Understand the different nuclear accelerator and decay process.

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SchemeofStudies:

Boardo f Study	Cours e Code	CourseTitle	Schemeofstudies(Hours/Week)					TotalCred its (C)
			Cl	LI	SW	SL	TotalStudyHour s (CI+LI+SW+SL)	
Program Core (PCC)	2PH501	**Nuclear Physics**	4	0	1	1	6	4

Legend: **CI:**ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)andothers),
LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworkshop, field or other locations using different instructional strategies)
SW: SessionalWork(includesassignment,seminar,miniprojectetc.),
SL: SelfLearning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacher to ensure outcome of Learning.

SchemeofAssessment:

Theory

Board ofSt udy	Cou seC ode	CourseTi tle	SchemeofAssessment(Marks)							
			ProgressiveAssessment(PRA)						EndSeme sterAsses sment (ESA)	Tota l Mark s (PRA+ ESA)
			Class/H omeAssi gnment5 number 3mar ksea ch (CA)	ClassT est2 (2bestout of3) 10mar kseach (CT)	Semi naro ne (SA)	Class Activ ityan yone (CAT)	ClassAttend ance (AT)	TotalMarks (CA+CT+SA+C AT+AT)		
PCC	PH50 2	Nuclear Physics	15	20	5	5	5	50	50	100

Course-CurriculumDetailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

2PH501.1: Understand the structure of nucleus and nuclear energy.

ApproximateHours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	1
Total	14

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO1.1 UnderstandBhabha Atomic Research Centre **SO1.2** Learn about Defence Research and Development Organisation and India Space Research Organisation **SO1.3**Learn aboutRaja Ramanna Centre forAdvanced Technology	.	**Unit-1Nucleus and Nuclear Forces** 1.1Introduction to Bhabha Atomic Research Centre 1.2 DefenceResearch and Development Organisation and India Space Research Organisation	2. Nuclear Forces, Binding energy, Deuteron, Radioactive disintegration .

SO1.4 To understand characteristics of nucleus **SO1.5**To understand the general concept of nuclear force .		1.3 Raja RamannaCentre for Advanced Technology 1.4 Indus-I and Indus-2 synchrotron 1.5 Composition, charge, size, shape, mass and density of the nucleus 1.6 Nuclear angular momentum: Nuclear magnetic dipole moment, Electric quadrupole moment 1.7 Mass defect 1.8 Packing fraction 1.9 Binding energy; Binding energy of Deuteron 1.10 Stability of nuclei (N vsZ curve), Binding energy curve 1.11 Nuclear Forces: General concept of Nuclear force 1.12 Yukawa Meson field theory of Nuclear forces; Properties ofNuclear forces.	

SW-1SuggestedSessionalWork(SW):

c. **Assignments:**

Explain Nuclear Forces? Give general concept of Nuclear force.

d. OtherActivities(Specify):

Present any one topic of this unit by power point presentation in front of departmental student and faculty.

2PH501.2: Understand the nuclear model and two body interaction processes.

ApproximateHours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	1
Total	14

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**

SO2.1 ToUnderstandtheNuclear liquid drop models **SO2.2** To learn about Nuclear shell models **SO2.3**TounderstandaboutHarmonic oscillator potential well **SO2.4**TounderstandtheTwo Body system **SO2.**5 To learn about Neutron-Proton scattering at low energies	.	**Unit-2Nuclear models and Nuclear interaction** 2.1 Nuclear models 2.2 Shell model; magic number 2.3 Square well potential 2.4 Harmonic oscillator potential well 2.5 Spin-Orbit potential 2.6 Unified (collective) model 2.7 Liquid Drop model; Semi-empirical mass formula. 2.8 Two Body system 2.9 The ground state properties of the Deuteron 2.10 Deuteron in Central potential (Square well) 2.11Excited state of the deuteron 2.12 Neutron-Proton scattering at low energies; Scattering length	1. Shell model, Liquid Drop model, Scattering

SW-2 SuggestedSessionalWork(SW):

c. **Assignments:**

Explain Deuteron in Central potential (Square well).

d. OtherActivities(Specify):
Present any one topic of this unit by power point presentation in front of departmental student and faculty.

2PH501.3:Develop the understanding for fission and fusion processes and nuclear power generation.

ApproximateHours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	1
Total	14

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO3.1 Brief review of Nuclear reactions **SO3.2**Learn about Compound Nucleus andconcept of direct reactions **SO3.3**To understand Nuclear Fission **SO3.4**Learn about Nuclear Fusion **SO3.**5Learn about Principle of atomic bomb and hydrogen bomb	.	**Unit-3 Nuclear reactions and Nuclear Energy** 3.1 Nuclear reactions 3.2 Kinds of Nuclear reactions 3.3 Nuclear reaction kinematics 3.4 Q-value 3.5 Compound Nucleus andconcept of direct reactions 3.6 Conservation laws; Nuclear reaction cross- sections 3.7 Nuclear energy: Nuclear Fission 3.8 Chain reaction and Critical Mass 3.9 Nuclear Reactors and its basic components	1. Nuclear reactions, Nuclear Fission. Q-value.

		3.10 Nuclear Fusion; Condition for the maintained Fusion reactions 3.11 Energy production in stars; Fusion reaction in Sun 3.12 Principle of atomic bomb and hydrogen bomb	

SW-3SuggestedSessionalWork(SW):

c. **Assignments:**

Explain Compound Nucleus and concept of direct reactions.

d. **OtherActivities(Specify):**
Present any one topic of this unit by power point presentation in front of departmental student and faculty.

2PH501.4:Understand the different forms of nuclear counter and detectors.

ApproximateHours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	1
Total	14

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO4.1 Evaluation of Nuclear counters and detectors **SO4.2** Experimental arrangement of Geiger-Mullercounter **SO4.3** Understanding theNature and production Gamma ray interactions NaI (Tl) Scintillation **SO4.4**L e a r n a b o u t Detector electronics and Pulse processing **SO4.5**T o u n d e r s t a n d Pulse countingsystems; Pulse height analysis systems; Pulse timing;Pulse shape discrimination	.	**Unit-4: Nuclear counters and detectors** 4.1 Ionization Chamber 4.2 Proportional counter 4.3 Geiger-Muller counter 4.4 Scintillation counter 4.5 Semiconductor detectors: P-N junction detector 4.6 Lithium drifted: High purity Ge Detector 4.7 Gamma ray interactions NaI (Tl) Scintillation 4.8 Detector electronics and Pulse processing 4.9Pulse counting systems 4.10 Pulse height analysis systems 4.11Pulsetiming 4.12 Pulse shape discrimination	1. Chamber, Detector, Pulse processing.

SW-4SuggestedSessionalWork(SW):

a. **Assignments:**

Explain Detector electronics and Pulse processing.

b. **OtherActivities(Specify):**
Present any one topic of this unit by power point presentation in front of departmental student and faculty.

2PH501.5: Understand the different nuclear accelerator and decay process.

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	1
Total	14

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO5.1 To Learn about Accelerators **SO5.2** Understanding about linear and cyclic accelerator with differences **SO5.3** Learn about Alpha decay **SO5.4**Overview of Beta decay: Shape of Beta ray spectrum **SO5.**5Learn about Gamma ray emission		**Unit 5: Nuclear AcceleratorsandNuclear Decay** **5.1** Accelerators 5.2 Cyclotron 5.3 Betatron 5.4Synchrotron 5.5 Alpha decay 5.6 Alpha particles spectra 5.7 Gamow's theory ofAlpha decay 5.8 Beta decay: Shape of Beta ray spectrum 5.9 Explanation of Beta decay on the basis of Neutrino andAntineutrino hypothesis 5.10 Fermi theory of Beta decay 5.11 Selection rules; Conservation of	2. Accelerators, Alpha decay, Beta decay

		β-decay 5.12 Gamma rayemission: Multipole radiation	

SW-5SuggestedSessionalWork(SW):

c. **Assignments:**
Explain alpha decay? Give Gamow's theory of Alpha decay.

d. **OtherActivities(Specify):**
Present any one topic of this unit by power point presentation in front of departmental student and faculty.

BriefofHourssuggestedfortheCourseOutcome

CourseOutcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Totalhour (Cl+SW+Sl)
2PH501.1: The students will be able to know Quantum technology in India: National Mission on Quantum Technologies & Applications (NM-QTA).	12	1	1	14
2PH501.2: The students will be able to know the quantum mechanics and its applications.	12	1	1	14
2PH501.3:The students will be able to explain the atomic structures and X-rays.	12	1	1	14
2PH501.4:The students will be able to analyse the atomic and molecular spectra such as electronic,rotational and vibrational.	12	1	1	14
2PH501.5: The students will be able to identify the various materials using Ramanspectroscopic techniques.	12	1	1	14
TotalHours	60	5	5	70

SuggestionforEndSemesterAssessment

SuggestedSpecificationTable (ForESA)

CO	**UnitTitles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	**Nucleus and Nuclear Forces**	03	04	03	10
CO-2	**Nuclear models and Nuclear interaction**	03	04	03	10
CO-3	**Nuclear reactions and Nuclear Energy**	03	04	03	10
CO-4	**Nuclear counters and detectors**	03	04	03	10
CO-5	**Nuclear AcceleratorsandNuclear Decay**	03	04	03	10
Total		15	20	15	50

Legend: R:Remember, U:Understand, A:Apply

TheendofsemesterassessmentforQuantum, Atomic and Molecular Physicswillbeheldwithwritten examination of 50 marks

Note.DetailedAssessmentrubricneedtobepreparedbythecoursewiseteachersforabovetasks.
Teacherscanalsodesigndifferenttasksasperrequirement,forendsemesterassessment.

SuggestedInstructional/ImplementationStrategies:

1. ImprovedLecture
2. Tutorial
3. CaseMethod
4. GroupDiscussion
5. RolePlay
6. Visittocementplant
7. Demonstration
8. ICT Based Teaching Learning (VideoDemonstration/Tutorials CBT, Blog,Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

SuggestedLearningResources:

(a)Books:

S. No.	Title	Author	Publisher	Edition& Year
1	Nuclear Physics	D. C. Tayal	Himalaya Publishing House	
2	Concepts OfNucIear Physics	B. L. Cohen	McGraw Hill Education	
3	Nuclear Physics: An Introduction	S. B. Patel	New Age International Publishers	
4	Fundamental of Nuclear Physics	Jahan Singh	Pragati Publications	
7	Lecturenoteprovidedby Dept.ofCementTechnology,AKSUniversity,Satna.			

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Cos, POs and PSOs Mapping

Course Code : 2PH501

Course Title: Nuclear Particle Physics

CourseOutcomes	ProgramOutcomes												ProgramSpecificOutcome			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO8	PO 9	PO10	PO1 1	PO1 2	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/ development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability:	Ethics	Individual and team work:	Communication:	Project management and finance:	Life-long learning	Theabilitytoapply technical &engineeringknowledgeforproductionquality cement	Abilityto understandthe day toplantoperational problemsofcementmanufacture	Abilityto understandthelatestcement manufacturing technology.	Abilityto usetheresearchbasedinnovative knowledgeforSDGs
CO.1: The students will be able to know Quantum technology in India: National Mission on Quantum Technologies & Applications (NM-QTA).	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1
CO.2: The students will be able to know the quantum mechanics and its applications.	1	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1
CO.3: The students will be able to explain the atomic structures and X-rays.	2	2	1	1	1	2	2	2	1	2	1	2	1	1	2	2

CO.4: The students will be able to analyse the atomic and molecular spectra such as electronic,rotational and vibrational.	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO.5: The students will be able to identify the various materials using Raman spectroscopic techniques.	**-**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend:1–Low,2–Medium,3– High

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CourseCurriculumMap

POs& PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO.1: The students will be able to know Quantum technology in India: National Mission on Quantum Technologies & Applications (NM-QTA).	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1Nucleus and Nuclear Forces** 1.1,1.2,1.3,1.4,1.5,1.6, 1.7	Asmentioned in Page number 2to6
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO.2: The students will be able to know the quantum mechanics and its applications.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**Unit-2Nuclear models and Nuclear interaction** 2.1,2.2,2.3,2.4,2.5,2.6, 2.7, 2.8,2.9,2.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO.3: The students will be able to explain the atomic structures and X-rays.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3 Nuclear reactions and Nuclear Energy** 3.1, 3.2,3.3,3.4,3.5,3.6,3.7, 3.8	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO.4: The students will be able to analyse the atomic and molecular spectra such as electronic, rotational and vibrational.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4: Nuclear counters and detectors** 4.1, 4.2,4.3,4.4,4.5,4.6,4.7, 4.8,4.9,4.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12	CO.5: The students will be able to identify the	SO5.1 SO5.2		**Unit 5: Nuclear**	

PSO1,2,3,4,5	various materials using Raman spectroscopic techniques.	SO5.3 SO5.4 SO5.5		**Accelerators and Nuclear Decay** 5.1,5.2,5.3,5.4,5.5	

Curriculum Development Team

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6. Ms. Swati Kushwaha, Lab Assistant, Department of Physics, AKS University Satna (M.P.)

Code: 1CH501
Course Name: Instrumental Technique in Chemistry

Pre-requisite: Student should have basic knowledge of Role of analytical chemistry, Errors and Evalution, Origin of water pollutants and their effects, Fuel analysis.

Rationale: The Course will provide applicable knowledge about General survey of instrumental techniques for the analysis of heavy metals in aqueous systems. drug analysis

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

CO1: **1CH501** Explain and apply theoretical aspect of analytical chemistry.
CO2: **1CH501**Analyse water, soil and biological fluid sample
CO3: **1CH501**Explain and identify the errors occurred during chemical analysis.
CO4: **1CH501** Handle glass ware and reagent in scientific way
CO5: **1CH501**Expertise in laboratory saftey

Unit I

Introduction - Role of analytical chemistry. Classification of analytical methods–classical and instrumental. Types of instrumental analysis. Selecting an analytical method. Neatness and cleanliness. Laboratory operations and practices. Analytical balance. Techniques of weighing, errors. Volumetric glassware cleaning and calibration of glassware. Sample preparations- dissolution and decomposition.Gravimetric techniques. Selecting and handling of reagents. Laboratory notebooks. Safety in the analytical laboratory.

UNIT II

Errors and Evalution- Definition of terms in mean and median. Precision-standard deviation, relatives standard deviation. Accuracy-absolute error.Types of error in experimental data- determinate (systmatic), indeterminate (or random) and gross.

UNITIII

Analysis of water pollutionp- Origin of water pollutants and their effects. Sources of water pollution domestic, industrial, agricultural soil and radioactive wastes as sources of pollution objectives of analysis-parameter for analysis-colour, turbidity,total solids, conductvity, acidity, alkalinity, hardness, chloride,sulphate,fluoride,silica,phosphates and different forms of nitrogen.Heavy metal pollution-public health significance of cadmium,chromium,copper,lead,zinc,manganese,mercury and arsenic. General survey of

instrumental techniques for the analysis of heavy metals in aqueous systems. Measurements of DO,BOD&COD. Pesticides as water pollutants and analysis. Water pollution laws and standards.

UNIT IV

Analysis of Soil, Fuel, Body Fluids and Drugs- (a) Analysis of soil: moisture,pH, total nitrogen ,phosphorus, silica, lime, magnesia, manganese, sulphur and alkali salts.

(a) **Fuel analysis**: solid, liquid and gas.Ultimate and proximate analysis-heating values- grading coal. Liquid fuels-flash point, aniline point, octane number and carbon residue. Gaseous fuels-producer gas and water gas –calorific values

UNIT V

Analysis of Soil, Fuel, Body Fluids and Drugs

(a) Clinical chemistry: Composition of blood collection and preservation of samples. Clinical analysis .Serum electrolytes , blood glucose , blood urea nitrogen, uric acid, albumin,globulins, barbiturates, acid and alkaline phosphateses. Immunoassay principles of ratio immunoassay (RIA) and applications.The blood gas analysis trace elements in the body.

(b) Drug analysis: Narcotics and dangerous grug.Classification of drugs.Screening by gas and thin-layarchromatography and spectrophotometric measurement.

Scheme of Studies:

Board				Scheme ofstudies(Hours/Week)	Total

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ofStudy	Course Code	CourseTitle	Cl	LI	SW	SL	Total Study Hours(CI+LI+SW+ SL)	Credits (C)
ProgramCore(PCC)	76CH-303	Analytical Chemistry	4	0	1	1	5	4

Legend: **CI:**Class room Instruction (Includes different instructiona lstrategies i.e.Lecture (L)and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances inlaboratory workshop ,field or other locations using different instructional strategies)
SW: Sessional Work (includesassignment,seminar,miniprojectetc.),
SL: Self Learning,
C: Credits.

Note: SW& SL has to be planned and performed under the continuous guidance and feed back of teacher to ensure outcome ofLearning.

SchemeofAssessment:

Theory

Board of Study	Couse Code	Course Title	**SchemeofAssessment(Marks)**						
			ProgressiveAssessment(PRA)					**EndSemesterAssessment**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test2 (2bestout of3) 10 marks each(CT)	Seminarone (SA)	ClassAttendance (AT)	TotalMarks (CA+CT+SA+AT)	**(ESA)**	(PRA+ESA)
PCC	76CH103	Analytical Chemistry	15	20	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1CH501**.1**: Explain and apply theoretical aspect of analytical chemistry

Activity	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes(SOs)	**Laboratory Instruction (LI)**	**Class room Instruction(CI)**	**Self Learning (SL)**
SO1.1 Explain Role of analytical chemistry. Classification of analytical methods –classsical and instrumental		Unit-1.0 Role of analytical chemistry. 1.1Classification of analyticalmethods – classsical and instrumental	Techniques of weighing, errors.

SO1.2 Explain Types of instrumentalanalysis. Selecting an analytical method.Neatness and cleanliness.Laboratory operations and practices.Analytical balance. SO1.3 Explain Techniques of weighing,errors. Volumetric glassware cleaning and calibration of glassware. SO1.4 Explain Sample preparations-dissolution and decomposition.Gravimetric techniques. SO1.5 Understand and explain Selecting and handling of reagents.Laboratory notebooks.Safety in the analytical laboratory.		Explain Types of instrumentalanalysis. Selecting an analyticalmethod. Neatness and cleanliness. Laboratory operations and practices. Analytical balance. Techniques of weighing,errors. Volumetric glassware cleaning and calibration of glassware. Sample preparations-dissolution and decomposition.Gravimetric techniques. Selecting and handling of reagents. Laboratory notebooks. Safety in the analytical laboratory.	

SW-1SuggestedSessionalWork(SW):

a.Assignments:

Discuss Techniques of weighing,errors. Volumetric glassware cleaning and calibration ofglassware.

b.Mini Project:

Sample preparations-dissolution and decomposition.Gravimetric techniques.

c.Other Activities (Specify):

Note on applications of selecting and handling of reagents.laboratory notebooks.safety in the analyticallaboratory.

1CH501.2: Analyse water, soil and biological fluid sample**.**

Activity	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning(SL)**

SO2.1 Understand Errors andEvalution-Definition of termsin mean and median.Precision-standard deviation. **SO2.2** Explain relativesstandard deviation. **SO2.3**Explain Accuracy-absolute error. **SO2.4** Explain types of errorin experimental data determinate(systmatic). **SO2.5** Understand and applyindeterminate(or random)and gross.		**Unit-2.0 Errors and Evalution-**2.1Introduction of errors and evalution. Introduction of terms in mean andmedian.Precision. Properties of the terms in meanand median.Precision. Definition of terms in mean and median.Precision-standard deviation. Introduction of relatives standarddeviation. Properties of the relatives standarddeviation. Importance of relatives standarddeviation. Introduction of accuracy-absoluteerror. Mechanism of the accuracy-absolute error. T1- Types of error in experimental datadeterminate(systmatic). T2- Indeterminate(or random)andgross. T3-Importance of Indeterminate(orrandom)and gross.	Properties and types oferror in experimental data determinate.

SW-2 Suggested Sessional Work (SW):

a.Assignments:

Apply Errors and Evalution-Definition of terms in mean and median.Precision-standard deviation,

b.Mini Project:

Types of error in experimental data-determinate(systmatic)

c.Other Activities (Specify):

Write an eassy on relatives standard deviation.Accuracy-absolute error.

1CH501.3: Explain and identify the errors occurred during chemical analysis

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Activity	AppX Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Understand and apply Origin of water pollutants and their effects. Sources of water pollution domestic, industrial, agricultural soil and radioactive wastes as sources of pollution. **SO3.2** Explain objectives of analysis- parameter for analysis- colour,turbidity,total solids,conductvity,acidity,alkalinity, hardness,chloride,sulphate,fluoride, silica,phosphates and different forms of nitrogen. **SO3.3** Explain Heavy metal pollution-public health significanceof cadmium, chromium, copper, lead,zinc,manganese,mercury and arsenic. **SO3.4** Explain General survey of instrumental techniques for the analysis of heavy metals in aqueous systems. Measurements of DO,BOD&COD.		Unit-3. **Analysis of waterpollution** Origin of water pollutants and their effects. Sources of water pollution domestic, industrial, agricultural. soil and radioactive wastes as sources of pollution. objectives of analysis- parameter for analysis- colour,turbidity,total solids. objectives of analysis- conductvity,acidity. objectives of analysis- alkalinity,hardness,chloride,sulphate. objectives of analysis- fluoride,silica,phosphates and different forms of nitrogen. Introduction and properties of heavy mketals. Heavy metal pollution-publichealth significance of cadmium, chromium, copper, lead,zinc,manganese,mercury and arsenic.	. General survey of instrumental techniques for the analysis of heavy metals in aqueous systems.

SO3.5 Explain Pesticides as water pollutants and analysis. Water		T1-General survey of instrumental techniques for the	
pollution laws and standards.		analysis of heavy metals in aqueous systems. T2-Measurements of DO,BOD&COD. T3-Pesticides as water pollutants and analysis. Water pollution laws and standards.	

SW-3 Suggested Sessional Work (SW):

a.Assignments:

Origin of water pollutants and their effects. Sources of water pollution domestic, industrial, agricultural soil and radioactive wastes as sources of pollution.

b.Mini Project:

Explain Heavy metal pollution-public health significance of cadmium, chromium, copper,lead,zinc,manganese,mercury and arsenic.

c.Other Activities (Specify):

Explain Pesticides as water pollutants and analysis. Water pollution laws and standards.

1CH501**.4:** Handle glass ware and reagent in scientific way.

Activity	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes(SOs)	**Laboratory Instruction (LI)**	**Class room Instruction(CI)**	**Self Learning (SL)**
SO4.1 Explain and apply The Analysis of soil: moisture,pH,total nitrogen , phosphorus, silica, lime, magnesia, manganese, sulphur and alkali salts. **SO4.2** Explainanalysis of Fuelanalysis: solid, liquid and gas. **SO4.3** Explain the Ultimate and proximate analysis- heating values- grading coal. SO4.4Explain and apply Liquid fuels-flash point, aniline point, octane number and carbon residue. SO4.5 Explain and apply Gaseous fuels-producer gasand water gas – calorific values. chemistry.		Unit-4.0 Drug design, Pharmacokinetics & Pharmacodynamics The Analysis of soil: moisture,pH,total nitrogen. The Analysis of soil: phosphorus,silica, lime, magnesia. The Analysis of soil: manganese, sulphur and alkali salts. Introduction of Fuel analysis. Properties of fuel analysis. Fuel analysis.solid. liquid and gas. The Ultimate and proximateanalysis. heating values- grading coal. T1- Liquid fuels-flash point, anilinepoint, T2- octane number and carbonresidue. T3-Gaseous fuels-producer gas andwater gas –calorific values. chemistry.	The Analysis of soil: moisture,pH, total nitrogen , phosphorus.

SW-4 Suggested Sessional Work (SW):

a.Assignments:

Explain and apply The Analysis of soil: moisture,pH, total nitrogen , phosphorus, silica, lime, magnesia, manganese, sulphur and alkali salts.

b.Mini Project:

Explainanalysis of Fuel analysis: solid, liquid and gas.

c.Other Activities (Specify):

Explain and apply Liquid fuels-flash point, aniline point, octane number and carbon residue.

1CH501**.5**: Expertise in laboratory safety.

Activity	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning(SL)**
SO5.1 Explain and apply the Clinicalchemistry: Composition of blood collection and preservation of samples **SO5.2** Explain Clinical analysis .Serum electrolytes , blood glucose , blood urea nitrogen, uric acid,	.	**5. Clinical Chemistry:** Composition of blood collection and preservation of samples. Introduction of Clinicalanalysis . blood urea nitrogen.	Properties of Barbiturates, acid and alkaline phosphateses.
albumin,globulins. **SO5.3** Explain and apply effect of substrate structure, leaving group andattacking nucleophile in aromatic nucleophilic reactions. **SO5.4**Explain and apply The blood gas analysis trace elements in the body. **SO5.5** Explain and apply The **Drug analysis**: Narcotics and dangerousgrug.Classification of drugs.Screening by gas and thin-layar chromatography and spectrophotometric measurement		barbiturates, acid and alkaline phosphateses. Immunoassay principles of ratio immunoassay (RIA) and applications. The blood gas analysis trace elements in the body. Drug analysis: Narcotics and dangerous grug. Clinical analysis uric acid, Screening by gas and thin-layar chromatography and spectrophotometric measurement T1- Clinical analysis .Serum electrolytes , blood glucose. T2- Classification of drugs. T3-Properties of chromatography.	

SW-5 Suggested Sessional Work (SW):

a.Assignments:

Explain and apply effect of substrate structure, leaving group andattacking nucleophile in aromatic nucleophilic reactions.

b.Mini Project:

Clinical chemistry: Composition of blood collection and preservation of samples.

c.Other Activities (Specify):

Drug analysis: Narcotics and dangerous grug.Classification of drugs.Screening by gas and thin-layarchromatography and spectrophotometric measurement.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
76CH303.1: Explain and apply theoretical aspect of analytical chemistry.	12	02	01	15
76CH303.2 Analyse water, soil and biological fluid sample	12	02	01	15
76CH303.3: Explain and identify the errors occurred during chemical analysis	12	02	01	15
76CH303.4:Handle glass ware and reagent in scientificway	12	02	01	15
76CH303.5:Expertise in laboratory saftey	12	02	01	15
Total Hours	60	15	05	75

Suggestion for End Semester Assessment

Suggested Specification Table(ForESA)

CO	UnitTitles	MarksDistribution			Total Marks
		R	U	A	
CO-1	Introduction of analytical chemistry	03	01	01	05
CO-2	Errors and Evalution	02	06	02	10

CO-3	Analysis of water pollution	03	07	05	15
CO-4	Analysis of Soil, Fuel, Body Fluids and Drugs –l	-	10	05	15
CO-5	Analysis of Soil, Fuel, Body Fluids and Drugs -ll	03	02	-	05
Total		11	26	13	50

Legend: **R:Remember,** **U:Understand,** **A:Apply**

The end of semester assessment for Medicinal Chemistry and Natural Product I will be heldwith written examination of 50 marks

Note.Detailed Assessment rubric need to be prepared by the coursewise teachers for above tasks.Teachers can also design different tasks as perrequirement,for end semester assessment.

Suggested Instructional/ImplementationStrategies:

1. ImprovedLecture
2. Tutorial
3. CaseMethod
4. GroupDiscussion
5. RolePlay
6. Visitto NCL, CSIR laboratories
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/T utorialsCBT,Blog,Facebook,Twitter,Whatsapp,Mob ile,Onlinesources)
9. Brainstorming

Suggested Learning Resources:

(i) **Books:**

S. No.	Title	Author	Publisher	Edition& Year
1	A Textbook of QuantitativeInorganic Analysis	A. I. Vogel	Longman,	Edition,1966
2	Fundamentals of Analytical Chemistry	Douglas A. Skoog, DonaldM. West, F. James Holler, Stanley R. Crouch	Cengage Learning,2021	Edition, 2021
3	Physical methods in chemistry.	Drago, Russell S. ,MNB	Ft. Worth : Saunders College Pub.	Edition,2021
4	Introduction to magnetic resonance with applications to chemistry and chemical physics	Carrington, Alan	New York : Harper& Row	Edition,2019
5	Instrumentalmethodso fAnalysis	L. L.Merrit, R.H. Willard and J.A. Dean;VanNostrand-Reinhold.	D. Van Nostrand &Co.	Edition,2023

SuggestedWebSources:

26. https://nptel.ac.in/course.html
27. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5
28. https://swayam.gov.in/explorer?category=Chemistry

ModeofDelivery:Lecture,demonstration,E-tutoring,discussion,assignments,quizzes, case study, power point;

LMS/ICT Tools: Digital Classrooms, DLMS, ZOOM, G-Suite,MSPower-Point, Online Resources.

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Title: Organic Analytical ChemistryI

Course Code : 1CH501

	Program Outcomes												Program Specific Outcome			
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
Course Outcomes	Knowledge	Research Aptitude	Communication	Problem Solving	Individual and Team Work	Investigation of Problems	Modern Tool usage	Science and Society	Life-Long Learning	Ethics	Project Management	Environment and sustainability	The detailed functional knowledge of theoretical concepts and experimental aspects of chemistry	To integrate the gained knowledge with various contemporary and evolving areas in chemical sciences like analytical, synthetic, pharmaceutical etc.	understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomenon -based problems in chemical sciences.	Provide opportunities to excel in academics, research or Industry by research based innovative knowledge for sustainable development in chemical science

CO1:Explain and apply theoretical aspect of analytical chemistry.	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**
CO2:Analyse water, soil and biological fluid sample.	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
CO3 Explain and identify the errors occurred during chemical analysis	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO4: Handle glass ware and reagent in scientific way	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO5: Expertise in laboratory saftey	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend:1–Low,2–Medium, 3–High

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Course Curriculum Mapping

POs &PSOsNo.	Cos No.&Titles	SOsNo.	LaboratoryInstruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO1: Explain and apply theoretical aspect of anytical chemistry.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1: 1.1,1.2,1.3,1.4,1.5,1.6,1.7, 1.8, 1.9 T1, T2,T3	Techniques of weighing, errors.
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO2:Analyse water, soil and biological fluid sample	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2: 2.1,2.2,2.3,2.4,2.5,2.6, 2.7, 2.8,2.9 T1, T2,T3	Properties and types of error in experimental data determinate.
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO3:Explain and identify the errors occurred during chemical analysis	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3 : 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9 T1, T2,T3	General survey of instrumental techniques for the analysis of heavy metals in aqueous systems.
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO4: Handle glass ware and reagent in scientific way	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4 : 4.1,4.2,4.3,4.4,4.5, 4.6,4.7,4.8,4.9 T1,T2,T3	The Analysis of soil: moisture,pH, total nitrogen , phosphorus.
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO5: Expertise in laboratory saftey	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit 5: 5.1,5.2,5.3,5.4,5.5,5.6,5.7, 5.8,5.9. T1,T2, T3	Properties of Barbiturates, acid and alkaline phosphateses.

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Course CODE: 2CH501

Course Titel: Green Chemistry

Pre-requisite: Students should have basic knowledge of chemistry
Rtional: After completion of course student will promote, develop and design environment benign chemical process and products.

COURSEOUTCOMES:

Afterthe completion of this course, the learner will

CO1 **2CH501.1**: Explain and apply concept and principle of green chemistry
CO2 **2CH501.2**: Design environment sustainable and economical route of a synthesis.
CO3 **2CH501.3**: Adopt renewable and alternate resources of energy in various

processes
CO4 **2CH501.4**: Solve environmental issues by adopting the principle of green chemistry

UNIT I

PRINCIPLES & CONCEPT OF GREEN CHEMISTRY: Introduction, Concept and Principles, development of Green Chemistry, Atom economy reactions–rearrangement reactions, addition reactions, atom uneconomic-sublimation,elimination, Wittig reactions, toxicity measures, Need of Green Chemistry in our day-to-day life.

UNIT II

EMERGING GREEN TECHNOLOGY AND ALTERNATIVE ENERGY SOURCES :

Design for Energy efficiency, Photo-chemical reactions, Advantages & Challenge faced by photochemical process. Microwave technology on Chemistry, Microwave heating, Microwave assisted reactions, Sono chemistry and Green Chemistry, Electrochemical Synthesis, Examples of Electrochemical synthesis.

UNIT III

RENEWABLE RESOURCES: Biomass, Renewable energy, Fossil fuels, Energy from Biomass, SolarPower, Otherformsofrenewableenergy,FuelCells,Alternativeeconomics,Syngaseconomy,hydrogeneconomy, Some other natural chemical resources.

UNIT IV

INDUSTRIAL CASE STUDIES: Methyl Methacrylate (MMA), Greening of Acetic acid manufacture, Dyeing, Application, Polyethylene, Ziegler-Natta Catalysis, Metallocene Catalysis, Eco friendly Pesticides-Insecticides.

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Scheme of Studies:

Board ofStudy	Course Code	CourseTitle	Scheme of studies(Hours/Week)					Total Credits(C)
			Cl	LI	SW	SL	Total Study Hours(CI+LI+SW+SL)	
ProgramCore(DCC)	2CH501	Green Chemistry	4	0	1	1	6	4

Legend: **CI:** Class room Instruction (Includes different in structional strategies i.e. Lecture (L) andTutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other location susing different in structional strategies)
SW: Sessional Work (includes assignment, seminar, mini-project etc.),
SL: Self Learning,
C: Credits.

Note: SW& SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme o fAssessment: Theory

Board ofStudy	Couse Code	CourseTitle	SchemeofAssessment(Marks)						
			ProgressiveAssessment(PRA)					EndSemesterAssessment	Total Marks
			Class/HomeAssignment5 number 3 markseach (CA)	Class Test2 (2bestout of3) 10 marks each(CT)	Seminarone (SA)	ClassAttendance (AT)	TotalMarks (CA+CT+SA+AT)	(ESA)	(PRA+ESA)
DCC	**2CH501**	**Green Chemistry**	15	20	10	5	50	50	100

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Course-Curriculum Detailing:
This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

2CH501.1: explain and apply concept and principle of green chemistry

Activity	**AppX Hrs**
Cl	10
LI	0
SW	2
SL	1
Total	09

Session Outcomes (SOs)	**Laboratory Instruction(LI)**	**Class room Instruction(CI)**	**Self Learning (SL)**
SO1.1 understand basics of green chemistry SO1.2 explain basic principles of green chemistry SO1.3 understand rearrangements reactions SO1.4 Explain addition reactions, atom uneconomic- sublimation , elimination,witting reactions SO1.5 Understand need of green chemistry in our day to day life		Unit-1 1.1Introduction, Concept and Principles, 1.2DevelopmentofGreenChemistry, 1.3Atomeconomyreactions–rearrangementreactions, 1.4Additionreactions, atomuneconomic-sublimation, elimination, Wittig reactions 1.5Toxicity measures, 1.6NeedofGreenChemistryin our day-to-daylife. 1.8 applications	Understand need of green chemistry day to day life.

SW-1SuggestedSessionalWork(SW):

a. Assignments: Discuss the principle of green chemistry and their synthesis

b. Mini Project:
chart on uses of green chemistry in day to day life
c. Other Activities (Specify):
Note on green synthesis reactions

2CH501: 2: design environment sustainable and economical route of a synthesis.

Activity	**AppX Hrs**
Cl	07
LI	0
SW	2
SL	1
Total	10

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO2.1 Understand greensynthesis techniques **SO2.2** Explain alternative energysources **SO2.3** Understand photochemical reactions and advantages and challenges facedby photochemical process **SO2.4** Explain Microwave technology , microwave heatingand microwave assisted reactions **SO2.5** Understand sono chemistry ,Green chemistry & Electrochemical synthesis with example		**Unit-2:** Design for Energy efficiency, Photochemical reactions, Advantages & Challenge faced byphotochemical process. 2.4Microwavetechnolog yonChemistry, 2.5Microwave heating, and Microwave assisted reactions, T-1SonochemistryandGreenChemistry,T-2 Electrochemical Synthesis, Examples of Electrochemical synthesis.	Studied different type of green synthesis techniques .

SW-2 Suggested Sessional Work (SW):

a. **Assignments:**
Apply different type of green synthesis techniques.

b. **Mini Project:**
Prepare chart on green synthesis techniques.

c. **Other Activities (Specify):**
Write an essay on sono chemistry and green chemistry

2CH501.3:Adoptrenewable andalternate resourcesof energy in various processes

Activity	**AppX Hrs**
Cl	10
LI	0
SW	2
SL	1
Total	10

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning(SL)**
SO3.1 Describe basics of Renewableresources **SO3.2** Explain Biomass ,Renewableenergy & Fossil fuels **SO3.3** Explain Solar power & otherforms of renewable energy and fuels **SO3.4** Understand alternative economics ,syngas economy and hydrogen economy **SO3.5** Explain some other natural chemical resources		**Unit-3 3.1** Biomass, Renewable energy from Fossilfuels, Energy fromBiomass SolarPower, Otherformsofrenewableenergy,FuelCells, Alternativeeconomics, T-1Syngaseconomy,hydrogeneconomy, T-2 Someothernaturalchemical resources.	Learn some other natural chemical resources

SW-3 Suggested Sessional Work (SW):

a. **Assignments:** Discuss the renewable energy resources

b. **Mini Project:** Pictorial presentation of renewable energy

c. **Other Activities (Specify):**

Explanatory note on importance of renewable resources

2CH501.4: Solve environmental issues which can be solved by adopting the principle of green chemistry

Activity	AppX Hrs
Cl	10
LI	0
SW	2
SL	1
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning(SL)
SO4.1 Discuss basics of industrial case studies **SO4.2** Explain Methyl Methacrylate & greening of acetic acid **SO4.3** Explain and apply dyeing and its application **S04.4** Explain polyethylene , Ziegler Natta Catalysis ,Metallocene catalysis, Ecofriendly pesticides-insecticides		**Unit-4** 4.1Methyl Methacrylate (MMA), 4.2 Greening of Acetic acid manufacture, 4.3Dyeing, Application, Polyethylene, Ziegler-Natta Catalysis,T-1 Metallocene Catalysis,T-2 Eco friendlyPesticides-Insecticides.	Eco friendly pesticides & insecticides

SW-4 Suggested Sessional Work (SW):

a. **Assignments:**
Note on natural dyes

b. **Mini Project:**

Prepare chart on Ziegler-Natta catalysis.

c. Other Activities (Specify):

Importance and applications of greening of acetic acid manufacture.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning(Sl)	Total hour (Cl+SW+Sl)
2CH501.1: Explain and apply concept and principle of green chemistry .	10	02	01	10
2CH501.2 Design Environment sustainable and economical routeof a synthesis	12	02	01	12
2CH501.3: Adopt renewable and alternate resources of energy in various processes	10	02	01	10
2CH501.4: Solve environmental issues which can be solved by adopting the principle of green chemistry	10	04	02	10
Total Hours	42	12	06	60

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Principle & Concept of Green Chemistry	03	01	01	05
CO-2	Emerging Green Technology and Alternative Energy sources	02	06	02	10
CO-3	Renewable resources	03	07	05	15
CO-4	Industrial case studies	-	10	05	15

Total	11	26	13	50

Legend:R:Remember, U:Understand, A:Apply

The end of semester assessment for Organic Chemistry I willbeheldwithwrittenexaminationof50 marks

Note.DetailedAssessmentrubricneedtobepreparedbythecoursewiseteachersforabovetasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

28. Improved Lecture
29. Tutorial
30. Case Method
31. Group Discussion
32. Role Play
33. Visit to NCL, CSIR laboratories
34. Demonstration
35. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
36. Brainst

Suggested Learning Resources:

(j) Books:

S. No.	Title	Author	Publisher	Edition& Year
1	GreenChemistryandIntroductorytext,	MikeLancaster,		IIEdition
2	P.T.AnastasandJ. C Warner,GreenChemistrytheoryandPractice	V Kumar	OxfordUniversitypress,Oxford	OxfordUniversitypress,Oxford(1988)
3	ATextBookofGreenChemistry	Sankar P. Dey Nayim Sepay	ProttiD.Dondi*et.al.*, GreenChemistry	
4	Green Chemistry A Text Book	V.K. Abdullah		
5	An Introductory Texton Green Chemistry	Indu Tucker Sidhwani Rakesh K. Sharma	Wiley	Blaclwell ,London(2007)

SuggestedWebSources:

32. https://nptel.ac.in/course.html
33. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5
34. https://swayam.gov.in/explorer?category=Chemistry

ModeofDelivery:Lecture,demonstration,E-tutoring,discussion,assignments,quizzes, case study, power point;

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LMS/ICT Tools: Digital Classrooms, DLMS, ZOOM, G-Suite,MS Power-Point, Online Resources

Cos, Pos and PSOs Mapping

Title: Green Chemistry **Course Code : 2CH501**

	Program Outcomes												Program Specific Outcome			
	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
Course Outcomes	**Knowledge**	**Research Aptitude**	**Communication**	**Problem Solving**	**Individual and Team Work**	Investigation of Problems	**Modern Tool usage**	**Science and Society**	**Life-Long Learning**	**Ethics**	**Project Management**	**Environment and sustainability**	**The detailed functional knowledge of theoretical concepts and experimental aspects of chemistry**	**To integrate the gained knowledge with various contemporary and evolving areas in chemical sciences like analytical, synthetic, pharmaceutical etc.**	**understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomenon -based**	**Provide opportunities to excel in academics, research or Industry by research based innovative knowledge for sustainable**

															problems in chemical sciences.	**development in chemical science**
CO1 Explain and apply concept and principle of green chemistry .	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**
CO 2 Design environmentsustainab leand economicalroute ofasynthesis	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
CO3 Adopt renewable and alternate resources of energy in various process	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO 4: Solve environmental issues which can be solved by adopting the principle of green chemistry	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**

Legend:1–Low,2–Medium, 3–Hig

.

Curriculum Map:

POs &PSOsNo.	COsNo.&Titles	SOsNo.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO-1Explain and apply concept and principle of green chemistry	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 Principle & Concept of Green Chemistry 1.1,1.2,1.3,1.4,1.5, T-1,T-2	Understand need of green chemistry day to day life
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO 2: Design environmentsustainableand economicalroute ofasynthesis	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2 Emerging Green Technology and Alternative Energy sources 2.1,2.2,2.3,2.4,2.5,T-1,T-2	. Studied different type of green synthesis techniques
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO3 : Adopt renewable and alternate resources of energy in various process	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit3 Renewable resources 3 3.1, 3.2,3.3,3.4,3.5,T-1,T-2	Understand natural chemical resources
PO1,2,3,4,5,6 7,8,9,10,11,12	CO 4: : Solve environmental issues which can be solved by adopting the principle of green chemistry	SO4.1 SO4.2 SO4.3 SO4.4		Unit-4 : Industrial case studies 4.1, 4.2,4.3,4.4,	Eco friendly pesticides & insecticides

PSO 1,2, 3, 4		SO4.5		4.5,T -1,T-2	

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Course Code: 1GO501

Course Title: Mining Geology-Mineral Beneficiation

Pre-requisite: Student should have basic knowledge of scope and purpose of geology, Rocks, Minerals, various methods of age determination of rock and minerals.

Rationale: The students studying Mining Geology should possess foundational understanding about principles of Stratigraphy mineral resource distribution. They must have knowledge of economic value of minerals. They should be able to prospect the minerals through various methods.

Course Outcomes:

1GE501.1: Student will acquire knowledge about Mining and related terminology.
1GE501.2: Students will learn mining methods and their classification.
1GE501.3: Students will acquire knowledge about mineral beneficiation process and its importance.
1GE501.4: Students will learn how crushing process is important during mineral beneficiation.
1GE501.5: Students will learn how particle separation method helps during mineral beneficiation.

Scheme of Studies:

Board of Study	**Course Code**	**Course Title**	**Scheme of studies(Hours/Week)**						
			Cl	**LI**	**T**	**SW**	**SL**	**Total Study Hours(CI+LI+T+SW+SL)**	**Total Credits (C)**
Program Core (PCC)	1GE501	Mining Geology-Mineral Beneficiation	3	2	1	1	1	8	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI : Lab instruction

SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Board of Study	Course Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	**(ESA)**	(PRA+ ESA)
PCC	1GE 501	Mining Geology - Mineral Beneficiation	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:
This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

GE501.1: Student will acquire knowledge about Mining and related terminology.

Approximate Hours

Items	Approx. Hrs
CI	9
LI	6
T	3
SW	2
SL	1
Total	21

Session Outcomes (SOs)	Lab Instructions	Classroom Instruction (CI)	Self Learning (SL)
SO1. Mining terminology classification of mining method. **SO1.2** Alluvial mining and opencast mining methods. **SO1.3** Underground mines ventilation and Draining of water. **SO1.4** Introduction of ocean bottom mining.	1.1 Physical identification of mineral on the basis of physical properties of following economic minerals; Magnetite, Hematite, Limonite, Goethite, Siderite, Pyrite. 1.2 Physical identification of mineral on the basis of physical properties of following economic minerals; Ilmenite, Pyrolusite, Psilomelane, Braunite, Chromite	**Unit-1: Introduction to Mining Geology.** 1.1 Mining terminology. 1.2 Mining methods. 1.3 Classification of Mining methods. 1.4 Opencast mining or quarrying. 1.5 Opencast mining methods. 1.6 Glory hole mining and Strip mining. 1.7 Alluvial mining methods. 1.8 Underground mining. 1.9 Underground mining methods. **Tutorial** 1.1 Underground mine ventilation. 1.2 Underground mine Draining of water. 1.3 Ocean Bottom Mining.	I. Compare opencast mine and undergroun d mine.

SW-1 Suggested Sessional Work (SW):

Assignments:

1. Discuss the classification of Mining.

Mini Project:

1. Report on minerals mined from Sea bed.

Other Activities (Specify):

1. Power point presentation on underground mining method.

1GE501.2: Students will learn mining methods and their classification.

Approximate Hours

Item	Approx. Hrs
CI	9
LI	6
T	3
SW	2
SL	1
Total	21

Session Outcomes (SOs)	Lab Instructions	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 Types of stopes. **SO2.2** Board/ Room and Pillar coal mining methods. **SO2.3** Long-wall advancing and Long-wall retreating coal mining methods. **SO2.4** Environmental impact of mining activities.	2.1 Physical identification of mineral on the basis of physical properties of following economic minerals; Chalcopyrite, Covellite, Bornite, Malachite, Azurite, Cuprite, Bauxite, Galena, Sphalerite, 2.2 Physical identification of mineral on the basis of physical properties of following economic minerals; Cassiterite, Wolframite, Molybdenite, Stibnite, Orphiment, Realgar.	**Unit-2: Mining methods.** 2.1 Open stopes, 2.2 Overhand stoping-with supports. 2.3 Coal mining methods. 2.4 Board and pillar method. 2.5 Board and Pillar with panels. 2.6 Long-wall advancing method 2.7 Long-wall retreating method. 2.8 Horizon mining. 2.9 Underground hydraulic mining. **Tutorial** 2.1 Striping Mining. 2.2 Environmental impact	i. Read how coal mining is different from metal mining.

		of mining. 2.3 Impact of mining in Ground water.	

SW-2 Suggested Sessional Work (SW):

Assignments:

I. Discuss the Long-wall advancing and Long-wall retreating coal mining methods.
II. Discuss the types of Stopes.

Mini Project:

I. Make a report on Board/ Room and Pillar coal mining methods.

Other Activities (Specify):

I. Compare between Long-wall advancing and Long-wall retreating coal mining methods.

GE501.3: Students will acquire knowledge about Drilling processes and its importance during prospecting.

Approximate Hours

Item	Approx. Hrs
CI	12
LI	6
T	3
SW	2
SL	1
Total	21

Session Outcomes (SOs)	Lab Instructions	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 Drilling and purpose of drilling. **SO3.2** Classification of drilling. **SO3.3** Churn drilling method. **SO3.4** Diamond Drilling.	3.1 Identification of hand specimen of non metallic minerals like Asbestos, Barite, Calcite, China-clay, Corundum, 3.2 Identification of hand specimen of non metallic minerals Fluorite, Graphite, Gypsum, Garnet,	**Unit-3:** Drilling Methods. 3.1 Drilling definition. 3.2 Objective of drilling. 3.3 Classification of Drilling 3.4 Percussion Drilling method. 3.5 Rotary mining drilling. 3.6 Churn drill. 3.7 Diamond Drilling. 3.8 Miscellaneous types of drilling. 3.9 Drilling Machine classification. **Tutorial**	i. Compare drilling in hard rock terrain and soft rock terrain.

		3.1 Problems in drilling. 3.2 Bore hole logging. 3.3 Preservation and sampling of core.	

SW-3 Suggested Sessional Work (SW):

Assignments:

1. Discuss about role of drilling in prospecting and mining.
2. Discuss how hard rock drilling is different from soft rock drilling.

Mini Project:

1. Prepare a report on Diamond drilling.

Other Activities (Specify):

1. Compare between Churn drilling and Diamond drilling.

1GE501.4: Students will learn how crushing process is important during mineral beneficiation.

Approximate Hours

Item	Approx. Hrs
CI	12
LI	6
T	3
SW	2
SL	1
Total	21

Session Outcomes (SOs)	**Lab Instructions**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4.1 Types of Crushers. **SO4.2** Types of Grinding mills. **SO4.3** Industrial Screening **SO4.4** Laboratory sizing of Particles.	4.1. Identification of hand specimen of non metallic minerals like Apatite, Quartz, Sillimanite, Wollastonite, 4.2 Identification of hand specimen of non metallic minerals like Talc, Magnesite, Fireclay, Kyanite, Mica.	**Unit-4:** Mineral Beneficiation 4.1Mineral beneficiation/Ore dressing. 4.2 Ore dressing Processes. 4.3 Process of crushing and its importance in mineral beneficiation. 4.4 Types of crushers. 4.5 Factors affecting efficiency of crushers. 4.6 Manual Crushing. 4.7 Process of Grinding and its importance in mineral beneficiation. 4.8 Types of grinding and	i. ompare crushing and grinding processes.

		grinding machine. 4.9 process of Industrial screening. **Tutorial** 4.1 Sizing by Screening. 4.2Classifers. 4.3 Miscellaneous.	

SW-4 Suggested Sessional Work (SW):

Assignments:

1. Discuss about Types of crushers use in mineral beneficiation.
2. Evaluate industrial screening in mineral beneficiation.

Mini Project:

1. **Visit a mining industry and prepare a report on mineral beneficiation.**

Other Activities (Specify):

1. Power Point Presentation on Crushing, Grinding and industrial screening processes.

1GE501.5: Students will learn how particle separation method helps during mineral beneficiation.

Approximate Hours

Item	Approx. Hrs
CI	12
LI	6
T	3
SW	2
SL	1
Total	21

Session Outcomes (SOs)	Lab Instructions	Classroom Instruction (CI)	Self Learning (SL)

SO5.1 Gravity separation. **SO5.2** Magnetic separation. **SO5.3** Heavy Medium separation. **SO5.4** Floatation technique of separation.	5.1 Distribution of economic minerals in the outline map of India. 5.2 Identification of Raw material and minerals as Various finished products.	**Unit 5:** Particles separation methods. 5.1 Introduction to particle separation method used in mineral beneficiations. 5.2 Gravity separation method. 5.3 Magnetic separation method. 5.4 Electrostatic separation method. 5.5 Heavy Medium separation. 5.6 Floatation. 5.7 Conditioning and collection process in Floatation. 5.8 Levitation and Frothing. 5.9 Miscellaneous method of particle separation. **Tutorial** 5.1 Amalgamation and Dewatering. 5.2 Thickening and Filtration. 5.3 Flow sheets.	1. Study about mineral separated by gravity separation method.

SW-5 Suggested Sessional Work (SW):

d. Assignments:

i. Discuss froth floatation method of particle separation method.

e. **Mini Project:**

Prepare power point presentation for application gravity and magnetic separation method.

f. Other Activities(Specify):

List out minerals separated by different particle separation method.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CL)	Lab instruction	Tutorial (T)	Sessional Work (SW)	Self Learning (SL)	Total hour (CL+SW+T +SL)
1GE501**.1:** Student will acquire knowledge about Mining and related terminology.	9	6	3	2	1	21
1GE501**.2:** Students will learn mining methods and their classification.	9	6	3	2	1	21
1GE501**.3:** Students will acquire knowledge about Drilling processes and its importance	9	6	3	2	1	21

during prospecting.						
1GE501**.4:** Students will learn how crushing process is important during mineral beneficiation.	9	6	3	2	1	21
1GE501**.5:** Students will learn how particle separation method helps during mineral beneficiation.	9	6	3	2	1	21
Total Hours	45	30	15	10	5	105

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Introduction to Mining Geology.	03	01	01	05
CO-2	Mining Methods.	02	06	02	10
CO-3	Drilling Methods.	03	07	05	15
CO-4	Mineral Beneficiation	-	10	05	15
CO-5	Particles separation methods.	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U:Understand, A:Apply

The end of semester assessment for Mining Geology-II will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to running mine
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
9. Brainstorming

Suggested Learning Resources:

Suggested Readings

1. Arogyaswamy, R.N.P. courses in mining geology. Oxford and IBH publishing company, 4th edition,2017.
2. Deb, S. Industrial Minerals and Rocks of India, Allied Publishers Pvt, Ltd.,1980.
3. Lal, J.K., Ore Geology and Mining Geology; Anmol Publications Pvt, Ltd., 2013.
4. Hartman Howard L., Jan M. Mutmansky; Introductory Mining Engineering,2nd ED, Wiley India ED.,2002.

Digital platform web link

1. https://mines.gov.in/UserView?mid=1319
2. https://www.mines.ap.gov.in/miningportal/Downloads/NewDocs/National%20mineral%20Policy.pdf
3. https://ibm.gov.in/writereaddata/files/03202018150002PNG_AR_2017. pdf [for the petroleum and natural gas occurrences in India,2018]
4. https://ibm.gov.in/writereaddata/files/10192020104607 Coal_2019_R.pdf

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Cos, Pos and PSOs Mapping

Program Title: B.Sc Geology

Course Code: 1GE501

Course Title: Mining Geology-Mineral Beneficiation

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO1 0	PO1 1	PO 12	PSO1	PSO2	PSO3	PSO4
	Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool usage	The engineer and society	Environment and sustain ability:	Ethics	Individual and teamwork:	Communication:	Project management And finance:	Life-long learning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and	Development of the base for innovation & research in the field of mining geology
CO-1 Student will acquire knowledge about Mining and	1	2	-	1	-	2	1	2	2	1	-	2	2	3	2	-
CO-2 Students will learn mining methods and their classification.	1	1	2	2	1	2	3	2	1	1	2	2	2	-	2	1
CO-3 Students will acquire knowledge about Drilling processes and its importance during prospecting of minerals.	-	-	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO-4 Students will learn how crushing process is important during mineral	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2

CO-5 Students will learn how particle separation method helps during mineral beneficiation	1	2	1	-	1	3	3	3	-	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–High

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Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,67, 8,9,10,11,12 PSO1,2,3,4	CO-1 Student will acquire knowledge about Mining and related terminology.	SO1.1 SO1.2 SO1.3 SO1.4	Unit- Introduction to Mining Geology.1.0 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9. Tutorial 1.1, 1.2,1.3	As mentioned in Page number 2to6
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-2 Students will learn mining methods and their classification.	SO2.1 SO2.2 SO2.3 SO2.4	Unit-2 Mining Methods. 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9. Tutorial 2.1,2.2,2.3	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-3 Students will acquire knowledge about Drilling processes and its importance during prospecting.	SO3 .1 SO3 .2 SO3.3 SO3.4	Unit-3: Drilling Methods. 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9. Tutorial 3.1,3.2,3.3	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-4 Students will learn how crushing process is important during mineral beneficiation.	SO4.1 SO4.2 SO4.3 SO4.4	Unit-4: Mineral Beneficiation 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9. Tutorial 4.1,4.2,4.3	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO -5 Students will learn how particle separation method helps during mineral beneficiation.	SO5.1 SO5.2 SO5.3 SO5.4	Unit5: Particles separation methods. 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9. Tutorial 5.1,5.2,5.3,	

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(Revised as on 01 August 2023)

Curriculum Team:

1. Dr. B.K. Mishra HoD Department of Miming, AKS University, Satna (M.P.).
2.Mr. P.C. Tiwari Asst. Prof. Department of Miming, AKS University, Satna (M.P.).
3.Miss. Ritu Patel Asst. Prof. Department of Miming, AKS University, Satna (M.P.).

Course Code: **2GO501**

Course Title: **Mineral resources of India.**

Pre-requisite: Student should have basic knowledge of scope and purpose of geology, Rocks, Minerals, various methods of age determination of rock and minerals.

Rationale: The students studying Mining Engineering should possess foundational understanding about principles of Stratigraphy mineral resource distribution. They must have knowledge of economic value of minerals. They should be able to prospect the minerals through various methods.

Course Outcomes:

1GE502.1: Develop an understanding of the natural processes associated with the formation of mineral deposits
1GE502.2: Students will learn processes of of ore formation specially sedimentary and metamorphic deposits.
1GE502.3: Students will learn about metallic mineral resources-1 of India, their origin and occurrences.
1GE502.4: Students will learn about metallic mineral resources-2 of India, their origin and occurrences.
1GE502.5: Students will learn about nonmetallic mineral wealth of India, their origin and occurrences.

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies(Hours/Week)				
			Cl	**SW**	**SL**	**Total Study Hours(CI+LI+SW+SL)**	**Total Credits (C)**
Program Core (DSE)	2GO501	Mineral resources of India.	3	1	1	9	4

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

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Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Board of Study	Course Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	**(ESA)**	(PRA + ESA)
DSE	2GO501	Mineral resources of India.	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:
This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

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2GO501.1: Develop an understanding of the natural processes associated with the formation of mineral deposits

Approximate Hours

Item	Approx. Hrs
Cl	9
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Classroom Instruction (CI)	Self Learning (SL)
SO1.1 Introduction to Economic Geology. **SO1.2** Processes of mineral deposit Formation. **SO1.3** Magmatic concentration processes. **SO1.4** Hydrothermal processes. **SO1.5** Contact metsomatic replacement processes.	**Unit-1Introduction and processes of mineral deposit formation.** 1.1 Introduction to Economic Geology. 1.2 Classification of mineral deposits. 1.3 Geological thermometry. Magmatic processes of ore formation. 1.4 Classification of Magmatic processes of ore formation. 1.5 Hydrothermal processes. Classification of 1.6 Hydrothermal deposits. 1.7 Cavity filling deposits. 1.8 Contact metasomatic 1.9 Replacement processes.	3. Find out India biggest magmatic deposits study their geological conditions.

SW-1 Suggested Sessional Work (SW):

A. Assignments:
Discuss hydrothermal deposits and its types in Detail.

B. **Mini Project:**
Make a flow chart of classification of magmatic ore deposit.

C. **Other Activities (Specify):**
Make a report on any hydrothermal ore deposit of India and study their geology.

2GO501.2: Students will learn processes of ore formation specially sedimentary and metamorphic deposits.

Approximate Hours

Item	Approx. Hrs
Cl	9
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 Sedimentary ore Deposit Formation. **SO2.2** Oxidation and Supergene Sulphide Enrichment processes. **SO2.3** Mechanical concentration processes. **SO2.4** Residual processes ore formation. **SO2.5** Metamarphic Ore Deposits.	**Unit-2: Processes of mineral deposit formation**. 2.1 Sedimentary ore Deposit Formation. 2.2 Oxidation and Supergene Sulphide Enrichment processes. 2.3 Reaction involved in Oxidation and Supergene Sulphide Enrichment processes. 2.4 Gossans and Box work structure. 2.5 Mechanical concentration processes. 2.6 Placer Deposits. 2.7 Residual processes of ore formation. 2.8 Metamorphic Ore Deposits. 2.9 Classification of metamorphic ore Deposits.	ii. Study bauxite deposits of Madhya Pradesh and also find out role of climate in formation of Bauxite.

SW-2 Suggested Sessional Work (SW):

Assignments:

1. Discuss the sedimentary process of ore formation of economic minerals.

Mini Project:

1. Show economic minerals zones in India map.

Other Activities (Specify):

1. Compare between Mechanical concentration of ore deposit and Residual ore deposits.

2GO501.3: Students will learn about metallic mineral resources-1 of India, their origin and occurrences.

Approximate Hours

Item	Approx. Hrs
Cl	9
SW	2
SL	1
Total	12

Session Outcomes (SOs)	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO3.1 With reference to their mode of occurrences, ore minerals and chemical composition, geographic distribution and economic uses , Evaluate about	**Unit-3 :Metallic mineral resources of India.** 3.1 Aluminium ore mineral, occurrences and deposit. 3.2 Aluminium ore deposits classification .	ii. Study of porphyry copper ore deposit of world with reference to origin.

aluminum **SO3.2** Evaluate about Chromium. **SO3.3** Evaluate about Gold and Copper. **SO3.4** Evaluate about Lead deposits **SO3.5** Assess Origin and occurrence of Zinc deposits.	3.3 Chromium ore deposit. 3.4 Sukinda-Naushahi ore deposits and its genesis. 3.5 Copper ore deposit 3.6 Gold ore deposit. 3.7 Lead ore deposit. 3.8 Zinc ore deposit. 3.9 Lead Zinc ore deposit distribution in India.	

SW-3 Suggested Sessional Work (SW):

Assignments:

1. Discuss about Lead and Zinc minerals, Occurrences and deposits in India.

Mini Project:

1. Study about kolar gold field and prepare a short report on it.

Other Activities (Specify):

1. Visit Malanjhkhand copper mine of Madhya Pradesh.

2GO501.4: Students will learn about metallic mineral resources-2 of India, their origin and occurrences.

Approximate Hours

Item	Approx. Hrs
Cl	9
SW	2
SL	1
Total	12

s

Session Outcomes (SOs)	Classroom Instruction (CI)	Self Learning (SL)

SO4.1 With reference to their mode of occurrences, ore minerals and chemical composition, geographic distribution and economic uses, Evaluate about Iron. **SO4.2** Manganese. **SO4.3** Titanium and Tin **SO4.4** Uranium and Thorium **SO4.5** Mineral wealth of Madhya Pradesh.	**Unit-4:** 4.1 Iron ore in India 4.2 Distribution of Iron ore Deposits of India. 4.3 Difference between Ironstones and banded iron Formation. 4.4 Manganese minerals and deposits in India 4.5 Tin Deposits in India. 4.6 Titanium deposits in India. 4.7 Uranium mineral and its deposit. 4.8 Thorium Deposits in India. 4.9 Mineral wealth of Madhya Pradesh.	1.1 Study about Tin, Titanium, Thorium and Uranium mineral deposits as a placer deposits.

SW-4 Suggested Sessional Work (SW):

Assignments:

1. Discuss about Iron ore minerals and its deposit in India.

Mini Project:

1. Prepare a map that shows heavy placer deposits in India.

Other Activities (Specify):

1. Power Point Presentation on Mineral wealth of Madhya Pradesh.

2GO501.5: Students will learn about nonmetallic mineral wealth of India, their origin and occurrences.

Approximate Hours

Item	Approx. Hrs
Cl	9
SW	2
SL	1
Total	12

Session Outcomes (SOs)	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO5.1 With reference to their mode of occurrences, ore minerals and chemical composition, geographic distribution and economic uses, Evaluate about Asbestos, Barite, Beryl, Corundum, Diamond. **SO5.2** Dolomite, Fireclay, Fluorite, Graphite, Gypsum. **SO5.3** Kynite-Sillimanite, Magnesite, Mica and Talc **SO5.4** Minerals used in Fertilizes and Cement Industries.	**Unit 5: Non-Metallic Deposits in India.** 5.1 Asbestos, Beryl and Barite. 5.2 Barite and Corundum, 5.3 Diamond. 5.4 Dolomite, Fireclay, Fluorite, 5.5Graphite and Gypsum mineral and Deposits. 5.6 Kynite-Sillimanite-Andalusite. 5.7 Magnesite, Mica and Talc 5.8 Minerals used in Fertilizer industries. 5.9 Minerals used in Cement Industries.	1.1 Study about mineral used in Glass and Ceramic industry.

SW-5 Suggested Sessional Work (SW):

Assignments:

1. Discuss the diamond deposits of India.

Mini Project:

1. Prepare power point presentation for dolomite and Limestone and its effect on Cement Industries.

Other Activities (Specify):

1. List out Gem minerals found in India with their occurrences and use.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture	Sessional	Self	Total hour

	(Cl)	Work (SW)	Learning (Sl)	(Cl+SW+Sl)
2GO501.1: Develop an understanding of the natural processes associated with the formation of mineral deposits.	9	2	1	12
2GO501.2: Students will learn processes of ore formation specially sedimentary and metamorphic deposits.	9	2	1	12
2GO501.3: Students will learn about metallic mineral resources-1 of India their origin and occurrences.	9	2	1	12
2GO501.4: Students will learn about metallic mineral resources-2 of India their origin and occurrences.	9	2	1	12
2GO501.5: Students will learn about nonmetallic mineral wealth of India their origin and occurrences..	9	2	1	12
Total Hours	45	10	5	60

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Introduction and mineral deposit formation.	03	01	01	05
CO-2	Processes of mineral deposit formation	02	06	02	10
CO-3	Metallic mineral resources of India-1	03	07	05	15
CO-4	Metallic mineral resources of India-2	-	10	05	15
CO-5	Non metallic deposits of India.	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U:Understand, A:Apply

The end of semester assessment for Mineral resources of India will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
9. Brainstorming

Suggested Learning Resources:

Suggested Readings

5. Arogyaswamy, R.N.P. courses in mining geology. Oxford and IBH publishing company, 4th edition,2017.
6. Deb, S. Industrial Minerals and Rocks of India, Allied Publishers Pvt, Ltd.,1980.
7. Lal, J.K., Ore Geology and Mining Geology; Anmol Publications Pvt, Ltd., 2013.
8. Hartman Howard L., Jan M. Mutmansky; Introductory Mining Engineering, 2nd ED, Wiley India ED.,2002.

Digital platform web link

5. https://mines.gov.in/UserView?mid=1319
6. https://www.mines.ap.gov.in/miningportal/Downloads/NewDocs/National%20mineral%20Policy.pdf
7. https://ibm.gov.in/writereaddata/files/03202018150002PNG_AR_2017. pdf [for the petroleum and natural gas occurrences in India,2018]
8. https://ibm.gov.in/writereaddata/files/10192020104607 Coal_2019_R.pdf

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Cos, Pos and PSOs Mapping

Program Title: B.Sc Geology
Course Code: 2GO501
Course Title Mineral resources of India

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustain ability:	Ethics	Individual and teamwork:	Communication:	Project management And finance:	Life-long learning	Develop analytical skills in identifying and accordingly take actions for solution of problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of geology.
Co-1 Develop an understanding of the natural processes associated with the formation	1	2	-	1	-	2	1	2	2	1	-	2	2	3	2	-

CO-2 Students will learn processes of of ore formation specially sedimentary and metamorphic	1	1	2	2	1	2	3	2	1	1	2	2	2	-	2	1
CO-3 Students will learn about metallic mineral resources-1 of India, their origin and occurrences.	-	-	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO-4 Students will learn about metallic mineral resources-2 of India, their origin and occurrences.	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO-5 Students will learn about nonmetallic mineral wealth of India, their origin and occurrences.	1	2	1	-	1	3	3	3	-	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning (SL)
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	Co-1 Develop an understanding of the natural processes associated with the formation of mineral deposits.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1	Unit-1.0 Introduction and mineral deposit formation. 1.1,1.2,1.3,1.4,1.5,1.6,1.7, 1.8,1.9	As mentioned in Page number 2 to 6
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-2 Students will learn processes of of ore formation specially sedimentary and metamorphic deposits.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1	Unit-2 Processes of mineral deposit formation 2.1,2.2,2.3,2.4,2.5,2.6,2.7, 2.8,2.9	
PO1,2,3,4,5, 6 7,8,9,10,11,12 PSO1,2,3,4	CO-3 Students will learn about metallic mineral resources-1 of India, their origin and occurrences.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1	Unit-3 : Metallic mineral resources of India-1 3.1,3.2,3.3,3.4,3.5,3.6,3.7, 3.8,3.9	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-4 Students will learn about metallic mineral resources-2 of India, their origin and occurrences.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1	Unit-4: Metallic mineral resources of India-2 4.1,4.2,4.3,4.4, 4.5,4.6,4.7,4.8, 4.9	
PO1,2,3,4,5,6 7,8,9,10,11,12	CO-5 Students will learn about nonmetallic mineral wealth of India, their origin	SO5.1 SO5.2	5.1 5.2	Unit5: Non metallic deposits of India 5.1,5.2,5.3,5.4,5.5,5.6,5.7	

PSO1,2,3,4	and occurrences.	SO5.3 SO5.4 SO5.5		,5.8,5.9	

Curriculum Team:

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2) Mr. P.C. Tiwari Asst. Prof. Department of Miming, AKS University, Satna (M.P.).
3) Miss. Ritu Patel Asst. Prof. Department of Miming, AKS University, Satna (M.P.).

Course Outcomes:

Course Code:	1CS601
Course Title:	Programming with Python
Pre-requisite:	To study this course, a student must have successfully completed thecourse on Programming at Certificate/Diploma Levels. This course can be opted as an elective by the students of ComputerScience.
Rationale:	The study of this subject will develop understanding of Python core concepts. Python is an open-source programing language that is best suited for Internet applications. All these concepts will help students to develop elementary graphical statical and applications using python that solve real world problems.

1CS601.1: Python programs that effectively utilize conditional statements and loops for decision-making and iteration.

1CS601.2: Proficiency in utilizing various data structures such as lists, tuples, dictionaries, strings, and sets to store and manipulate data efficiently.

1CS601.3: Implement file handling operations, including reading, writing, and appending data to files, and utilize functions effectively for data processing tasks.

1CS601.4: Will be able to design and implement object-oriented programs using classes, inheritance, and encapsulation principles, and handle exceptions gracefully using try-except blocks.

1CS601.5: demonstrate the ability to create Graphical User Interfaces (GUI) using the Tkinter module and perform database operations such as CRUD (Create, Read, Update, Delete) operations on SQLite databases using Python.

Scheme of Studies:

Board of Study	**Course Code**	**Course Title**	**Scheme of studies(Hours/Week)**					**Total Credits (C)**
			Cl	**LI**	**SW**	**SL**	**Total Study Hours (CI+LI+SW+SL)**	
	1CS601	Programming with Python	4	4	1	1	6	6

Legend: **CI:**ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.,Lecture(L)andTutorial (T)and others),
LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworkshop, field or other locations using different instructional strategies)
SW: Sessional Work(includes assignment, seminar, mini projected.),
SL: Self-Learning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback teachers ensure outcome of Learnin

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			e Assignmen t 5 number 3 marks each	2 (2 best out of 3) 10 marks each	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Marks (CA+CT+S A+CAT+A		
		Programming with Python	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self-Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1CS601.1: Python programs that effectively utilize conditional statements and loops for decision-making and iteration.

Approximate Hours

Item	Appx. Hrs.
CI	12
LI	12
SW	2
SL	2
Total	28

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Write Python programs incorporating conditional statements and loops to solve simple problems. **SO1.2** Explain the concept of dynamically typed and strongly typed features in Python and provide examples.	1 Demonstrate how to use the Python interpreter and IDLE (Integrated Development and Learning Environment) for writing and	**Unit-1.0 Introduction to Programing in Python** 2 Introduction to Python: Begin by introducing Python as a programming language, highlighting its popularity, versatility, and applications in various domains.	1. Explore various resources such as online courses, textbooks, tutorials, documentation, and forums related to the topic you want

SO1.3 Demonstrate proficiency in using Python interpreter and IDLE for program development and debugging. **SO1.4** Differentiate between various data types in Python and utilize them appropriately in programs. **SO1.5** Create and execute Python scripts to perform basic input/output operations and implement flow control using if-else statements and loops.	executing Python code. Iterative Statements (while and for loops): Introduce while and for loops for iteration in Python. Demonstrate their usage with examples and exercises.	3 Python Interpreter and IDLE: Demonstrate how to use the Python interpreter and IDLE (Integrated Development and Learning Environment) for writing and executing Python code. 4 Explaining Dynamically Typed and Strongly Typed Features: Provide an explanation of dynamically typed and strongly typed features in Python, illustrating with examples to clarify the concept. 5 Basic Data Types and Variables: Introduce basic data types in Python such as integers, floats, strings, and booleans. Explain how to declare and use variables to store data of different types. 6 Input and Output Statements: Teach how to use input() and print() functions for taking user input and displaying output respectively. Provide examples to illustrate their usage. 7 Conditional Statements (if-else): Explain the syntax and usage of if-else statements for decision making in Python programs. Provide examples and exercises for practice. 8 Iterative Statements (while and for loops): Introduce while and for loops for iteration in Python. Demonstrate their usage with examples and exercises. 9 Break, Continue, and	to learn. Choose resources that suit your learning style and preferences. 2. Take advantage of the vast array of online resources available for self-learning, including video tutorials, interactive courses, blogs, and forums.

		Pass Statements: Explain the purpose and usage of break, continue, and pass statements within loops, highlighting their significance in controlling loop execution. 10 Implementing 'for' Loop through range(): Demonstrate how to use the range() function to generate sequences of numbers and iterate through them using for loops. 11 Sequence Traversal using 'in' and 'not in' Operators: Teach students how to traverse sequences such as lists, tuples, and strings using 'in' and 'not in' operators, emphasizing their usefulness in conditional statements. 12 Creating and Executing Python Scripts: Guide students through the process of creating Python scripts (.py files) using a text editor or an IDE. Show how to execute scripts from the command line or IDE environment. 13 Hands-on Practice and Exercises: Allocate time for students to practice the concepts learned through hands-on coding exercises. Provide feedback and assistance as they work through the exercises to reinforce their understanding of Python basics.	

SW-1 Suggested Sessional Work (SW):

1. **Assignments:**

1.1. Assignment Question 1: Basic Calculator

Develop a Python program for a basic calculator. Users should be able to perform addition, subtraction, multiplication, and division operations on two numbers. Ensure error handling for invalid inputs.

1.2. Assignment Question 2: Text Analysis Script
Create a Python script that analyzes a text file. It should count words and sentences, calculate average word length, and identify the longest and shortest sentences. Implement error handling for file operations.

2. **Mini Project:**
Python Dice Simulator

Description:Create a Python program that simulates rolling dice. The program should prompt the user to enter the number of dice to roll and the number of sides each die should have. After receiving the input, the program should simulate rolling the dice and display the outcomes.

1CS601.2: Proficiency in utilizing various data structures such as lists, tuples, dictionaries, strings, and sets to store and manipulate data efficiently.

Approximate Hours

Item	Appx. Hrs.
CI	12
LI	12
SW	2
SL	2
Total	28

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 Demonstrate understanding of various data structures such as lists, tuples, dictionaries, strings, and sets in Python. **SO2.2**Utilize lists effectively to store and manipulate collections of data, including performing operations such as appending, extending, slicing, sorting, and reversing. **SO2.3** Explain the characteristics and usage of tuples, including indexing, slicing, and tuple packing/unpacking. **SO2.4**Utilize dictionaries for efficient data storage and retrieval, including accessing, adding, modifying, and deleting key-value pairs. **SO2.5** Demonstrate proficiency in working with strings, including utilizing string methods for text manipulation and processing. **SO2.6**Apply set operations for set manipulation, including performing operations such as union, intersection, subset, superset, difference, and symmetric difference. **SO2.7I**dentify suitable data structures for different types of data and tasks, and justify their choices based on performance, functionality, and readability.	Dictionary Fundamentals: Explain dictionaries as key-value pairs and basic operations like addition and deletion. Dictionary Comprehension: Teach creating dictionaries efficiently using comprehension.	**Unit-2.0 Data Structures** 2.1 Introduction to Data Structures: Introduce the concept and importance of data structures in programming. 2.2 Lists Basics: Teach creating, accessing, and basic operations on lists. 2.3 Advanced List Techniques: Cover sorting, reversing, and counting elements in lists. 2.4 Tuples Overview: Introduce tuples as immutable sequences and explain packing, unpacking, and indexing. 2.5 Dictionary Fundamentals: Explain dictionaries as key-value pairs and basic operations like addition and deletion. 2.6 Dictionary Comprehension: Teach creating dictionaries efficiently using comprehension. 2.7 String Manipulation: Explore string formatting, splitting, joining, and searching techniques. 2.8 Sets Introduction: Introduce sets and common operations like union and intersection. 2.9 Nested Data Structures: Discuss handling nested structures like lists of dictionaries. 2.10 Choosing Data Structures: Guide students	1. Data manipulation in Dictonary. 2. List Techniques

		in selecting appropriate structures based on factors like performance and memory efficiency. 2.11 Hands-on Practice: Provide coding challenges for students to apply their knowledge practically. 2.12 Peer Collaboration: Encourage collaboration and code review sessions for mutual learning and improvement.	

SW-2 Suggested Sessional Work(SW):

a. Assignments:

1. Create a Python program to:
   a. Sort a list of numbers.
   b. Reverse the sorted list.
   c. Calculate the sum and average.
   d. Remove duplicates.
2. Create a Python program to:
   a. Sort a list of numbers.
   b. Reverse the sorted list.
   c. Calculate the sum and average.
   d. Remove duplicates.

b. Mini Project:

Python Data Analyzer

Create a Python program that serves as a data analyzer capable of processing various types of data structures such as lists, dictionaries, and tuples. The program should allow users to input their data and perform analysis tasks such as sorting, filtering, and statistical calculations.

c. Other Activities(Specify):

NA

1CS601.3: Implement file handling operations, including reading, writing, and appending data to files, and utilize functions effectively for data processing tasks.

Approximate Hours

Item	Appx. Hrs.
CI	12
LI	12
SW	2
SL	2
Total	28

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)

SO3.1 Define and call functions with appropriate arguments and return values. **SO3.1**Differentiate between global and local variables and understand their scopes. **SO3.2**Utilize lambda functions, map(), filter(), and reduce() functions for data processing tasks. **SO3.3**Implement file handling operations, including reading, writing, and appending data to files. **SO3.4**Understand the purpose and usage of read(), readline(), readlines(), write(), writelines(), seek(), and tell() functions for file manipulation. **SO3.5**Write scripts to perform common file operations such as copying files and counting words. **SO3.6**Demonstrate proficiency in handling exceptions using try-except blocks and raise statements. **SO3.7**Understand the hierarchy of exceptions and know how to handle specific types of errors effectively.	Using map(), filter(), and reduce(): Explore the map(), filter(), and reduce() functions and their applications for transforming, filtering, and aggregating data. File Handling Basics: Introduce file handling in Python, including opening, reading, writing, and closing files.	**Unit-3.0 Functions & File Handling:** 3.1 Introduction to Functions: Start by introducing the concept of functions in programming and their importance in modularizing code for better organization and reusability. 3.2 Defining Functions: Teach students how to define functions in Python using the def keyword, including specifying parameters and return values. 3.3 Calling Functions: Explain how to call functions with appropriate arguments and handle return values. 3.4 Global vs. Local Variables: Discuss the concept of variable scope in Python, distinguishing between global and local variables, and how they are accessed within functions. 3.5 Lambda Functions: Introduce lambda functions as anonymous functions that can be used for simple tasks and as arguments to higher-order functions like map(), filter(), and reduce(). 3.6 Using map(), filter(), and reduce(): Explore the map(), filter(), and reduce() functions and their applications for transforming, filtering, and aggregating data. 3.7 File Handling Basics: Introduce file handling in Python, including opening, reading, writing, and closing files. 3.8 Reading from Files: Teach students how to read data from files using various methods such as read(),	1. User definee function and built in function 2. Multiple types of varibales

		readline(), and readlines(), and handle file pointers using seek() and tell(). 3.9 Writing to Files: Explain how to write data to files using the write() and writelines() methods, and demonstrate proper file closing techniques. 3.10 Appending to Files: Discuss how to append data to existing files using the append mode ('a') and its implications. 3.11 Exception Handling: Introduce exception handling in Python, including the try-except block for catching and handling errors gracefully. 3.12 Handling Specific Exceptions: Teach students how to handle specific types of exceptions using multiple except blocks, and how to raise custom exceptions using the raise statement.	

SW-3 Suggested Sessional Work(SW):

a. Assignments:

1. Word Frequency Counter
   Create a Python program that reads a text file containing a passage of text and analyzes the frequency of each word.

2. File Copy Script
   Write a Python script that copies the contents of one text file to another.

b. Mini Project:

Python File Organizer
Create a Python script that organizes files within a specified directory based on their file types. The script should scan the directory, identify different types of files (e.g., images, documents, videos), and then move or copy them to corresponding folders. For example, images could be moved to an "Images" folder, documents to a "Documents" folder, and so on.

b. Other Activities(Specify):
NA

1CS601.4: Will be able to design and implement object-oriented programs using classes, inheritance, and encapsulation principles, and handle exceptions gracefully using try-except blocks.

Approximate Hours

Item	Appx. Hrs.
CI	12
LI	12
SW	2
SL	2

Total	28

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO4.1 Define classes and create objects, understanding the concepts of attributes and methods. **SO4.2** Demonstrate proficiency in defining member variables and methods within classes, and understand the principles of data encapsulation. **SO4.3** Implement constructors and destructors to initialize and clean up class instances. **SO4.4** Apply inheritance to create derived classes that inherit attributes and methods from base classes. **SO4.5** Resolve conflicts arising from multiple inheritance using the diamond problem-solving technique. **SO4.6** Understand the role of modules in Python and import external modules to extend program functionality. **SO4.7** Utilize inbuilt modules such as sys, random, and time, and understand their functions and applications. **SO4.8** Import modules using various methods, including import	Creating Objects: Demonstrate how to create objects (instances) of a class and access their attributes and methods. Multiple Inheritance: Explain multiple inheritance and demonstrate how to resolve conflicts using the diamond problem-solving technique	**Unit-4 Classes, Modules, and Exception Handling** 4.1 Introduction to Classes: Begin by introducing the concept of classes in object-oriented programming and their role in modeling real-world entities. 4.2 Defining Classes: Teach students how to define classes in Python, including specifying attributes and methods. 4.3 Creating Objects: Demonstrate how to create objects (instances) of a class and access their attributes and methods. 4.4 Data Encapsulation: Explain the principles of data encapsulation and demonstrate how to define member variables as private or public. 4.5 Constructors and Destructors: Introduce constructors (init) and destructors (del) in Python classes and explain their significance. 4.6 Inheritance: Discuss inheritance as a mechanism for creating new classes (derived classes) that inherit attributes and methods from existing classes (base classes). 4.7 Multiple Inheritance: Explain multiple inheritance and demonstrate how to resolve conflicts using the	1. Classes and Objects, Hands-on practice. 2. Encapsulation techniques.

statement, from...import statement, and from...import* statement. **SO4.9** Construct packages by organizing modules into hierarchical directories and using the init.py file. **SO4.10** Implement exceptional handling using try-except blocks to gracefully handle runtime errors.		diamond problem-solving technique. 4.8 Introduction to Modules: Introduce modules as reusable Python code units and explain their role in organizing and extending program functionality. 4.9 Using Inbuilt Modules: Explore commonly used inbuilt modules such as sys, random, and time, and demonstrate their functions and applications. 4.10 Importing Modules: Teach students how to import external modules using various methods, including import statement, from...import statement, and from...import* statement. 4.11 Constructing Packages: Discuss how to organize modules into hierarchical directories and create packages, including the significance of the init.py file. 4.12 Exception Handling: Introduce exceptional handling as a mechanism for gracefully handling runtime errors in Python programs and demonstrate the use of try-except blocks.	

SW-4 Suggested Sessional Work(SW):

a. Assignments:

1. Student Management System
   Design and implement a Python program for a student management system using object-oriented programming concepts.

2. File Organizer Script
   Write a Python script that organizes files within a specified directory based on their file types.

b. Mini Project:

Python Task Scheduler
Create a Python program that acts as a task scheduler, allowing users to manage and organize their tasks

efficiently.

c. **Other Activities(Specify):**
NA.

1CS601.5: Able to implement I/O operations and connect to database to solve real world problems.

Approximate Hour

Item	Appx. Hrs.
CI	12
LI	12
SW	2
SL	2
Total	28

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1 Explain the role of databases in storing and managing structured data and understand the basics of relational databases. **SO5.2** Demonstrate proficiency in using SQLite, including connecting to a database, creating tables, and performing CRUD (Create, Read, Update, Delete) operations. **SO5.3** Design and implement database schemas to represent real-world entities and relationships. **SO5.4** Apply SQL queries to retrieve and manipulate data stored in SQLite databases. **SO5.5** Understand the principles of graphical user interface (GUI) programming and the event-driven programming paradigm. **SO5.6** Introduce the tkinter module for creating GUI applications in Python and understand its basic components such as buttons, labels, entry fields, and dialogs.	Creating Tables: Teach students how to create tables in SQLite using SQL data definition language (DDL) statements. CRUD Operations: Explain the concept of CRUD (Create, Read, Update, Delete) operations and demonstrate how to perform these operations in SQLite using SQL queries.	**Unit-5.0 Database & GUI Programming:** 5.1 Introduction to Databases: Begin by introducing the concept of databases and their importance in storing and managing structured data. 5.2 Relational Databases: Explain the basics of relational databases, including tables, rows, columns, and relationships between tables. 5.3 SQLite Basics: Introduce SQLite as a lightweight and embedded relational database management system (RDBMS) and demonstrate how to connect to a SQLite database. 5.4 Creating Tables: Teach students how to create tables in SQLite using SQL data definition language (DDL) statements. 5.5 CRUD Operations: Explain the concept of CRUD (Create, Read, Update, Delete) operations and demonstrate how to perform these operations	1. Simple project to demonstrate GUI Bases scripts. **2.** Tkinter module, overview.

SO5.7 Create simple GUI applications using tkinter to perform common tasks such as data entry, display, and manipulation. **SO5.8** Customize GUI widgets' attributes such as sizes, fonts, colors, and layouts to enhance the appearance and usability of GUI applications. **SO5.9** Understand the concept of event handling and respond to user interactions with GUI elements using event bindings and callbacks.		in SQLite using SQL queries. 5.6 Database Design: Discuss the principles of database design, including entity-relationship (ER) modeling and normalization. 5.7 Introduction to GUI Programming: Introduce the concept of graphical user interface (GUI) programming and its significance in creating interactive software applications. 5.8 Tkinter Basics: Teach students the basics of tkinter, the standard GUI toolkit for Python, including creating windows, labels, buttons, and entry fields. 5.9 Widget Attributes: Explain how to customize GUI widgets' attributes such as sizes, fonts, colors, and layouts to enhance the appearance and usability of GUI applications. 5.10 Event Handling: Discuss the concept of event-driven programming and demonstrate how to handle user interactions with GUI elements using event bindings and callbacks. 5.11 Database Integration: Show students how to integrate database operations with GUI programming to develop interactive database applications. 5.12 Testing and Debugging: Emphasize the importance of testing and debugging GUI and database applications to ensure their functionality	

		and usability.	

SW-5 Suggested Sessional Work (SW):

a. Assignments:

1. Expense Tracker Application
   Create a Python program for an expense tracker application that helps users manage their expenses and track their spending using a GUI

2. Address Book Application
   Develop a Python program that serves as an address book application, allowing users tostore and manage contact information using a graphical user interface (GUI).

b. Mini Project:

"Python Weather Forecast App"
Create a Python application that provides users with weather forecasts for specified locations. The app should utilize a weather API to fetch current weather data and display it to the user in a user-friendly format. Users should be able to input their desired location(s) and view details such as temperature, humidity, wind speed, and weather conditions.

3. **Other Activities(Specify):**
   NA.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture(Cl)	LI(Laboratory Instruction)	Sessional Work(SW)	Self-Learning(Sl)	Total hour(Cl+SW+Sl)
CO.1: Python programs that effectively utilize conditional statements and loops for decision-making and iteration.	12	12	2	2	28
CO.2:Proficiency in utilizing various data structures such as lists, tuples, dictionaries, strings, and sets to store and manipulate data efficiently.	12	12	2	2	28

CO.3:Implement file handling operations, including reading, writing, and appending data to files, and utilize functions effectively for data processing tasks	12	12	2	2	28
CO.4:Will be able to design and implement object-oriented programs using classes, inheritance, and encapsulation principles, and handle exceptions gracefully using try-except blocks.	12	12	2	2	28
CO.5:Demonstrate the ability to create Graphical User Interfaces (GUI) using the Tkinter module and perform database operations such as CRUD (Create, Read, Update, Delete) operations on SQLite databases using Python.	12	12	2	2	28
Total Hours	60	60	10	10	140

Suggestion for End Semester Assessment

Suggested Specification Table(ForESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO.1	Python Basics	02	05	01	08
CO.2	Data Structures: Lists	02	03	05	10

CO.3	Functions & File Handling	02	03	07	12
CO.4	Classes, modules and exceptional handling	1	3	7	10
CO.5	Database & GUI Programming	1	05	05	10
Total		13	26	13	50

Legend: R:Remember, U:Understand, A:Apply

The end of semester assessment for Internet Applications using JavaProgramming will be held with written examination of 50 marks.

Suggested Learning Resources:

a. Books:

S. No.	Title	Author	Publisher
1	Python Programing, A Modular Approach	TanejaSheetal &Kumar Naveen	Pearson
2	Introduction to Programing using Python	Liang Y. Daniel	Pearson
3	Learn Python the Hard Way	Zed A.Shaw	
4	Introduction to Computer Science using Python	Charles Dierbach	Wiley
5	Data Structure & Algorithm in Python	Michael T. Goodrich.	Wiley

. **COs, POs and PSOs Mapping**
Course Code: 1CS601
Course Title: Programming with Python

Course Outmes	ProgramOutcomes												ProgramSpecificOutcome				
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4	PS0 5

	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct studies of difficult problems	Utilization of modern tools	Engineers and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-longlearning	Use fundamental knowledge of math, science, and engineering to comprehend, evaluate, and create computer Programmes in the fields of algorithms, multimedia, big data analytics, machine learning, artificial intelli	Utilize relevant methods and cutting-edge hardware and software engineering tools to develop and integrate computer systems and related technologies. This PSO2 also encourages lifelong learning for the	Applying professional engineering solutions for societal improvement while taking into account the environmental context, being conscious of professional ethics, and being able to effectively	Learn and use the most recent Artificial Intelligence and Data Science technologies in the fields of engineering and computer science	Recognize and examine issues in real life, then offer creative software solutions with the help of AI and Data Science Technologies.

CO 1: Python programs that effectively utilize conditional statements and loops for decision-making and iteration.	**2**	**2**	**3**	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**2**	**3**	**3**	**1**	**2**
CO 2: Proficiency in utilizing various data structures such as lists, tuples, dictionaries, strings, and sets to store and manipulate data efficiently.	**1**	**3**	**2**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**2**	**2**	**2**	**1**	**3**
CO3: Implement file handling operations, including reading, writing, and appending data to files, and utilize functions effectively for data processing	**2**	**2**	**2**	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**1**	**2**	**2**	**2**

tasks.																	
CO 4: Will be able to design and implement object-oriented programs using classes, inheritance, and encapsulation principles, and handle exceptions gracefully using try-except blocks.	**1**	**2**	**3**	**2**	**3**	**2**	**1**	**1**	**1**	**2**	**1**	**3**	**3**	**3**	**3**	**2**	**2**
CO 5: Demonstrate the ability to create Graphical User Interfaces (GUI) using the Tkinter module and perform database operations such as CRUD (Create, Read, Update, Delete) operations on	**1**	**2**	**2**	**3**	**3**	**1**	**1**	**2**	**1**	**2**	**1**	**3**	**3**	**3**	**1**	**3**	**3**

SQLite databases using Python.																		

Legend: 1 – Low, 2 – Medium, 3 – High

AKS University
Faculty of Basic Science
Curriculum of B. Sc. (Honours / By Research) Program
(Revised as on 01 August 2023)

Course Curriculum Map

POs&PSOsNo.	COsNo.&Titles	SOsNo.	LaboratoryInstruction (LI)	Classroom Instruction(CI)	Self-Learning(
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4,5	CO 1: Python programs that effectively utilize conditional statements and loops for decision-making and iteration.	SO1.1, SO1.2, SO1.3, SO1.4, SO1.5		Unit-1 Python Basics 1.1,1.2,1.3,1.4,1.5, 1.6,1.7,1.8,1.9,1.10 ,1.11,1.12,1.13,1.14,1.15	Asmentioned pagenumber _to_
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4,5	CO 2: Proficiency in utilizing various data structures such as lists, tuples, dictionaries, strings, and sets to store and manipulate data efficiently.	SO2.1, SO2.2, SO2.3, SO2.4, SO2.5, SO2.6, SO2.7		Unit-2Data Structures: Lists 2.1,2.2,2.3,2.4,2.5, 2.6,2.7,2.8,2.9,2.10 ,2.11	
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4,5	CO3: Implement file handling operations, including reading, writing, and appending data to files, and utilize functions effectively for data processing tasks.	SO3.1, SO3.2, SO3.3, SO3.4, SO3.5, SO3.6, SO3.7		Unit-3 Functions & File Handling 3.1,3.2,3.3,3.4,3.5, 3.6,3.7,3.8,3.9,3.10 ,3.11	
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4,5	CO 4: Will be able to design and implement object-oriented programs using classes, inheritance, and encapsulation principles, and handle exceptions gracefully using try-except blocks.	SO4.1, SO4.2, SO4.3, SO4.4, SO4.5, SO4.6, SO4.7, SO4.8, SO4.9, SO4.10		Unit-4Classes, modules, and exceptional handling 4.1,4.2,4.3,4.4,4.5,4.6 ,4.7,4.8,4.9,4.10,4.11, 4.12,4.13	
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4,5	CO 5: Demonstrate the ability to create Graphical User Interfaces (GUI) using the Tkinter module and perform database operations such as CRUD (Create, Read, Update, Delete) operations on SQLite databases using Python.	SO5.1, SO5.2, SO5.3, SO5.4, SO5.5, SO5.6, SO5.7, SO5.8, SO5.9		Unit-5 Database & GUI Programming 5.1,5.2,5.3,5.4,5.5, 5.6,5.7,5.8,5.9,5.10	

Curriculum Development Team:

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Course Code: 2CS601

Course Title: Data Analysis and Visualization with Python

Pre- requisite: Python Programming

Rationale: This is the era of data its going to be more important along with its customized presentation. For customization of data, it needs to analyses and visualize by using various programming methodologies. Python is one of the most useful languages for data analytics.

Course Outcomes (CO):

Course Code	Course Outcomes
CO1	Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.
CO2	Express proficiency in the handling of strings, functions and file handling
CO3	Determine the method to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples, and sets.
CO4	Develop proficiency in using NumPy for data manipulation, and data visualization using Matplotlib.
CO5	Apply NumpPy and Matplotlib to analysis and visualize real-world datasets.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Program Core	2CS601	Data Analysis and Visualization with Python	4	2	1	1	7	6

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Legend:

CI	**Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others)**
LI	**Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)**
SW	**Sessional Work (includes assignment, seminar, mini project etc.)**
SL	**Self Learning**
C	**Credits**

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment (Theory +Practical):

Theory

Board of Study	Couse Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	**(ESA)**	(PRA+ ESA)
	2CS601	Data Analysis and Visualization with	15	20	5	5	5	50	50	100

		Python								

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1: Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.

Approximate Hours

Item	**CL**	**LI**	**SW**	**SL**	**Total**
Approximate Hours	**12**	**06**	**01**	**01**	**20**

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)** **Unit-1**	**Self Learning (SL)**
SO1.1 Understanding Development Environment of Python **SO1.2** Understanding various Data Types of Python. **SO1.3** Understanding conditionals using in Python. **SO1.4** Understanding iterations in Python	1.1 Find all numbers which are multiple of 17, but not the multiple of 5, between 2000 and 2500. 1.2 Print the first 2 and last 3 characters in a given string, using the string slicing. 1.3 Write a program that eliminates	1.1 Python interpreter, Python idle 1.2 Dynamically typed and strongly typed features 1.3 Basic data types, Variables 1.4 Expresiions, Statements 1.5 Operators, Flow of execution 1.6 Input and Output statements 1.7 Conditionals: Boolean values and operators, 1.8 Conditional (if), alternate (else) chained conditional (if-else-if). 1.9 Iteration: while, for, break, continue, pass, 1.10 Implementing ‘for’ through range(), 1.11 ‘in’ and ‘not in’ operators for	Study basics of Python Programming

	duplicates in a list. 1.4 Implement Shallow Copy and Deep Copy of a list 1.5 Find the largest of n numbers, using a user defined function largest().	sequence traversal. 1.12 Creating and executing .py scripts.	

SW-1 Suggested Sessional Work (SW):

c. Assignments:
3. Conditionals
4. Iterations

d. Mini Project:
Creating and executing .py scripts.

e. Other Activities (Specify):

CO2: Express proficiency in the handling of strings, functions and file handling.

Approximate Hours

Item	CL	LI	SW	SL	Total
App X Hrs	**12**	**06**	**01**	**01**	**20**

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)** **Unit-2**	**Self Learning (SL)**
SO1.1 Understanding various operations associated with List. **SO1.2** Understanding various operations associated with Tuple. **SO1.3** Understanding various operations associated with Dictionary. **SO1.4** Understanding various operations associated with String.	2.1 Write a function that capitalizes all vowels in a string. 2.2 Read a line containing digits and letters. 2.3 Write a program to give the count of digits and letters. 2.4 Write a function myReverse() which receives a string as an input and returns the	2.1 Lists-append, extend, insert, remove, pop, count, sort, reverse, slicing, 2.2 List comprehension, copying a list: deep copy, shallow copy. 2.3 Tuples: index, count, usage, 2.4 Use of tuple as swap function. 2.5 Dictionaries: keys, values, tuples, 2.6 Nested dictionaries, dictionary comprehension. 2.7 String- single line and multi-line strings, formatter, 2.8 isdigit, isalpha, isalnum, islower, istitle, isspace, title, lower, upper, strip, split, splitlines, join etc. 2.9 Sets- union, intersection,	Learn Basic Data Structures of Python Programming.

	reverse of the string. 2.5 Use the list comprehension methodology in python, to generate the squares of all odd numbers in a given list. 2.6 Create a NumPy array with values from 1 to 20.	subset, superset, difference, symmetric difference, 2.10 copy, add, remove, discard etc. 2.11 Inbuilt Functions- id, len, chr, ord, etc. defining and calling a function, arguments, 2.12 Global verses local variables, defining and calling lambda functions, the map(), filter(), reduce() functions.	

SW-2 Suggested Sessional Work (SW):

a. **Assignments:**
   1. List
   2. Tuple
b. **Mini Project:**
   Defining and calling lambda functions.
c. **Other Activities (Specify):**
   NA

CO3: Determine the method to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples, and sets.

Item	CL	LI	SW	SL	Total
App X Hrs	**12**	**06**	**01**	**01**	**20**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI) Unit-3	Self Learning (SL)
SO1.1 Understanding basics of NumPy. **SO1.2** Understanding NumPy Array in Python. **SO1.3** Understanding Array Creation. **SO1.4** Understanding Array Indexing.	3.1 Create a 3X3 identity matrix using NumPy. 3.2 Generate an array of 10 random integers between 0 and 100. 3.3 Calculate the mean, median, and standard deviation of an array. 3.4 Reshape a 1D array into a 2D array. 3.5 Filter even numbers from an array using Boolean indexing.	3.1 Introduction to NumPy, NumPy array in Python, Basics of NumPy arrays, 3.2 Comparison of Python Lists with NumPy Arrays. 3.3 Array Creation, The Arrange Method, The Zero Method, NumPy array filled with all ones, 3.4 The linspace method, The eye method, NumPy Meshgrid function, 3.5 Empty and full NumPy array, NumPy array filled with all zeros, 3.6 2D Gaussian array, creating vector in Python using NumPy. 3.7 Array Indexing, Array Slicing, Data Types, 3.8 Copy vs View, Array Shape, Array Reshap, 3.9 Array Iterating, Array Join, Array Split, Array Search, 3.10 Array Sort, Array Filter, 3.11 Concatenation of tow arrays, splitting and comparison of two arrays. 3.12 Binary Operations, Mathematical Functions, String Operations.	Learn Array Operations Using NumPy Library.

SW-3 Suggested Sessional Work (SW):

a. Assignments:
1. Array Indexing
2. Array Iterating

b. Mini Project:
Concatenation of tow arrays, splitting and comparison of two arrays.

c. Other Activities (Specify):
NA

***CO4:** Develop proficiency in using NumPy for data manipulation, and data visualization using Matplotlib.*

Approximate Hours

Item	CL	LI	SW	SL	Total
App X Hrs	12	06	01	01	20

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI) Unit-4	Self Learning (SL)
SO1.1 Understanding basics of Matrix manipulation. **SO1.2** Understanding various functions associated with Matrix manipulation. **SO1.3** Understanding Vector Manipulation in Python. **SO1.4** Understanding Searching and Sorting of NumPy Arrays.	4.1 Calculate the dot product of two matrices. 4.2 Normalize an array to have values between 0 and 1. 4.3 Calculate the sum along both rows and columns of a 2D array. 4.4 Perform element wise multiplication and division between arras. 4.5 Generate a dataset of x and y values and plot it.	4.1 Matrix manipulation in Python, 4.2 empty() function, zeros() function, ones() function, 4.3 eye() function, identity() function, 4.4 Adding and Subtracting Matrices in Python. 4.5 Vector manipulation, 4.6 Dot product of two arrays. 4.7 Broadcasting with NumPy Arrays, 4.8 Sorting, Searching and Counting of NumPy arrays. 4.9 Variations in different sorting techniques in Python. 4.10 Creation of ufunc, Simple Arithmetic, 4.11 Rounding, Trigonometric, 4.12 Hyperbolic, Set Functions.	Learn Matrix Operations using Python Programming.

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SW-4 Suggested Sessional Work (SW):

a. Assignments:
1. Adding Matrices in Python.
2. Subtracting Matrices in Python.

b. Mini Project:
Sorting, Searching and Counting of NumPy arrays.

c. Other Activities (Specify):
NA

CO5: Apply NumpPy and Matplotlib to analysis and visualize real-world datasets.

Item	CL	LI	SW	SL	Total
AppX Hrs	12	06	01	01	20

Session Outcomes (SOs)	*Laboratory Instruction (LI)*	*Class room Instruction (CI) Unit-5*	*Self Learning (SL)*
SO1.1 Understanding basics of Matplotlib. **SO1.2** Understanding various types of plots creation using Matplotlib. **SO1.3** Understanding various types of charts creation using Matplotlib. **SO1.4** Understanding 3D data visualization using Matplotlib.	*5.1 Analyze and visualize a simple dataset using both libraries.* *5.2 Create a bar plot showing comparison of data from two different sources.* *5.3 Visualize data from a CSV file using NumPy and Matplotlib.* *5.4 Generate a contour plot of a 2D function.* *5.5 Analyze and visualize trends in a dataset over time.* *5.6 Create an interactive plot using Matplotlib's interactive mode.*	5.1 Overview of Matplotlib and its capabilities, 5.2 Creating line plots 5.3 Creating scatter plots, 5.4 Customizing labels, titles, 5.5 Colors, legends, 5.6 Creating bar plots and histograms, 5.7 Adding annotations and text to plots, 5.8 Creating subplots and multiple plots, 5.9 Saving and exporting plots. 5.10 Creating pie charts and box plots, 5.11 Visualizing 3D data with Matplotlib, 5.12 Interactive visualization using widgets.	*Learn Data Visualization Using Matplotlib Library.*

SW-1 Suggested Sessional Work (SW):

a. Assignments:
1. Creating Bar Plots
2. Creating Pie Charts

b. Mini Project:
Visualizing 3D Data with Matplotlib

c. Other Activities (Specify):
NA

Brief Hours suggested for the course outcomes

Course Outcomes	Class Lecture (CL)	Lab insturuction (LI)	Sessional Work (SW)	Self Learning (SL)	Total Hours (CL+SW+SL)
Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.	12	12	1	1	26
Express proficiency in the handling of strings, functions and file handling	12	12	1	1	26
Determine the method to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples, and sets.	12	12	1	1	26
Develop proficiency in using NumPy for data manipulation, and data visualization using Matplotlib.	12	12	1	1	26
Apply NumPy and Matplotlib to analysis and visualize real-world datasets.	12	12	1	1	26
Total	60	60	5	5	130

Suggestion for End Semester Assessment

CO		**Marks Distribution**			**Total Marks**
		R	**U**	**A**	

Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.		2	3	5	10
Express proficiency in the handling of strings, functions and file handling		2	3	5	10
Determine the method to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples, and sets.		2	3	5	10
Develop proficiency in using NumPy for data manipulation, and data visualization using Matplotlib.		2	3	5	10
Apply NumpPy and Matplotlib to analysis and visualize real-world datasets.		2	3	5	10
Total		10	15	25	**50**

Suggested Specification Table (For ESA)

Legend: **R: Remember, U: Understand,** **A: Apply**

The end of semester assessment for Data Analysis and Visualization with Python will be held with written examination of 50 marks.

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks.
Teachers can also design different tasks as per requirement, for end semester assessment.
Suggested Instructional/Implementation Strategies:

1. Improved Lecture and Tutorial
2. Case Method
3. Group Discussion and Role Plan
4. Industrial Visit
5. Demonstration
6. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Instagram, WhatsApp, Mobile and other Online sources)
7. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	***Data Analysis and Visualization Using Python***	***Dr. Ossama Embarak***	***Apress***	***20 November 2018***

COs, POs and PSOs Mapping

Course Code: 2CS601

Course Title : Data Analysis and Visualization with Python

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustain ability:	Ethics	Individual and team work:	Communication:	Project management and finance:	Life-long learning	The ability to apply technical & engineering knowledge for production and quality of food manufacture.	Ability to understand the day to plant operational problems of food manufacture	Ability to understand the latest food manufacturing technology.	Ability to use the research based innovative knowledge for SDGs
CO.1 Interpret	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**2**

the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.																
CO.2 Express proficiency in the handling	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**3**	**3**	**2**	**2**

of strings, functions and file handling																
CO.3 Determine the method to create and manipulate Python programs by utilizing the data structures like lists, dictionari	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**2**

es, tuples, and sets.																
CO.4 Develop proficiency in using NumPy for data manipulation, and data visualization using Matplotlib.	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**2**
CO5 Apply NumpPy and Matplotli	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**

b to analysis and visualize real-world datasets.																

Legend: 1 – Low, 2 – Medium, 3 – High

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Course Curriculum Map

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO:1,2,3,4,5,6,7,8,9,10,11,12 PSO:1,2,3,4,5	CO.1 Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.	**SO1.1 SO1.2 SO1.3 SO1.4 SO1.5**	**1.1 1.2**	Unit 1 1.1,1.2,1.3,1.4,1.5,1.6,1.7, 1.8,1.9,1.10, 1.11, 1.12	**As mentioned in page number 2 to 10**
PO:1,2,3,4,5,6,7,8,9,10,11,12 PSO:1,2,3,4,5	CO.2 Express proficiency in the handling of strings, functions and file handling	**SO2.1 SO2.2 SO2.3 SO2.4 SO2.5**	**2.1 2.2**	Unit 2 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8, 2.9, 2.10, 2.11, 2.12	
PO:1,2,3,4,5,6,7,8,9,10,11,12 PSO:1,2,3,4,5	Determine the method to create and manipulate Python programs by utilizing the data structures like lists,	**SO3.1 SO3.2 SO3.3 SO3.4 SO3.5**	**3.1 3.2**	Unit 3 3.1, 3.2,3.3,3.4,3.5,3.6,3.7.3.8,3.9,3.11, 3.12	

	dictionaries, tuples, and sets.				
PO:1,2,3,4,5,6,7,8,9,10,11, 12 PSO:1,2,3,4,5	Develop proficiency in using NumPy for data manipulation, and data visualization using Matplotlib.	**SO4.1 SO4.2 SO4.3 SO4.4 SO4.5**	**4.1 4.2**	Unit 4 4.1, 4.2,4.3,4.4,4.5,4.6 ,4.7.4.8.4.9,4.10,4 .11, 4.12	
PO:1,2,3,4,5,6,7,8,9,10,11, 12 PSO:1,2,3,4,5	**CO5** Apply NumpPy and Matplotlib to analysis and visualize real-world datasets.	**SO5.1 SO5.2 SO5.3 SO5.4 SO5.5**	**5.1 5.2**	Unit 5 5.1, 5.2,5.3,5.4,5.5,5.6 ,5.7.5.8.5.9,5.10,5 .11, 5.12	

Curriculum Development Team:

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Course Code: 2CS602

Course Title: Cloud Computing

Pre- requisite: Computer Network

Rationale: This is the era of data its going to be processed and stored for future reference. For processing large amount of data, it needs to high amount of scalable memory space. Cloud is one of the most useful tool for data processing and storage along with safety.

Course Outcomes (CO):

Course Code	**Course Outcomes**
CO1	Analyze the trade offs between deploying applications in the cloud and over the local infrastructure.
CO2	Deploy applications over commercial cloud computing infrastructure such as Amazon Web Services, Windows Azure, and Google App Engine.
CO3	Program data intensive parallel applications in the cloud.
CO4	Analyze the performance, scalability, and reliability of the underlying cloud technologies and software.
CO5	Identify security and privacy issues in cloud computing.

Scheme of Studies:

Course Category	**Course Code**	**Course Title**	**Scheme of studies (Hours/Week)**					**Total Credits (C)**
			Cl	**LI**	**SW**	**SL**	**Total Study Hours (CI+LI+SW+SL)**	
Program Core	2CS602	Cloud Computing	3	2	1	1	7	4

Legend:

CI	**Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others)**

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LI	**Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)**
SW	**Sessional Work (includes assignment, seminar, mini project etc.)**
SL	**Self Learning**
C	**Credits**

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment (Theory +Practical):

Theory

Board of Study	Couse Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	**(ESA)**	(PRA+ ESA)
	2CS602	Cloud Computing	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1: Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure.

Approximate Hours

Item	CL	LI	SW	SL	Total
Approximate Hours	12	06	01	01	20

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI) Unit-1	Self Learning (SL)
SO1.1 Understanding basics of cloud. **SO1.2** Understanding various cloud deployment models. **SO1.3** Understanding cloud service models. **SO1.4** Understanding cloud computing platforms.	1.1 Download and install Virtual Machine. 1.2 Installing Virtual Machine 1.3 Controlling Virtual Machine 1.4 Editing Virtual Machine Hardware 1.5 Creating and Using Image Snapshot 1.6 Importing and Exporting Virtual Machine Image	1.1 Introduction, Definition, 1.2 Characteristics, Components, 1.3 Cloud Service Provider, 1.4 The role of networks in cloud computing 1.5 Cloud Deployment Models-Private, Public, and Hybrid, 1.6 Cloud Service Models, 1.7 Multitenancy, 1.8 Cloud Economics and Benefits. 1.9 Cloud Computing Platforms 1.10 Iaas: Amazon EC2, S3 Bucket, 1.11 Paas: Google App Engine, Microsoft Azure, 1.12 Saas: AWS IAM (Identity Management).	Learn basics of Cloud Server.

SW-1 Suggested Sessional Work (SW):

f. Assignments:

5. Cloud Computing Platforms.
6. Cloud Deployment Models.

g. Mini Project:

Cloud Service Provider

h. Other Activities (Specify):

NA

CO2: Deploy applications over commercial cloud computing infrastructure such as Amazon Web Services, Windows

Azure, and Google App Engine.

Approximate Hours

Item	CL	LI	SW	SL	Total
App X Hrs	**12**	**06**	**01**	**01**	**20**

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)** **Unit-2**	**Self Learning (SL)**
SO2.1 Understanding virtualization in cloud. **SO2.2** Understanding virtual machine. **SO2.3** Understanding various features of hypervisors. **SO2.4** Understanding containerization technology.	2.1 Accessing Linux Command Line 2.2 Managing Files from the Command Line 2.3 Creating, Viewing, and Editing Text Files 2.4 Installing and Updating Software Packages 2.5 Controlling Services 2.6 Create AWS Free Tier Account	2.1 Virtualization components, 2.2 Server virtualization, 2.3 Storage virtualization, 2.3 Storage services, 2.4 Network virtualization, 2.5 Service virtualization, 2.6 Virtualization Management, 2.7 Virtualization Technologies and Architecture, 2.8 Virtual Machine, 2.9 Measurement and Profiling of Virtualized Applications. 2.10 Hypervisors: KVM, Xen, VMware, Hypervisors and their features. 2.11 Introduction to Containerization Technology, Virtualization vs Containerization, 2.12 Container engine tools: Docker/Podman.	Learn Virtualization in Cloud Server.

SW-2 Suggested Sessional Work (SW):

a. Assignments:
1. Storage virtualization.
2. Network virtualization.

b. Mini Project:
Virtualization Technologies and Architecture

c. Other Activities (Specify):
NA

CO3: Program data intensive parallel applications in the cloud.

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Item	CL	LI	SW	SL	Total
AppX Hrs	**12**	**06**	**01**	**01**	**20**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI) Unit-3	Self Learning (SL)
SO3.1 Understanding data and database using in cloud. **SO3.2** Understanding cloud file system. **SO3.3** Understanding parallel computing using cloud. **SO3.4** Understanding MapReduce and Extensions.	3.1 Introduction to IAM 3.2 Creating a User and Group 3.3Authorization via Policies 3.4 Creating and Attaching Policies 3.5 Launching an EC2 Running Linux 3.6 How to SSH into EC2 Using Linux/Windows	3.1 Data in Cloud Computing 3.2 Relational Database, 3.3 Cloud file system: 3.4 GFS 3.5 HDFS, 3.6 Big-Table, 3.7 HBase, 3.8 Dynamo, 3.9 MapReduce and Extensions: 3.10 Parallel Computing the map-reduce model, 3.11 Parallel efficiency of MapReduce, 3.12 Enterprise batch processing using MapReduce.	Learn File-System in Cloud Server.

SW-3 Suggested Sessional Work (SW):

a. Assignments:
1. HDFS
2. HBase

b. Mini Project:
Enterprise batch processing using MapReduce.

c. Other Activities (Specify):
NA

\

CO4: *Analyze the performance, scalability, and reliability of the underlying cloud technologies and software.*

Approximate Hours

Item	CL	LI	SW	SL	Total
App X Hrs	12	06	01	01	20

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI) Unit-4	Self Learning (SL)
SO4.1 Understanding fundamentals of cloud security. **SO4.2** Understanding Trusted Cloud Computing. **SO4.3** Understanding Identity Management and Access Control **SO4.4** Understanding Secure execution environment and communication in Cloud.	4.1 Launching an EC2 Running Windows 4.2 Connect Windows Instance Using RDP 4.3 Hosting Website on EC2 Instance 4.4 Create AWS Custom AMI 4.5 Copy AMI From One Region to Another 4.6 Share AMI with AWS Account	4.1 Cloud security fundamentals, 4.2 Vulnerability assessment tool for cloud, 4.3 Privacy and Security in Cloud. 4.4 Cloud computing security architecture-General issues, 4.5 Trusted cloud computing, 4.6 Secure execution environment and communication, 4.7 Micro-Architecture, 4.8 Identity Management and Access Control, Automatic Security. 4.9 Virtualization security management- virtual threats, 4.10 VM security recommendation, 4.11 VM specific security techniques, 4.12 Secure execution environment and communication in Cloud.	Learn Privacy and Security in Cloud Server.

SW-4 Suggested Sessional Work (SW):

a. Assignments:
1. Trusted cloud computing.
2. Identity Management and Access Control.

b. Mini Project:
Secure execution environment and communication in Cloud.

c. Other Activities (Specify):
NA

CO5: Identify security and privacy issues in cloud computing.

Item	CL	LI	SW	SL	Total
App X Hrs	12	06	01	01	20

Session Outcomes (SOs)	*Laboratory Instruction (LI)*	*Class room Instruction (CI) Unit-5*	*Self Learning (SL)*
SO5.1 Understanding real time application over cloud platform. **SO5.2** Understanding monitoring in a cloud computing environment. **SO5.3** Understanding Mobile cloud computing. **SO5.4** Understanding Resources Optimization in cloud.	*5.1 Crete S3 Bucket* *5.2 Upload/Download files from S3 Bucket* *5.3 Containerized Application Using Docker Container* *5.4 Install Docker on EC2 Instance* *5.5 Creating and Managing Docker Containers.* *5.6 Pull and Push Docker Images from Docker Hub*	5.1 Implementing real time application over cloud platform, 5.2 Issues in inter-cloud environment, 5.3 QOS Issues in cloud, 5.4 Dependability, Data Migration, 5.5 Streaming in cloud, 5.6 Quality of Service 5.7 Monitoring in a cloud computing environment, 5.8 Cloud Middleware, Mobile cloud computing, 5.9 A grid of clouds, 5.10 Sky computing, Load Balancing, 5.11 Resources Optimization, resource dynamic reconfiguration, 5.12 Monitoring in cloud.	*Learn Issues in Cloud in Environment.*

SW-5 Suggested Sessional Work (SW):

a. Assignments:
1. Data Migration,
2. Cloud Middleware.

b. Mini Project:
Implementing real time application over cloud platform.

c. Other Activities (Specify):
NA

Brief Hours suggested for the course outcomes

Course Outcomes	Class Lecture (CL)	Sessional Work (SW)	Self Learning (SL)	Total Hours (CL+SW+SL)
Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure.	09	6	1	16
Deploy applications over commercial cloud computing infrastructure such as Amazon Web Services, Windows Azure, and Google App Engine.	09	6	1	16
Program data intensive parallel applications in the cloud.	09	6	1	16
Analyze the performance, scalability, and reliability of the underlying cloud technologies and software.	09	6	1	16
Identify security and privacy issues in cloud computing.	09	6	1	16
Total	45	30	5	80

Suggestion for End Semester Assessment

CO		**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure.		2	3	5	10
Deploy applications over commercial cloud computing infrastructure such as Amazon Web Services, Windows Azure, and Google App Engine.		2	3	5	10
Program data intensive parallel applications in the cloud.		2	3	5	10

Analyze the performance, scalability, and reliability of the underlying cloud technologies and software.		2	3	5	10
Identify security and privacy issues in cloud computing.		2	3	5	10
Total		10	15	25	**50**

Suggested Specification Table (For ESA)

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Cloud Computing will be held with written examination of 50 marks.

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks.
Teachers can also design different tasks as per requirement, for end semester assessment.
Suggested Instructional/Implementation Strategies:

1. Improved Lecture and Tutorial
2. Case Method
3. Group Discussion and Role Plan
4. Industrial Visit
5. Demonstration
6. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Instagram, WhatsApp, Mobile and other Online sources)
7. Brainstormin

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	***Cloud Computing, A Practical Approach***	***Toby Velte, Anthony Velte, Robert C. Elsenpeter***	***McGraw Hill India***	***November 18, 2009***

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(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Course Code: 2CS602

Course Title: Cloud Computing

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problem	Modern tool usage	The engineer and society	Environment and sustainability:	Ethics	Individual and team work:	Communication:	Project management and finance:	Life-long learning	The ability to apply technical & engineering knowledge for production and quality of food manufacture.	Ability to understand the day to plant operational problems of food manufacture	Ability to understand and the latest food manufacturing technology.	Ability to use the research based innovative knowledge for SDGs

				s												
CO.1 Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**2**
CO.2 Deploy applications over commercial cloud computing infrastr	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**3**	**3**	**2**	**2**

ucture such as Amazon Web Services, Windows Azure, and Google App Engine.																
CO.3 Program data intensive parallel applications in the cloud.	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**2**
CO.4 Analyze the performance, scalability, and	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**2**

reliability of the underlying cloud technologies and software.																
CO.5 Identify security and privacy issues in cloud computing.	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**

Legend: 1 – Low, 2 – Medium, 3 – High

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Course Curriculum Map

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO:1,2,3,4,5,6,7,8,9,10,11,12 **PSO:1,2,3,4,5**	**CO.1** Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure	**SO1.1** **SO1.2** **SO1.3** **SO1.4** **SO1.5**	**1.1** **1.2**	Unit 1 1.1,1.2,1.3,1.4,1.5,1.6,1.7, 1.8,1.9,1.10, 1.11, 1.12	**As mentioned in page number 2 to 10**
PO:1,2,3,4,5,6,7,8,9,10,11,12 **PSO:1,2,3,4,5**	**CO.2** Deploy applications over commercial cloud computing infrastructure such as Amazon Web Services, Windows Azure, and Google App Engine.	**SO2.1** **SO2.2** **SO2.3** **SO2.4** **SO2.5**	**2.1** **2.2**	Unit 2 2.1,2.2,2.3,2.4,2.5,2.6,2.7, 2.8, 2.9, 2.10, 2.11, 2.12	
PO:1,2,3,4,5,6,7,8,9,10,11,12 **PSO:1,2,3,4,5**	**CO.3** Program data intensive parallel applications in the cloud.	**SO3.1** **SO3.2** **SO3.3** **SO3.4** **SO3.5**	**3.1** **3.2**	Unit 3 3.1, 3.2,3.3,3.4,3.5,3.6,3.7.3.8, 3.9,3.11, 3.12	
PO:1,2,3,4,5,6,7,8,9,10,11,12 **PSO:1,2,3,4,5**	**CO.4** Analyze the performance, scalability, and reliability of the underlying cloud technologies and software.	**SO4.1** **SO4.2** **SO4.3** **SO4.4** **SO4.5**	**4.1** **4.2**	Unit 4 4.1, 4.2,4.3,4.4,4.5,4.6,4.7.4.8.4.9,4.10,4.11, 4.12	

PO:1,2,3,4,5,6,7,8,9,10,11,12 **PSO:1,2,3,4,5**	**CO.5** Identify security and privacy issues in cloud computing.	**SO5.1** **SO5.2** **SO5.3** **SO5.4** **SO5.5**	**5.1** **5.2**	Unit 5 5.1, 5.2,5.3,5.4,5.5,5.6,5.7.5.8.5.9,5.10,5.11, 5.12	

Curriculum Development Team:

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Course Code:	**1MS601**
Course Title :	Integral Transform
Pre- requisite:	Students should have basic knowledge of and deep understanding of the theory of the Integral Transform
Rationale:	To describe the ideas of Fourier and Laplace Transforms and indicate their applications in the fields such as application of PDE, Digital Signal Processing, Image Processing, Differential Equations and many others.

CO1-1MS601.1 Understanding about Laplace transform and its properties

CO2-1MS601.2 Understanding about Inverse Laplace transform and its properties

CO3-1MS601.3 Determine the Method for Solve ordinary differential equations using Laplace transform

CO4-1MS601.4 Define and recognize theParseval's identity and applications of Fourier series

CO5-1MS601.5 Demonstrate an understanding of the theory of the Familiarisewith Fourier transform of functions, relation) between Laplace and Fourier transform.

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Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Program Core (PCC)	1MS601	Integral Transform	6	0	1	1	8	6

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA + ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+ AT)		
PCC	**1MS601**	Integral Transform	15	20	5	5	5	50	50	100

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Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1-1MS601.1 Understanding about Laplace transform and its properties

Approximate Hours

Item	AppX Hrs
Cl	14
LI	0
SW	1
SL	1
Total	16

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO1.1 Understand the concept of LaplaceTransform **SO1.2** Understand the Properties of Laplace transforms **SO1.3** Understand the Integration of the Laplace transforms. **SO1.4** Understand the Multiplication and Division by Y Periodic function		**Unit-1.0** **1.1** Laplace Transform **1.2** Linearity property **1.3** Existence theorem **1.4** First Shifting theorem **1.5** Second Shifting theorem **1.6** Laplace transform of discontinuous functions **1.7** Change of scale **1.8** Properties of Laplace transforms **1.9** Laplace transforms of derivatives **1.10** Integration of Laplace transform **1.11** Differentiation **1.12** Integration of the Laplace transforms **1.13** Multiplication and **1.14** Division by Y Periodic function	**SL1.1**

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SW-1 Suggested Sessional Work (SW):

a. Assignments:

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO2-1MS601.2 Understanding about Inverse Laplace transform and its properties

Approximate Hours

Item	AppX Hrs
Cl	14
LI	0
SW	1
SL	1
Total	16

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO2.1 Understand the concept Inverse Laplace Transform SO2.2 Understand the Shifting theorem SO2.3 Understand the integrals inverseLaplace transforms SO2.4 Understand the Change of scale property		**2.1**Inverse Laplace Transform 2.2 Linearity property 2.3 first Shifting theorem 2.4 Change of scale property 2.5 Second Shifting theoremInverse Laplace transforms 2.6Inverse Laplace transforms by using partial fraction 2.7 Derivatives of Laplace transforms 2.8 integrals of Inverse Laplace transforms 2.9 Multiplication by S 2.10 division by powers of S, 2.11 Convolution property 2.12 Corollary 2.13 Convolution	**SL.1**

		theorem 2.14 Inverse Laplace transforms by inspections 2.15 Heaviside expansion theorem	

SW-2 Suggested Sessional Work (SW):
a. Assignments:
b. Mini Project: Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO3-1MS601.3 Determine the Method for Solve ordinary differential equations using Laplace transform

Approximate Hours

Item	AppX Hrs
Cl	4
LI	0
SW	1
SL	1
Total	6

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO3.1 understand the application of Laplace Transform SO3.2 Understand the Solution of ordinary differential equations SO3.3 Understand the ordinary differential equations with variable coefficients		**Unit-3.0** 3.1Application of Laplace Transform: 3.2 procedure for application of L.T. 3.3 Solution of ordinary differential equations with constant coefficients 3.4 Solution of ordinary differential equations with variable coefficients	**SL.1** some definitions and some theorems

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SW-3 Suggested Sessional Work (SW):

a. **Assignments:**

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO4-1MS601.4 Define and recognize theParseval's identity and applications of Fourier series

Approximate Hours

Item	AppX Hrs
Cl	14
LI	0
SW	1
SL	1
Total	16

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO4.1 Understand Fourier Series SO4.2 Understand the Fourier series for even and odd function SO4.3Understand Half range Fourier series SO4.4 understand Fourier series for discontinuous function		**Unit-4.0** 4.1Fourier Series Introduction 4.2 Periodic function of Fourier series 4.3 Some important results of the definite integral 4.4 Full range fourier series 4.5 Dirichlets conditions 4.6 Fourier series for discontinuous function 4.7 Fourier series of function with period 2pie 4.8 Fourier series for even function 4.9 Fourier series for odd function 4.10 Half range Fourier series 4.11 Fourier series in (a,b)	**SL.1** Some theorems and some definitions

		4.12 some theorems 4.13 Fourier series with function 2l 4.14 Fourier series with function (0,2pie)	

SW-4 Suggested Sessional Work (SW):

a. **Assignments:**

b. Mini Project:

Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):

Quiz, Class Test.

CO5-1MS601.5 Demonstrate an understanding of the theory of the Familiarisewith Fourier transform of functions, relation) between Laplace and Fourier transform.

Approximate Hours

Item	Appx Hrs
Cl	14
LI	0
SW	1
SL	1
Total	16

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO5.1 Understand the Fourier Transfom **SO5.2** Understand the Convolution theorem **SO5.3** Understand the Modulation **SO5.4** Understand Relationsbetween Fourier transform and Laplace transform		**Unit-5.0** **5.1** FourierTransfom 5.2 inearityproperty 5.3 hifting theorem 5.4 hange of scale property 5.5 odulation	**SL.1** Some theorems with problems

		5.6 onvolution theorem 5.7 ourier transform of derivatives 5.8 ourier sine transform 5.9 ourier cosine transform 5.10 ourier transform of derivatives of function 5.11 Relationsbetween Fourier transform and Laplace transform 5.12 ome important formulae 5.13 arseval'sidentity 5.14 ourier transform of differential equations using	

SW-3 Suggested Sessional Work (SW):
a. Assignments

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

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Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
CO1-1MS601.1 Understanding about Laplace transform and its properties	15	1	1	17
CO2-1MS601.2 Understanding about Inverse Laplace transform and its properties	15	1	1	17
CO3-1MS601.3 Determine the Method for Solve ordinary differential equations using Laplace transform	4	1	1	6
CO4-1MS601.4 Define and recognize theParseval's identity and applications of Fourier series	14	1	1	16
CO5-1MS601.5 Demonstrate an understanding of the theory of the Familiarise with Fourier transform of functions, relation) between Laplace and Fourier transform.	14	1	1	16
Total Hours	62	5	5	72

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**					**Total Marks**
		R	**U**	**A**			
CO-1	Understanding about Laplace transform and its properties	03	01	01			05

CO-2	Understanding about Inverse Laplace transform and its properties	02	06	02			10
CO-3	Determine the Method for Solve ordinary differential equations using Laplace transform	03	07	05			15
CO-4	Define and recognize theParseval's identity and applications of Fourier series	-	10	05			15
CO-5	Demonstrate an understanding of the theory of the Familiarise with Fourier transform of functions, relation) between Laplace and Fourier transform.	03	02		-		05
Total		11	26		13		50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies

1. Improved Lecture
2. Tutorial
3. Presentation
4. Group Discussion
5. Online sources
6 .Seminar
7. Workshop

Suggested Learning Resources:

a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Integral Transforms and Their Applications.	Lokenath Debnath, Dambaru Bhatta	Chapman and Hall/CRC: 3rd edition, 2014.	2014
2	Fourier Series and Integral Transforms	Sreenadh S. Ranganatham S.. Prasa.	S. Chand Publishing, 2014.	2014
3	Integral Transforms and Fourier Series	A. N. Srivastava	Narosa Publications, 2012	2012

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<u>Cos,POs and PSOs Mapping</u>

Course Title: B.Sc. Mathematics
Course Code : 1MS601
Course Title: Integral transform

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO3	PSO 4
	Advanced Mathematical Knowledge	Problem-solving Skills	Research Abilities	Quantitative Analysis	Teaching and Academia	Theoretical Understanding	Communication Skills	Operations Research	Application in Industry	Engineering and Technology	Government and Public Sector	Consulting	Understand the mathematical concepts and applications in the field of algebra	Handle the advanced techniques	Develop necessary skills and expertise in th	Creates Mathematical Models

															e field of research	
CO1-1MS601.1 Understanding about Laplace transform and its properties	2	3	1	1	1	2	1	1	1	1	1	1	2	2	1	
CO2-1MS601.2 Understanding about Inverse Laplace transform	2	2	1	1	3	1	1	1	1	1	1	1	2	2	2	

and its properties																
CO3-1MS601.3 Determine the Method for Solve ordinary differential equations using Laplace transform	3	2	1	2	1	1	3	2	2	1	2	2	1	2	3	
CO4-1MS601.4 Define and recognize theParseval 's identity and	2	3	1	2	2	2	3	2	1	1	1	2	2	1	1	

applications of Fourier series																
CO5-1MS601.5 Demonstrate an understanding of the theory of the Familiarise with Fourier transform of functions, relation) between Laplace and Fourier	3	2	1	1	2	1	2	3	1	1	1	1	1	1	1	

transform.																

Legend: 1 – Low, 2 – Medium, 3 – High

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Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO1-1MS601.1**Understanding about Laplace transform and its properties	SO1.1 SO1.2 SO1.3 SO1.4		Unit-1.0 Laplace transform1.1,1.2,1.3,1.4,1.5,1.6.1.7,1.8,1.9,1.10,1.11,1.12,1.13,1.14,1.15	SL1.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO2-1MS601.2**Understanding about Inverse Laplace transform and its properties	SO2.1 SO2.2 SO2.3 So2.4		Unit-2 Inverse Laplace transform2.1, 2.2, 2.3, 2.4,2.5,2.6,2.7,2.8,2.9,2.10,2.11,2.12,2.13,2.14,2.15	SL2.1 SL2.2
PO 1,2,3,4,5,6 PSO 1,2, 3, 4	**CO3-1MS601.3** Determine the Method for Solve ordinary differential equations using Laplace transform	SO3.1 SO3.2 SO3.3		Unit-3Application of Inverse Laplace transform 3.1, 3.2, 3.3, 3.4,	SL3.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO4-1MS601.4** Define and recognize theParseval's identity and applications of Fourier series	SO4.1 SO4.2 SO4.3 SO4.4		Unit-4 Fourier series 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8,4.9,4.10,4.11,4.12, 4.13,4.14	SL4.1 SL4.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO5-1MS601.5** Demonstrate an understanding of the	SO5.1 SO5.2 SO5.3 SO5.4		Unit-5Fourier transform 5.1, 5.2, 5.3, 5.4, 5.5, 5.6 ,5.7,5.8,5.9,5.10,5.11,	SL5.1

	theory of the Familiarise with Fourier transform of functions, relation) between Laplace and Fourier transform.			5.12,5.13,5.14	

Curriculum Development Team

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Course Code:	2MS601
Course Title :	Fundamentals of Boolean Algebra
Pre- requisite:	A student must have had the subject mathematics in Diploma Course or equivalent**.**
Rationale:	The objective of Fundamentals of Boolean Algebra is crucial for anyone involved in digital circuit design, computer science, and other related fields. It provides the necessary foundation to work with logical systems and enables the design and analysis of efficient and reliable digital systems.

Course Outcome :

CO1-2MS601.1Student will aware of history of Indian logic of mathematics and hence of its Past, present and future role as part of our culture and Using the Boolean algebra in logical problems.
CO2-2MS601.2 Understand the Application of Boolean Algebra in Mathematics and Engineering .
CO3-2MS601.3 Minimize the Boolean function using Karnaugh-Map .
CO4-2MS601.4 Understand the Applications of Logic Gates
CO5-2MS601.5 Applying the circuits in logical problems.

Scheme of Studies:

Board of Study	**Course Code**	**Course Title**	**Scheme of studies (Hours/Week)**					**Total Credits (C)**
			Cl	**LI**	**SW**	**SL**	**Total Study Hours (CI+LI+SW+SL)**	
Program Core (PCC)	2MS601	Fundamentals of Boolean Algebra	4	0	1	1	6	4

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,

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C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA + ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+ AT)		
PCC	2MS601	Fundamentals of Boolean Algebra	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1-2MS601.1

Student will aware of history of Indian logic of mathematics and hence of its Past, present and future role as part of our culture and Using the Boolean algebra in logical problems.

Approximate Hours

Item	AppX Hrs
Cl	12

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LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO1.1 Student will aware of history of indian logic of mathematics **SO1.2** To understand the application of Boolean Algebra **SO1.3** To understand the construction of Truth Tables **SO1.4** To understand the meaning of Logical Equivalence		**Unit-1. Indian Logic** **1.1** Indian Logic **1.2** origins **1.3** The school Vaisheshika **1.4** Catuskoti **1.5** Nyaya Jain logic and Buddhist logic **1.6** Navya –Nyaya **1.7** Influence of indian logic on modern logic **1.8** Boolean logic and Indian thoughts **1.9** Boolean Algebra and Properties of Boolean Algebra **1.10** Theorems on Boolean Algebra **1.11** Demorgan's law **1.12** Truth Tables	**SL.1** History of Indian mathematics **SL.2** Tautology and Contradiction

SW-1 Suggested Sessional Work (SW):

a. Assignments:-

i. Knowledge of Indian logic
ii. Nyaya Jain logic and Buddhist logic
iii. Navya –Nyaya
iv. Influence of indian logic on modern logic
v. Boolean logic and Indian thoughts
vi. Hasse diagram
vii. Lattices

b. Other Activities

Quiz , Oral presentation

CO2-2MS601.2

Understand the Application of Boolean Function in Mathematics and Engineering .

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Approximate Hours

Item	AppX Hrs
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO2.1 Understand the relationships between Expression of Boolean Function and logical connectives **SO2.2** Understand the Difference between DNF and complete DNF **SO2.3** Understand the meaning of term Min-term and Max term. SO2.4 Understand the application of Boolean Function		**UNIT 2 Boolean Function as DNF** **2.1** oolean Function **2.2** oolean Expression **2.3** Boolean Extension theorem **2.4** Min-term or Minimal Boolean Function **2.5** isjunctive Normal Form or Canonical Form **2.6** Complete Disjunctive Normal Form or Complete Canonical Form **2.7** utorial-I **2.8** Complement Function **2.9** .F. of a Boolean Function **2.10** .F. for Disjunctive Normal Form. **2.11** Boole's Expansion Theorem. **2.12** utorial-II	**SL.1** Understand the concept of Boolean Expression **SL.2** Construction of Disjunctive Normal Form with examples

SW-2 Suggested Sessional Work (SW):

a. **Assignments:-**
   (1) Boolean Function
   (2) DNF
   (3) Bool's Expantion theorem
   (4) Theorems on Boolean Algebra

b. **Mini Project:**
   Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
   Quiz, Class Test.

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CO3-2MS601.3
Minimize the Boolean function using Karnaugh-Map

Approximate Hours

Item	AppX Hrs
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO2.1 Understand the relationships between Expression of Boolean Function and logical connectives **SO2.2** Understand the Difference between CNF and complete CNF **SO2.3** Understand the meaning of term Min-term and Max term. **SO2.4** Understand the difference of SOP and POS **SO2.4** Understand the concept of Karnaugh-		**UNIT 3 Boolean Function as CNF** **3.1** Max-term or Maximal Boolean Function **3.2** Conjunctive Normal Form or Dual Canonical Form **3.3** Complete Conjunctive Normal Form **3.4** Tutorial-I **3.5** Complement Function of a Boolean Function in Conjunctive Normal Form **3.6** SOP Forms **3.7** POS Forms	**SL.1** Understand the concept of Boolean Expression **SL.2** Construction of conjunctive Normal Form with examples

Map		**3.8** Karnaugh-Map **3.9** Karnaugh-Map for two variables **3.10** Karnaugh-Map for three variables **3.11** Minimize the Boolean function using Karnaugh-Map upto 3 variables **3.12** Tutorial-II	

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Relationships between algebraic structures of ring with familiar numbers systems.
ii. Application of Ring group theory in real life.
iii. Permutation group.
iv. Mapping defined on Rings.
V. Polynomial Ring

b. Mini Project:

Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):

Quiz, Class Test.

CO4-2MS601.4
Understand the Applications of Logic Gates

Approximate Hours

Item	AppX Hrs
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**

SO4.1 Understand the Concept of Logic gates **SO4.2** Understand the application of Logic gates in real life **SO4.3** Understand the difference between many Logic gates **SO4.4** Understand the relationships between Boolean Function and Logic gates.		**Unit 4 Logic Gates** **4.1** Logic Gates **4.2** AND Gate **4.3** OR Gate **4.4** NOT Gate **4.5** NAND Gate **4.6** NOR Gate **4.7** XOR Gate **4.8** XNOR Gate **4.9** Buffer Gate **4.10** Universal Gate **4.11** Applications of Logic Gates. **4.12** Tutorial-I	**SL.1** Learn about Boolean algebra properties Gates **SL.2** Learn about Gates

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Logic gates
ii. Buffer Gate
iii. Universal Gate
iv. Application of logic gates in Mathematics and Engineering.
v. Application of logic gates in real life.

b. Other Activities (Specify):
Quiz, Class Test.

CO5-2MS601.5 Applying the circuits in logical problems.

Approximate Hours

Item	AppX Hrs
Cl	12

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LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO5.1 Understand the concept Switching Circuits **SO5.2** Understand to draw Switching Circuits from mathematical expression **SO5.3** Understand the concepts of Combinational Circuits		**Unit 5 Circuits** **5.1** Circuits **5.2** Switching Circuits, Parallel Circuits, Series Circuits **5.3** Relay Circuit **5.4** Various Positions of Switches **5.5** Currents in Electric Circuits **5.6** Simple Arithmetic **5.7** Logic Circuits **5.8** Combinational Circuits **5.9** Adder and Substractor **5.10** Simple Combinational Circuits **5.11** Design Problems **5.12** Tutorials	**SL.1** learn to draw switching circuit Diagram **SL.2** understand the use of switching circuit in electric circuits **SL.3** understand the mathematical expression for Logic Circuits

SW-5 Suggested Sessional Work (SW):
a. Assignments:
i. . Logic circuits
ii. Logic circuits Design Problems
iii. Adder and Substractor
iv. Application of logic circuits in Mathematics and Engineering.
v. Application of logic circuits in real life

b. Other Activities (Specify):
Quiz, Class Test.

Brief of Hours suggested for the Course Outcome

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Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
CO1-2MS601.1 Student will aware of history of Indian logic of mathematics and hence of its Past, present and future role as part of our culture and Using the Boolean algebra in logical problems.	12	1	1	14
CO2-2MS601.2 Understand the Application of Boolean Algebra in Mathematics and Engineering .	12	1	1	14
CO3-2MS601.3 Minimize the Boolean function using Karnaugh-Map .	12	1	1	14
CO4-2MS601.4 Understand the Applications of Logic Gates.	12	1	1	14
CO5-2MS601.5 Applying the circuits in logical problems.	12	1	1	14
Total Hours	60	5	5	70

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	**U**	**A**	
CO-1	Indian Logic	05	03	02	10
CO-2	Boolean Function as DNF	05	03	02	10
CO-3	Boolean Function as CNF	05	03	02	10
CO-4	Logic Gates	05	04	01	10
CO-5	Circuits	05	04	01	10
Total		**25**	**17**	**08**	**50**

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies

1. Improved Lecture
2. Tutorial
3. Presentation
4. Group Discussion
5. Online sources
6. Seminar
7. Workshop

b) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Discrete Mathematical Structures With Applications To Computer Science	J. P. Tremblay and R. Manohar	McGraw Hill Education	1st edition, 2017
2	Discrete Mathematics (Schaums Outline)	Seymour Lipschutz and Mark Lipson	McGraw Hill Education.	3rd edition, 2017.

3	Discrete Mathematics with Graph Theory	Edgar G Goodaire and Michael M. Parmenter	Pearson Education Pt. Ltd., Indian Reprint	2003
4	Basic Abstract Algebra	P.B. Bhattacharya , S.K.Jain &S.R. Nagpaul	Cambridge University press	--------------
5	Discrete Mathematics structures with application to computer science	J.P. Tremblay and R. Manohar	MacGraw Hill Education,	1st edition ,2017

b)Reference Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Di screte Mathematics	Seymour Lipschutz and Mark Lipson	(Schaums Outline). McGraw Hill Education	3rd edition, 2017
2.	Discrete Mathematics with Graph Theory	Edgar G Goodaire and Michael M. Parmenter	Pearson Education Pt. Ltd. , Indian Reprint	2003

c)Suggested Digital Platforms Web links:

https://www.eshiksha.mp.gov.in/mpdhe

Suggested Equivalent online courses:

https://nptel.ac.in/courses/111106086/

https://igemoocs.inflibnet.ac.in/index.php/courses/view ug/311

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Cos, POs and PSOs Mapping

Course Title: B.Sc. Mathematics
Course Code: 2MS601
Course Title: Fundamental of Boolean Algebra

Course Outcome	Program Outcome												PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PO4
	Knowledge	Research	Communication	Problem Solving	Individual and Team	Investigation of	Modern Tool	Science and	Life-Long Learning	Ethics	Project Management	Environment and	Thedetailed function	To integrate	To understa	Provide
CO1- 01MS602.1 Student will aware of history of Indian logic of mathematics and hence of its Past, present and future role as part of our culture and Using the Boolean algebra in logical problems.	2	3	1	2	2	2	2	2	3	3	1	1	2	1	1	3
CO2- 01MS602.2 Understand the Application of Boolean Algebra in Mathematics and Engineering.	1	3	2	1	1	1	1	1	1	2	3	1	3	1	1	2
CO3- 01MS60	2	3	2	2	1	1	3	2	1	2	3	1	2	1	2	2

2.3 Minimize the Boolean function using Karnaugh-Map .																
CO4 01MS602.4 Understand the Applications of Logic Gates.	2	3	2	2	1	1	3	2	1	1	3	1	2	1	2	2
CO5- 01MS602.5 Applying the circuits in logical problems.	2	3	2	2	1	1	3	2	1	1	3	1	2	1	2	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO1-**01MS602.1 Student will aware of history of Indian logic of mathematics and hence of its Past, present and future role as part of our culture and Using the Boolean algebra in logical problems.	SO1.1 SO1.2 SO1.3 SO1.4		Unit-1.0 Group 1.1,1.2,1.3,1.4,1.5, 1.6,1.7,1.8,1.9,1.10	SL1.1 SL1.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO2-**01MS602.2 Understand the Application of Boolean Algebra in	SO2.1 SO2.2 SO2.3		Unit-2 Ring 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	SL2.1 SL2.2

	Mathematics and Engineering .				
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO3-**01MS602.3 Minimize the Boolean function using Karnaugh-Map .	SO3.1 SO3.2 SO3.3 SO3.4		Unit-3 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	SL3.1 SL3.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO4-**01MS602.4 Understand the Applications of Logic Gates.	SO4.1 SO4.2 SO4.3 SO4.4		Unit-4 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	SL4.1 SL4.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO5-**01MS602.5 Applying the circuits in logical problems.	SO5.1 SO5.2 SO5.3		Unit-5 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	SL5.1 SL5.2

Curriculum Development Team

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7. Ms. Pushpa Kushwaha, Assistant Professor, Department of Mathematics.
8. Ms. Arpana Tripathi, Assistant Professor, Department of Mathematics.

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Course Code:	2MS602
Course Title :	Probability & Statistics
Pre- requisite:	A student must have had the subject mathematics in Diploma Course or equivalent**.**
Rationale:	Probability And Statistics are the two important concepts in Maths. Probability is all about chance. Whereas statistics is more about how we handle various data using different techniques. It helps to represent complicated data in a very easy and understandable way.

Course Outcome :

CO1-2MS602.1 Student will aware of history of Indian Contribution in statistics and hence of its Past, present and future role as part of our culture.

CO2-2MS6022 Understand The concept Of Measures of Central Tendency

CO3-2MS602.3 Understand the Application of Dispersion and distribution in Mathematics and Engineering .

CO4-2MS602.4 Students will constructing methods of least squares, curve Fitting & correlations

CO5-2MS602.5 With this Course students are prepared to learn about Sampling of large sampling

Scheme of Studies:

Board of Study	**Course Code**	**Course Title**	**Scheme of studies (Hours/Week)**					**Total Credits (C)**
			Cl	**LI**	**SW**	**SL**	**Total Study Hours (CI+LI+SW+SL)**	
Program Core (PCC)	2MS602	Probability & Statistics	4	0	1	1	6	4

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

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LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA + ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+ AT)		
PCC	2MS602	Probability & Statistics	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1- 2MS602.1
Student will aware of history of Indian Contribution in statistics and hence of its Past, present and future role as part of our culture.

Approximate Hours

Item	AppX Hrs
Cl	16

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LI	0
SW	1
SL	1
Total	18

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**

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SO1.1 Student will aware of history of Indian Contribution in statistics **SO1.2** To understand the application of sample space **SO1.3** 1.1 To understand the Addition Theorem of Probability 1.2 **SO1.4** To understand the meaning of Probability of an Event		**Unit-1. Indian Contribution in Statistics:** 1.3 P.C. Mahalanobis 1.4 C. Radhkrishna Rao 1.5 Samanta Chandra Sekhar Harichandran 1.6 J.K. Ghose 1.7 P. Maiti **Theory of Probability:** 1.8 Event **,**Sample Space 1.9 Probability of an Event 1.10 Addition Theorem and Multiplication Theorem of Probability 1.11 Inverse Probability & Continuous Probability 1.12 Baye's Theorem 1.13 Probability Density Functions and its Applications 1.14 Standard Deviation of Various Continuous Probability Distributions 1.15 Mathematical Expectation 1.16 Expectation of Sum and Product of Random Variable	S**L.1** Determine whether two events are mutually exclusive and independent S**L.2** Calculate probabilities using the addition and multiplication rules

SW-1 Suggested Sessional Work (SW):

a. Assignments:-

i . Knowledge of **Indian Contribution in Statistics**
ii . To understand the Addition Theorem of Probability
iii. Expectation of Sum and Product of Random Variable
iv. Standard Deviation of Various Continuous Probability Distributions
v. To understand the application of sample space

b. Other Activities

Quiz , Oral presentation

CO2- 2MS602.2 Understand The concept of Measures of Central Tendency

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Item	AppX Hrs
Cl	8
LI	0
SW	1
SL	1

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO2.1 Understand the Methods of Calculating Arithmetic mean **SO2.2** Understand the Methods of Calculating Median		**UNIT 2 Measures of central Tendency** **2.1** rithmetic mean **2.2** ethods of Calculating Arithmetic mean **2.3** eighted mean **2.4** Mode **2.5** Tutorial -1 **2.6** edian **2.7** ethods of Calculating Median **2.8** Tutorial -2	**SL.1** Calculate the mean, median and mode for the given data **SL.2** Understand the basic concept of mean, median and mode

SW-2 Suggested Sessional Work (SW):

Assignments:-

a. Methods of Calculating Median
b. Weighted mean
c. Methods of Calculating Arithmetic mean

Mini Project:

Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):

Quiz, Class Test.

.

CO3-2MS602.3

Understand the Application of Dispersion and distribution in Mathematics and Engineering .

Approximate Hours

Item	AppX Hrs
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**

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SO3.1 Understand the concept of Range and interquartile range **SO3.2** Understand Mean Deviation and Standard Deviation **SO3.3** Understand the concept of Constants of Binomial distribution		**UNIT 3 Dispersion and Distribution:** **3.1** ange and interquartile range **3.2** ean Deviation and Standard Deviation **3.3** oments, Skewness and Kurtosis **3.4** oment Generating Function **Theoretical distribution with their properties and uses:** **3.5** inomial distribution **3.6** onstants of Binomial distribution **3.7** xamples of Binomial distribution **3.8** oisson distribution **3.9** onstants of Poisson distribution **3.10** xamples of Poisson distribution **3.11** ectangular distribution **3.12** xponential distribution	**SL.1** describe and calculate the mean deviation And standard deviation **L.2** Understand the concept of Constants of Binomial distribution

SW-3 Suggested Sessional Work (SW):
a. Assignments:
i. Examples of Binomial distribution

ii. Application of Binomial distribution

iii. Constants of Poisson distribution

iv. Examples of Poisson distribution

V. Exponential distribution

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO4 -2MS602.4
Students will constructing methods of least squares, curve Fitting & correlations

Approximate Hours

Item	AppX Hrs
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**

SO4.1 Understand the Concept of Least Squares **SO4.2** Understand the application of Correlation and Regression **SO4.3** Understand the concept of positive or negative Correlation **SO4.4** Understand the relationships karl pearson's Coefficient of Correlation		**Unit-4 Curve Fitting & Correlation:** **4.1** Methods of Least Squares **4.2** principle of least squares **4.3** Normal equation of least squares **4.4** Curve Fitting **4**.5 tutorial 1 **4.6** the Methods of Least Squares used in curves fitting **4.7** Correlation and Regression **4.8** positive or negative Correlation **4.9** Coefficient of Correlation **4.10** karl pearson's Coefficient of Correlation **4.11** Partial and Multiple Correlations (up to three variables only) **4.12** tutorial -2	**SL.1** Learn about the principle of least squares **SL.2** Learn about Curve Fitting

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. the Methods of Least Squares used in curves fitting
ii. Normal equation of least squares

iii. Understand the concept of Correlation and Regression

iv. karl pearson's Coefficient of Correlation
v. Application of Curve Fitting

b. Other Activities (Specify):
Quiz, Class Test.

CO5- 06MS603.5
With this Course students are prepared to learn about Sampling of large sampling

Approximate Hours

Item	AppX Hrs
Cl	12
LI	0
SW	1
SL	1
Total	14

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Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO5.1 Understand the concept of Sampling **SO5.2** Understand the concept of Standard Error of sampling distribution of means **SO5.3** Understand the concepts of purposive sampling ,simple sampling		**Unit- 5 Sampling:** **5.1** Sampling of Large Samples **5.2** Types of sampling **5.3** Random sampling **5.4** purposive sampling ,simple sampling **5.5** tutorial 1 **5.6** Comparison of two large samples **5.7** Null and alternative Hypothesis **5.8** Standard Error of sampling distribution of means **5.9** Errors of First and Second Kinds **5.10** Level of Significance and Critical Region **5.11** Tests of Significance based on chi-square (X), t, Fand Z distribution **5.12** tutorial -2	**SL.1** To learn about Types of sampling **SL.2** understand the use of Errors of First and Second Kinds **SL.3** understand the Level of Significance and Critical Region

SW-5 Suggested Sessional Work (SW):
a. Assignments:
i. Errors of First and Second Kinds

ii. Comparison of two large samples

iii. Tests of Significance based on chi-square (X), t, Fand Z distribution
iv. Application of Random sampling

v. Application of Sampling of Large Samples
in real life

b. Other Activities (Specify):
Quiz, Class Test.

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Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
CO1- 06MS603.1 Student will aware of history of Indian Contribution in statistics and hence of its Past, present and future role as part of our culture.	16	1	1	18
CO2- 06MS603.2 Understand The concept Of Measures of Central Tendency	8	1	1	10
CO3. 06MS603.3 Understand the Application of Dispersion and distribution in Mathematics and Engineering	12	1	1	14
CO4 -06MS603.4 Students will constructing methods of least squares, curve Fitting & correlations	12	1	1	14
CO5- 06MS603.5 With this Course students are prepared to learn about Sampling of large sampling	12	1	1	14
Total Hours	60	5	5	70

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	**Unit-1. Indian Contribution in Statistics:**	05	03	02	10
CO-2	**Unit- 2 Measures of central Tendency**	05	03	02	10
CO-3	**Unit- 3 Dispersion and Distribution**	05	03	02	10

CO-4	**Unit-4 Curve Fitting & Correlation:**	05	04	01	10
CO-5	**Unit -5 Sampling:**	05	04	01	10
Total		**25**	**17**	**08**	**50**

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies

1. Improved Lecture
2. Tutorial
3. Presentation
4. Group Discussion
5. Online sources
6. Seminar
7. Workshop

Suggested Learning Resources:

a) Books :

Title	Author	Publishers	Edition &year
Introductory methods of numerical analysis	S.S Sastry	Prentice Hall India learning private limited	5th edition 2012
Numerical methods of scientific and Engineering Computation	M K Jain SRK Lyengar RK jain	New Age International	Ltd. 1999
Numerical methods	E. Balagurusamy	TaTa MC Graw Hill	Publication 2017

b)Suggested Digital Platforms Web links:

https://www.eshiksha.mp.gov.in/mpdhe

c) Suggested Equivalent online courses:

https://nptel.ac.in/courses/111106101/

https://igemoocs.inflibnet.ac.in/index.php/courses/view ug/311

AKS University
Faculty of Basic Science
Department of Mathematics
Curriculum & Syllabus of B.Sc. Mathematics program
Semester-I

Cos, POs and PSOs Mapping

Course Code : 2MS602
Course Title: Probability & Statistics

Course Outcome	Program Outcome												PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4

AKS University

Faculty of Basic Science

Department of Mathematics

Curriculum & Syllabus of B.Sc. Mathematics program

Semester-I

	Knowledge	Research Aptitude	Communication	Problem Solving	Individual and Team Work	Investigation of Problems	Modern Tool usage	Science and Society	Life-Long Learning	Ethics	Project Management	Environment and sustainability	The detailed functional knowledge of theoretical conceptsand experimental aspects of science.	To integrate the gained knowledge with various contemporary and evolving areas in chemical sciences, physical sciences	To understand, analyze, plan and implement qualitative as well	Provide opportunities to excel in academics, research

CO1-06MS603.1 Student will aware of history of Indian Contribution in statistics and hence of its Past, present and future role as part of our culture	2	3	1	2	2	2	2	2	3	3	1	1	2	1	1	3
CO2-06MS603.2 Understand The concept Of Measures of Central Tendency	1	3	2	1	1	1	1	1	1	2	3	1	3	1	1	2
CO3-06MS603.3 Understand the Application of Dispersion and distribution in Mathematics and Engineering	2	3	2	2	1	1	3	2	1	2	3	1	2	1	2	2

CO4 06MS603.4 Students will constructing methods of least squares, curve Fitting & correlations	2	3	2	2	1	1	3	2	1	1	3	1	2	1	2	2
CO5-06MS603.5 With this Course students are prepared to learn about Sampling of large sampling	2	3	2	2	1	1	3	2	1	1	3	1	2	1	2	3

Legend: 1 – Low, 2 – Medium, 3 – High

AKS University

Faculty of Basic Science

Department of Mathematics

Curriculum & Syllabus of B.Sc. Mathematics program

Semester-I

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO1-2MS602.1** Student will aware of history of Indian Contribution in statistics and hence of its Past, present and future role as part of our culture	SO1.1 SO1.2 SO1.3 SO1.4		Unit-1.0 **Indian Contribution in Statistics:** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8, 1.9,1.10 1.11 1.12 1.13 1.14 1.15 1.16 1.17	SL1.1 SL1.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO2-2MS602.2** Understand The concept Of Measures of Central Tendency	SO2.1 SO2.2 SO2.3		Unit-2 **measure of central tendency** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,	SL2.1 SL2.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO3-2MS602.3** Understand the Application of Dispersion and distribution in Mathematics and Engineering .	SO3.1 SO3.2 SO3.3 SO3.4		Unit-3 **Dispersion and Distribution** 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8,3.9,3.10 3.11 3.12	SL3.1 SL3.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO4-2MS602.4** Students will constructing methods of least squares, curve Fitting & correlations	SO4.1 SO4.2 SO4.3 SO4.4		Unit-4 **Curve fittings and correlation** 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8,4.9,4.10 4.11 4.12	SL4.1 SL4.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO5-2MS602.5** With this Course students are prepared to learn about Sampling of large sampling	SO5.1 SO5.2 SO5.3		Unit-5 **sampling** 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8,5.9,5.10 5.11 5.12	SL5.1 SL5.2

Curriculum Development Team

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Course Code: 1PHY601

Course Title: Solid State Physics and Electronics

Course Code:	**1PHY601**
Course Title:	**Solid State Physics and Electronics**
Pre-requisite:	Students should have a good understanding of classical mechanics, electromagnetism, thermodynamics, and classical wave theory. These topics provide the necessary background for understanding the principles of solid-state physics
Rationale:	The study of Solid State Physics and Electronics (Theory) provides a theoretical framework that is essential for understanding the behavior of materials and electrons in solid-state systems. This understanding, in turn, is critical for the development and advancement of electronic devices and technologies that shape the modern world. The course equips students with the knowledge and skills needed for careers in research, technology development, and innovation in various industries.

CourseOutcomes:

1PHY601.1: Students should possess a comprehensive knowledge of the contributions of premier Indian institutes, as well as a thorough understanding of the classification of solids, space lattice, crystallographic concepts, simple crystal structures, reciprocal lattice, and diffraction in crystals.

1PHY601.2: Students should have a deep understanding of the principles governing specific heat in solids, lattice vibrations in crystals, and the motion of electrons in metals. They should also be familiar with classical theories and models, as well as experimental methods for determining physical properties related to these topics.

1PHY601.3: **S**tudents should have a thorough understanding of the principles and applications of energy bands, semiconductors, P-N junctions, diodes, and rectifiers, enabling them to analyze and design electronic circuits involving these components.

1PHY601.4: Students with a solid foundation in transistor operation, biasing techniques, and amplifier design, enabling them to apply this knowledge to the analysis and design of electronic circuits.

1PHY601.5: To equip students with the knowledge and skills necessary to analyze and design circuits involving oscillators and modulation techniques in communication systems.

SchemeofStudies:

Boardof Study	Course Code	CourseTitle	Schemeofstudies(Hours/Week)					TotalCredits (C)
			CI	LI	SW	SL	TotalStudyHours (CI+LI+SW+SL)	
Program Core (PCC)	1PHY601	**Solid State Physics and Electronics**	4	4	1	1	10	6

Legend: **CI:**ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)andothers),
LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworkshop, field or other locations using different instructional strategies)
SW: SessionalWork(includesassignment,seminar,miniprojectetc.),
SL: SelfLearning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacher to ensure outcome of Learning.

SchemeofAssessment:

Theory

Board ofStudy	CouseCode	CourseTitle	SchemeofAssessment(Marks)							
			ProgressiveAssessment(PRA)						EndSemesterAssessment (ESA)	Total Marks (PRA+ ESA)
			Class/HomeAssignment5number 3marks each (CA)	ClassTest2 (2bestoutof3) 10marks each (CT)	Seminarone (SA)	Class Activityanyone (CAT)	ClassAttendance (AT)	TotalMarks (CA+CT+SA+CAT+AT)		
PCC	1PHY601	**Solid State Physics and Electronics**	~~15~~	~~20~~	~~5~~	~~5~~	~~5~~	~~50~~	~~50~~	~~100~~

Course-CurriculumDetailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1PHY601.1: Students should possess a comprehensive knowledge of the contributions of premier Indian institutes, as well as a thorough understanding of the classification of solids, space lattice, crystallographic concepts, simple crystal structures, reciprocal lattice, and diffraction in crystals

ApproximateHours	
Item	AppXHrs
Cl	14
LI	12
SW	2
SL	3
Total	31

SessionOutcomes (SOs)	**ClassroomInstruction (CI)**	**Laboratory Instruction (LI)**	**Self Learning (SL)**
SO1.1: Students should understand the significance and reputation of premier Indian institutes in the field of science and technology and awareness of the academic . **SO1.2:** Understanding the concept of unit cells and their significance in describing crystal structures and recognition of primitive and non-primitive unit cells. **SO1.3:** Knowledge of the different types of Bravais lattices and understanding the characteristics and symmetries of these lattices. **SO1.4:** Familiarity with symmetry operations and their role in crystallography and understanding point groups and space groups . **SO1.4:** Understanding the coordination number, packing efficiency, and other properties of the simple cubic structure. **SO1.5:** Understanding the concept of reciprocal lattice and its importance in crystallography and Knowledge of diffraction phenomena in crystals. **SO1.6:** Understanding the	**Unit1:Crystal Structures** **1.1.** Introduction to Premier Indian Institutes **1.2.** Crystalline and amorphous solids. **1.3.** Basics of space lattice, basis, lattice translational vector, and unit cell. **1.4.** Differentiate between primitive and non-primitive cells. **1.5.** Introduction to Bravais lattice in two and three dimensions. **1.6.** Overview of the seven crystal systems. **1.7.** Fundamentals of elements of symmetry, point groups, and space groups. **1.8.** Understanding lattice planes and Miller indices. **1.9.** Study of simple cubic structure. **1.10.** Face-centered (NaCl) & body-centered cubic (CsCl) structure. **1.11.** Hexagonal closed-packed and diamond and zinc sulfide structures.	**1.1.** To determine the energy band gap of a semiconductor using P-N diode in reverse bias. **1.2.** To determine ripple factor and voltage regulation of half wave and full wave rectifiers. **1.3.** To determine ripple factor and voltage regulation of a full wave rectifiers using filter circuit. **1.4.** To study frequency response curve of single stage	**i.** Vector **ii.** Symmetry **iii.** Group

principles behind Laue's and Bragg's equationsand application of these equations in the analysis of crystal structures.	**1.12.** Reciprocal lattice and diffraction in crystals. **1.13.** Laue's and Bragg's equation and its applications. **1.14.** Determination of crystal structure by X-rays, the powder method.	RC amplifiers in CE mode.	

SW-1SuggestedSessionalWork(SW):

a. Assignments:

i. Study of simple cubic structure
ii. Lattice planes and Miller indices.

1PHY601.2: Students should have a deep understanding of the principles governing specific heat in solids, lattice vibrations in crystals, and the motion of electrons in metals. They should also be familiar with classical theories and models, as well as experimental methods for determining physical properties related to these topics.

ApproximateHours	
Item	AppXHrs
Cl	11
LI	12
SW	2
SL	3
Total	28

SessionOutcomes (SOs)	**ClassroomInstruction (CI)**	**Laboratory Instruction (LI)**	**Self Learning (SL)**

SO2.1: Recognition of the limitations of classical theories in explaining specific heat at low temperatures. **SO2.2:** Familiarity with the assumptions underlying the Debye model and recognition of how the Debye model. **SO2.3:** Understanding the concept of lattice vibrations in mono-atomic lattices and knowledge of dispersion relations. **SO2.4:** Understanding the classical theory of electrical conductivity through the Lorentz-Drude model and awareness of the assumptions and limitations. **SO2.5:** Derivation and application of Ohm's law and understanding the relationship between electrical resistivity, conductivity, and electric current. **SO2.6:** Understanding the Wiedemann-Franz law relating electrical and thermal conductivity and knowledge of the Hall Effect .	**Unit.2:Physical properties of matter** **2.1.** Classical theory of specific heat: Dulong and Petit's law. **2.2.** Limitations of classical theory and need for quantum models. **2.3.** Einstein model derivation of specific heat and Limitations. **2.4.** Assumptions of the Debye model. **2.5.** Derivation of specific heat using the Debye model and validity . **2.6.** Mono-atomic lattice vibrations and dispersion relation. **2.7.** Brillouin Zones and their significance. **2.8.** Concept of phonons and their role in heat conduction. **2.9.** Overview of the Lorentz-Drude theory. **2.10.** Electrical resistivity , conductivity and Ohm's Law (J = σE) . **2.11.** Wiedemann-Franz Law and Hall effect	**2.1.** Study of characteristic curve of Photodiode. **2.2.** To study the characteristic curve of Light Dependent Resistor (LDR). **2.3.** Study of characteristic curve of solar cell. **2.4.** To determine ripple factor and voltage regulation of a full wave rectifiers using filter circuit..	**i.** Quantum Models **ii.** Specific heat **iii.** Hall effect

SW-2 SuggestedSessionalWork(SW):

a. Assignments:

i. Einstein model derivation of specific heat and Limitations.
ii. Concept of phonons and their role in heat conduction.
iii.

1PHY601.3: **S**tudents should have a thorough understanding of the principles and applications of energy bands, semiconductors, P-N junctions, diodes, and rectifiers, enabling them to analyze and design electronic circuits involving these components

ApproximateHours	
Item	AppXHrs
Cl	13
LI	4
SW	2
SL	3

Total	22

SessionOutcomes (SOs)	**ClassroomInstruction (CI)**	**Laboratory Instruction (LI)**	**Self Learning (SL)**
SO.3.1: Knowledge of the properties of intrinsic and extrinsic semiconductors and understanding the role of dopants in altering semiconductor conductivity. **SO.3.2:** Understanding Fermi energy as a measure of electron energy in a system and knowledge of how Fermi energy level varies with temperature and doping. **SO.3.3:** Understanding the formation of a P-N junction and the role of depletion layer and knowledge of the construction and basic operation of a P-N junction diode. **SO.3.4:** Knowledge of the mechanisms leading to avalanche and Zener breakdown and understanding the application of Zener diodes in voltage regulation. Understanding the structure and operation of Zener diodes. **SO.3.5:** Understanding the principles of solar energy conversion in solar cells and knowledge of the key parameters affecting the efficiency of solar cells. **SO.3.6:** Ability to calculate and interpret the efficiency and ripple factor of rectifiers and understanding the concept of voltage regulation and its calculation.	**Unit-3.Solid state devices and applications** **3.1.** Formation of energy bands. **3.2.** Semiconductors: Intrinsic and extrinsic. **3.3.** Concept of Fermi energy and Fermi energy level. **3.4.** Mobility, drift velocity, and conductivity in semiconductors. **3.5.** P-N Junction (Depletion layer and potential barrier) **3.6.** Current equation , Construction and operation of P-N Junction Diode. **3.7.** Characteristics curve in forward and reverse bias and resistance **3.8.** Avalanche and Zenerbreakdown. **3.9.** Zener diode and Photodiode: Structure and working principle. **3.10.** Light Emitting Diode (LED): Operation and applications. **3.11.** Solar Cell: Basics of solar energy conversion. **3.12.** Half & full-wave, rectifiers and Electrical circuit and its working. **3.13.** Determination of efficiency, ripple factor, and voltage regulation	**3.1.** To study characteristic curve of a PN Junction diode. **3.2.** To study characteristics curve of a Zener diode. **3.3.** To study characteristics curve of a light emitting diode (LED). **3.4.** To study unregulated and regulated power supply.	**i.** Fermi energy **ii.** Mobility **iii.** Depletion layer

SW-3SuggestedSessionalWork(SW):

a. Assignments:

i. Formation of energy bands.
ii. Half & full-wave, rectifiers and Electrical circuit and its working.

SessionOutcomes (SOs)	**ClassroomInstruction (CI)**	**Laboratory Instruction (LI)**	**Self Learning (SL)**
SO4.1: Understanding the structure and working principle of BJTs. Differentiating between PNP and NPN transistors and understanding the biasing of transistors and their operating regions. **SO4.2:** Understanding the characteristics and applications of transistors in common base, common emitter, and common collector configurations and ability to analyze and design transistor amplifier circuits in these modes. **SO4.3:** Ability to interpret and analyze the characteristic curves of JFETs and MOSFETs and understanding the impact of different parameters on device performance. **SO4.4:** Recognition of thermal runaway and its consequences in transistor circuits and understanding stability factors and their role in maintaining circuit stability. **SO4.5:** Understanding the concept of amplification and the classification of amplifiers and knowledge of the common emitter configuration and its advantages. **SO4.6:** Understanding the operation of RC-coupled amplifiers and ability to design and analyze single-stage RC-coupled amplifiers. Understanding the concepts of Q-point and load line.	**Unit.4:Transistor and amplifier** **4.1.** Bipolar Junction Transistors (BJTs). **4.2.** Types of transistors: PNP and NPN and Biasing and operation of transistors. **4.3.** Operation of transistors in common base, common emitter, and common collector modes. **4.4.** Hybrid (h)-parameters of JFETs and MOSFETs. **4.5.** Characteristic curves for JFETs and MOSFETs. **4.6.** Biasing stabilization in transistors. **4.7.** Thermal runaway and stability factor. **4.8.** Amplifiers and their classification Single-stage common emitter **4.9.** RC-coupled amplifier: **4.10.** Q-point, load line, and frequency response curve.	**4.1.** To study characteristics curves of PNP/ NPN transistor in common base mode configuration and determination current gain. **4.2.** To study characteristics curves of PNP/ NPN transistor in common emitter mode configuration and determination current gain. **4.3.** To study characteristics curves of Junction field effect transistor. **4.4.** To study thermal bias stability of transistor in common emitter mode.	**i.** Basing **ii.** Thermal stability **iii.** Amplifier

1PHY601.4: Students with a solid foundation in transistor operation, biasing techniques, and amplifier design, enabling them to apply this knowledge to the analysis and design of electronic circuits.

ApproximateHours	
Item	AppXHrs
Cl	10
LI	12
SW	2
SL	3
Total	27

SW-4SuggestedSessionalWork(SW):

a. *Assignments:*

i. Characteristic curves for JFETs and MOSFETs.
ii. Operation of transistors in common base, common emitter, and common collector modes.

1PHY601.5: To equip students with the knowledge and skills necessary to analyze and design circuits involving oscillators and modulation techniques in communication systems.

ApproximateHours	
Item	AppXHrs
Cl	12
LI	12
SW	2
SL	3

Total	29

SessionOutcomes (SOs)	ClassroomInstruction (CI)	Laboratory Instruction (LI)	Self Learning (SL)
SO5.1: Understanding the concept of feedback in amplifiers. Differentiating between positive and negative feedback and recognizing the impact of feedback on amplifier performance. **SO5.2:** Understanding the principles of oscillator circuits and knowledge of the Barkhausen criterion for determining oscillator stability. **SO5.3:** Understanding the operation of phase shift and Wien bridge oscillators and knowledge of the key components and configurations of each oscillator. **SO5.4:** Ability to describe the characteristics and working principles of phase shift and Wien bridge oscillators and recognizing the applications and limitations of each oscillator type. **SO5.5:** Deriving and analyzing the mathematical representation of frequency-modulated waves and understanding the advantages and characteristics of FM. **SO5.6:** Understanding the principles of demodulation in communication systems and knowledge of techniques for detecting amplitude-modulated waves.	**Unit-5:Oscillators, Modulation and demodulation** **5.1.** Feedback of amplifiers (Positive and negative). **5.2.** Principles of oscillators and Barkhausen criterion for oscillator stability. **5.3.** Phase Shift and Wien Bridge Oscillators. **5.4.** Characteristics and working principles of each oscillator. **5.5.** Definition of modulation. **5.6.** Theoretical analysis of amplitude modulation (AM) and its significance. **5.7.** Sidebands and bandwidth in amplitude-modulated waves. **5.8.** Mathematical analysis of frequency-modulated waves (FM). **5.9.** Modulation index, frequency spectrum, and bandwidth in FM. **5.10.** Definition and theoretical analysis of phase modulation (PM). **5.11.** Comparison among amplitude, frequency, and phase modulation. **5.12.** Principles of demodulation and Detection of amplitude-modulated waves	**5.1.** Find out closed loop gain of feedback amplifier. **5.2.** Study of wave form of Wein bridge oscillator and to measure frequency of oscillations **5.3.** Study of amplitude modulated wave and determination of modulation index using CRO. **5.4.** Study of frequency modulated wave and determination of modulation index using CRO	**i.** Oscillators **ii.** bandwidth **iii.** Modulation

SW-5SuggestedSessionalWork(SW):

a. Assignments:

i. Phase Shift and Wien Bridge Oscillators.

.

Principles of demodulation and Detection of amplitude-modulated waves

BriefofHourssuggestedfortheCourseOutcome

CourseOutcomes	**Class Lecture (Cl)**	**Laboratory instruction (Li)**	**Sessional Work (SW)**	**Self Learning (Sl)**	**Totalh (Cl+SV Sl)**
1PHY601.1: Students should possess a comprehensive knowledge of the contributions of premier Indian institutes, as well as a thorough understanding of the classification of solids, space lattice, crystallographic concepts, simple crystal structures, reciprocal lattice, and diffraction in crystals.	14	12	2	**2**	30
1PHY601.2: Students should have a deep understanding of the principles governing specific heat in solids, lattice vibrations in crystals, and the motion of electrons in metals. They should also be familiar with classical theories and models, as well as experimental methods for determining physical properties related to these topics.	11	12	2	**3**	28
1PHY601.3: Students should have a thorough understanding of the principles and applications of energy bands, semiconductors, P-N junctions, diodes, and rectifiers, enabling them to analyze and design electronic circuits involving these components.	13	12	2	**3**	30
1PHY601.4: Students with a solid foundation in transistor operation, biasing techniques, and amplifier design, enabling them to apply this knowledge to the analysis and design of electronic circuits.	10	12	2	**3**	28
1PHY601.5: To equip students with the knowledge and skills necessary to analyze and design circuits involving oscillators and modulation techniques in communication systems.	12	12	2	**3**	29
TotalHours	60	60	10	**15**	185

SuggestionforEndSemesterAssessment

SuggestedSpecificationTable (ForESA)

CO	UnitTitles	Marks Distribution			Total Marks
		R	U	A	
CO-1	**Crystal Structures**	03	01	01	05
CO-2	**Physical properties of matter**	02	06	02	10
CO-3	**Solid state devices and applications**	03	07	05	15
CO-4	**Transistor and amplifier**	-	10	05	15
CO-5	**Oscillators, Modulation and demodulation**	03	02	-	05
Total		11	26	13	50

Legend: R:Remember, U:Understand, A:Apply

TheendofsemesterassessmentforIntroductiontoPortlandcementwillbeheldwithwritten examination of 50 marks

Note.DetailedAssessmentrubricneedtobepreparedbythecoursewiseteachersforabovetasks.
Teacherscanalsodesigndifferenttasksasperrequirement,forendsemesterassessment.

SuggestedInstructional/ImplementationStrategies:

ii. ImprovedLecture
iii. Tutorial
iv. CaseMethod
v. GroupDiscussion
vi. RolePlay
vii. Visittocementplant
viii. Demonstration
ix. ICT Based Teaching Learning (VideoDemonstration/Tutorials CBT, Blog,Facebook,Twitter, Whatsapp, Mobile, Online sources)
x. Brainstorming

Suggested Learning Resources:

(a)Books:

S. No.	Title	Author	Publisher	Edition& Year
1	Introduction to Solid State Physics	K'ttel Charles,	Wiley India Pvt. Ltd., India	(2007), 7th Edition.
2	Elementary Solid State Physics	Omar M. Ali,	Pearson Education. India	(2009), 6th Edition.
3	Solid State Physics	Singhal R. L. P. A. Alvi. et. Al.	KedarNath Ram Nath and Co.	(2018)
4	Electronic Fundamentals and Application	Chattopadhyay D.Rakshit P.C.,	New Age International,	(2020).
5	Elements of Solid State Physics	Srivastava J. P	Prentice Hall of India.	2011. 3rd edition.
6	Solid State Physics	Ashcroft Neil W., Mermin N. David.	Harcourt College Publishing, New York,	2019.
7	A Hand Book of Electronics	Gupta S. L.Kumar V.	PragatiPrakashan. India	2013, 19lh Edition.
8	Electronic Communication Systems	Kennedy George. Davis Bernard and Prasanna S. R. M.,	McGraw Hill Education,	(2017), 6dl Edition.
9	Electronic Principles	Malvino Albert Paul. Bates David,	McGraw Hill International	

Cos,POsandPSOsMapping

Course Code: 1PHY601

Course Title: Solid State Physics and Electronics (Theory)

CourseOutcomes	ProgramOutcomes												ProgramSpecificOutcome				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
	Engineering knowledge	**Problem analysis**	**Design/development of solutions**	**Conduct investigations of complex problems**	**Modern tool usage**	**The engineer and society**	**Environment and sustainability:**	**Ethics**	**Individual and team work:**	**Communication:**	**Project management and finance:**	**Life-long learning**	Identify,formulate,andsolvePhysicsproblems.	Designandconductexperiments, aswellastoanalyseandinterpretdata.	Apply knowledge of Physics in a different stream of science and to communicate effectively.	Ability to use the techniques, skills, and modern physical tools in real world application.	Engage in life-long learning and will have recognition.
1PHY601.1: Students should possess a comprehensive knowledge of the contributions of premier Indian institutes, as well as a thorough understanding of the classification of solids, space lattice, crystallographic concepts, simple crystal structures, reciprocal lattice, and diffraction in crystals.	**1**	**1**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**2**	**1**

1PHY601.2: Students should have a deep understanding of the principles governing specific heat in solids, lattice vibrations in crystals, and the motion of electrons in metals. They should also be familiar with classical theories and models, as well as experimental methods for determining physical properties related to these topics.	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**
1PHY601.3: Students should have a thorough understanding of the principles and applications of energy bands, semiconductors, P-N junctions, diodes, and rectifiers, enabling them to analyze and design electronic circuits involving these components.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**3**	**2**
1PHY601.4: Students with a solid foundation in transistor operation, biasing techniques, and amplifier design, enabling them to apply this knowledge to the analysis and design of electronic circuits.	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**	**2**
1PHY601.5: To equip students with the knowledge and skills necessary to analyze and design circuits involving oscillators and modulation techniques in	**-**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**2**	**3**

communication systems.																	

Legend:1–Low,2–Medium,3– High

CourseCurriculumMap:

POs&PSOs No.	COsNo.&Titles	SOsNo.	Laboratory Instruction(LI)	ClassroomInstruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO-1:Understand the character of ancient Cementous building materialsandevolution ofPortland cement.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0Historical progression andadvancements inbinding materialsfor construction 1.1,1.2,1.3,1.4,1.5,1.6,1.7	Asmentionedin pagenumber 2to6
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO 2 : Acquire knowledge regardingthetypesofcement raw materials and fuel in Portland cement production and its physical and chemical properties.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2RawMaterialsandFuel usedforcement manufacture 2.1,2.2,2.3,2.4,2.5,2.6,2.7, 2.8,2.9,2.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO3:Gainanunderstandingof the various types of cement manufactured in India and their utilization in infrastructuredevelopment.	SO 3.1 SO 3.2 SO3.3 SO3.4 SO3.5		Unit-3:Typesofcement manufactured in India 3.1, 3.2,3.3,3.4,3.5,3.6,3.7,3.8	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO 4: Familiarize with a conciseoverview ofthe cement manufacturing process.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4: Concise Explanation of the Portland Cement Production Process: 4.1, 4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12	CO 5: Comprehend the	SO5.1 SO5.2		Unit5:TheCementSectorinIndi	

PSO1,2,3,4,5	functionsofdifferentreg ulatory bodiesinIndiathatoversee the production and quality of cement.	SO5.3 SO5.4 SO5.5		aand Regulatory Obligations. 5.1,5.2,5.3,5.4,5.5	

CourseCode: **2PH601**

CourseTitle: **Astronomy and Space physics**

Pre-requisite: To study this course, the student must had Physics as a subject in Diploma..

Rationale: The students studying Physics should possess foundational understanding about historical background of astronomy and space physics.

CourseOutcomes:

2PH601.1. Student will be able to know the basic concepts of astronomy and space physics.

2PH601.2. Student will be able to know about physical processesoptical telescope,in stars and ' evolution of stars.

2PH601.3. Student would be able to knowaboutstellardistancesandother.

2PH601.4. Student would be able todifferentiatebetweenvariouscoordinatesystems and know about Binarystarsandtheirmotions.

2PH601.5. Student would be able to know about the characteristics of Sun.

SchemeofStudies:

Boardof Study	Course Code	CourseTitle	Schemeofstudies(Hours/Week)					TotalCredits (C)
			CI	**LI**	**SW**	**SL**	**TotalStudyHours (CI+LI+SW+SL)**	
Program Core (PCC)	2PH601	**Astronomy and Space physics**	4	0	1	1	6	4

Legend: **CI:**ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)andothers),
LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworkshop, field or other locations using different instructional strategies)
SW: SessionalWork(includesassignment,seminar,miniprojectetc.),
SL: SelfLearning,

C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacher to ensure outcome of Learning.

Scheme of Assessment: Theory

Board ofStudy	CouseCode	CourseTitle	**SchemeofAssessment(Marks)**							
			ProgressiveAssessment(PRA)						**EndSemesterAssessment**	**Total Marks**
			Class/HomeAssignment5 number 3marks each (CA)	ClassTest2 (2bestoutof3) 10marks each (CT)	Seminarone (SA)	Class Activityanyone (CAT)	ClassAttendance (AT)	TotalMarks (CA+CT+SA+CAT+AT)	**(ESA)**	(PRA+ESA)
PCC	2PH601	**Astronomy and Space physics**	15	20	5	5	5	50	50	100

Course-CurriculumDetailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

2PH601.1 Student will be able to know the basic concepts of astronomy and space physics.

ApproximateHours

Item	AppX Hrs
Cl	12
LI	0
SW	1
SL	1
Total	14

SessionOutcomes (SOs)	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO1.1 To understand the Astronomical Coordinates. **SO1.2**To learn about the Horizon, Equatorial, Ecliptic and galactic system of coordinates. **SO1.3**To understand the Apparent and Mean solar time and their relations. **SO1.4**To learn aboutCalendar, Julian date and heliocentric correction. **SO1.5** To learn about H-R Diagram.	**UNIT – I (Observational Data)** 1.1 Astronomical Coordinates- Celestial Sphere 1.2 Horizon, Equatorial, Ecliptic and galactic system of coordinates 1.3 Conversion from one coordinate system to another 1.4 Aspects of sky from different places on the earth 1.5 Twilight, Seasons, Sidereal 1.6 Apparent and Mean solar time and their relations 1.7 Calendar. Julian date and heliocentric correction 1.8 Determination of Mass, luminosity, radius, temperature and distance of a star 1.9 H-R Diagram 1.10 Empirical mass-luminosity relation	1. Aspects of sky from different places on the earth

SW-1SuggestedSessionalWork(SW):

b. Assignments:

i. Explain solar radiation and origin of radiation.

c. OtherActivities(Specify):

Present any one topic of this unit by power point presentation in front of departmental student and faculty.

2PH601.2.Student will be able to know about physical optical telescope, processes in stars and ' evolution of stars.

ApproximateHours

Item	AppX Hrs
Cl	12
LI	0
SW	1
SL	1
Total	14

SessionOutcomes (SOs)	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO2.1 To understand the solar energy. **SO2.2** To learn about storage of solar energy. **SO2.3**To learn about solar water heater and solar cooker. **SO2.4** To learn about solar fuels **SO2.5** Understand the principle of solar green houses.	**UNIT – II (Telescopes)** 2.1 Basic Optics 2.2 Optical Telescopes 2.3 Radio Telescopes 2.4 Infrared Astronomy 2.5 Ultraviolet Astronomy 2.6 X-ray Astronomy 2.7 Gamma-Ray Astronomy 2.8 All-Sky Surveys 2.9 Virtual Observatories	1. Learn about Optics

SW-2 Suggested Sessional Work(SW):

b. Assignments:

i. Explain Optical Telescopes with principle, construction and working.
ii. Discuss aboutX-ray Astronomy.

c. Other Activities(Specify):

Present any one topic of this unit by power point presentation in front of departmental student and faculty.

2PH601.3. Student would be able to know about stellar distances and other.

Approximate Hours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 To learn about stellar motions. **SO3.2** To understand secular and moving cluster parallaxes**.** **SO3.3** To learn about atmospheric extinction. **SO3.4** To understandBlack-bodyapproximationtothecontinuous radiationandtemperaturesofstars**.** **SO3.5** To understand **v**ariable stars as distance indicators.	**UNIT – III (Stellar Distances and Magnitudes)** 3.1 Distances of stars from the trigonometric 3.2 secular and moving cluster parallaxes 3.3 Stellar motions 3.4 Magnitude scale and magnitude systems 3.5 Atmospheric extinction 3.6Absolutemagnitudes and distance modulus 3.7 Colour index 3.8 Black-bodyapproximationtothecontinuousradiationandtemperaturesofstars 3.9 Variable stars as distance indicators	1. Fundamental of Magnitude scale and magnitude systems for stellar motions.

SW-3 Suggested Seasonal Work(SW):

b. *Assignments:*

Explain Variable stars as distance indicators.

c. *Other Activities(Specify):*

Present any one topic of this unit by power point presentation in front of departmental student and faculty.

2PH601.4. Student would be able to differentiate between various coordinate systems and know

about Binary stars and their motions.

Approximate Hours

Item	AppX Hrs
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Classroom Instruction (CI)	Self Learning (SL)
SO4.1T o u n d e r s t a n d Visual,spectroscopic and eclipsing binaries. **SO4.2**Learn about importance of binary stars as source of basic Astorphysical data. **SO4.3** Learn about classification and properties of various stypes of intrinsic and eruptive variable stars**.** **SO4.4** Astrophysical importance of the study of variable stars. **SO4.5** Understanding about novae and supernovae.	**UNIT – IV (Binaries and Variable Stars)** 4.1 Visual, spectroscopic and eclipsing binaries 4.2 Importance of binary stars as source of basic astrophysical data 4.3Classificationandpropertiesofv arioustypesofintrinsic and eruptive variable stars 4.4Astrophysical importance of the study of variable stars. 4.5 Novae 4.6Supernovae	1. Learn about Supernovae.

SW-4 Suggested Sessional Work(SW):

b. *Assignments:*

i. Give classification and properties of various types of intrinsic and eruptive variable stars.

b) Other Activities(Specify):

Present any one topic of this unit by power point presentation in front of departmental student and faculty.

2PH601.5.Student would be able to know about the characteristics of Sun.

Item	AppX Hrs
Cl	12
LI	0
SW	1
SL	1

Total	14

Session Outcomes (SOs)	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO5.1 To understand Physical Characteristic of Sun. **SO5.2**Learn about solar magnetic fields**.** **SO5.3** Learn about organic sun -spots. **SO5.4** Learn about solar atmosphere-chromospheres and corona**.** **SO5.5** To understand advanced concepts of Solar activity.	**UNIT – V (The Sun)** 5.1 Physical Characteristic of Sun 5.2 Basic data, solar rotation 5.3solar magnetic fields 5.4 Photosphere- granulation 5.5 sun-spots 5.6 Bab cock model of sunspot formation 5.7 solar atmosphere-chromospheres and corona 5.8Solaractivity 5.9 flares 5.10 prominences 5.11 Solar wind and activity cycle 5.12Helioseismology	1. Learn about Solar wind and activity cycle.

SW-5 Suggested Sessional Work(SW):

b. Assignments:
Explain Solaractivity.

c. Other Activities (Specify):
Present any one topic of this unit by power point presentation in front of departmental student and faculty.

BriefofHourssuggestedfortheCourseOutcome

CourseOutcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Totalhour (Cl+SW+Sl)

2PH601.1. Student will be able to know the basic concepts of astronomy and space physics.	**12**	1	1	14
2PH601.2. Student will be able to know about physical processes optical telescope,in stars and ' evolution of stars.	12	1	1	14
2PH601.3. Student would be able to knowaboutstellardistancesandother.	12	1	1	14
2PH601.4. Student would be able todifferentiatebetweenvariouscoordinatesystems and know about Binarystarsandtheirmotions.	12	1	1	14
2PH601.5. Student would be able to know about the characteristics of Sun.	12	1	1	14
TotalHours	**60**	**5**	**5**	70

SuggestionforEndSemesterAssessment

Suggested Specification Table (For ESA)

CO	**UnitTitles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	**ObservationalData**	03	04	03	10
CO-2	**Telescopes**	03	04	03	10
CO-3	**StellarDistancesandMagnitudes**	03	04	03	10
CO-4	**BinariesandVariableStars**	03	04	03	10
CO-5	**The Sun**	03	04	03	10
Total		15	20	15	50

Legend: R:Remember, U:Understand, A:Apply

TheendofsemesterassessmentforIntroductiontoPortlandcementwillbeheldwithwritten examination of 50 marks

Note. Detailed Assessmentrubricneedtobepreparedbythecoursewiseteachersforabovetasks. Teacherscanalsodesigndifferenttasksasperrequirement,forendsemesterassessment.

SuggestedInstructional/ImplementationStrategies:

i. ImprovedLecture
ii. Tutorial
iii. CaseMethod
iv. GroupDiscussion
v. RolePlay
vi. Visittocementplant
vii. Demonstration
viii. ICT Based Teaching Learning (VideoDemonstration/Tutorials CBT, Blog,Facebook,Twitter, Whatsapp, Mobile, Online sources)
ix. Brainstorming

SuggestedLearningResources:

(a)Books:

S. No.	Title	Author	Publisher	Edition& Year
1	Text bookofSpherical Astronomy	**W.M.Smart**	Cambridge UniversityPress	6thedition,1977
2	Astronomy, The evolving Universe	**M. Zeilik**	Cambridge University Press	1st Edition,2002
3	SolarAstrophysics	**P.V.Foukal**	Wiley-VCH,UnitedStates	1st Edition,2004
4	Introduction to Astronomy and Cosmology	**I. Morrison**	Wiley, United States	1st Edition,2008
5	Lecturenoteprovidedby Department of Physics, AKS University, Satna(M. P.)			

Cos,POsandPSOsMapping

Course Title: B.Sc.

Course Code: 2PH601

Course Title: Astronomy and Space physics

CourseOutcomes	ProgramOutcomes												ProgramSpecificOutcome				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
	Engineering knowledge	Problem analysis	Design/development of solutions	Conductinvestigationsofcomplex problems	Modern tool usage	The engineer and society	Environment and sustainability:	Ethics	Individual andteamwork:	Communication:	Projectmanagement and finance:	Life-longlearning	Identify, formulate,andsolvePhysicsproblems.	Designandconductexperiments, aswellastoanalyseandinterpretdata.	Apply knowledge of Physics in a different stream of science and to communicate effectively.	Ability to use the techniques, skills, and modern physical tools in real world application.	Engage in life-long learning and will have recognition.
2PH601.1. Student will be able to know the basic concepts of astronomy	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1	1

and space physics.																	
2PH601.2. Student will be able to know about physical processes optical telescope, in stars and ' evolution of stars.	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	1
2PH601.3. Student would be able to know about stellar distances and other.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**	2
2PH601.4. Student would be able to differentiate between	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**	2

various coordinate systems and know about Binary stars and their motions.																	
2PH601.5. Student would be able to know about the characteristics of Sun.	**2**	**1**	**2**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**	3

Legend:1–Low,2–Medium,3– High

CourseCurriculumMap:

POs&PSOs No.	COsNo.&Titles	SOsNo.	Laboratory Instruction (LI)	ClassroomInstruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	1PH601.1. Student will be able to know the basic concepts of astronomy and space physics.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1,1.2	**UNIT – I (ObservationalData)** 1.1,1.2,1.3,1.4,1.5,1.6, 1.7, 1.8, 1.9, 1.10	Asmentionedin pagenumber 2to6
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	1PH601.2. Student will be able to know about physical processes optical telescope, in stars and evolution of stars.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1,2.2	**UNIT – II (Telescopes)** 2.1,2.2,2.3,2.4,2.5,2.6, 2.7, 2.8,2.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	1PH601.3. Student would be able to know about stellar distances and other.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1,3.2	**UNIT – III (StellarDistancesandMagnitudes)** 3.1, 3.2,3.3,3.4,3.5,3.6,3.7, 3.8, 3.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	1PH601.4. Student would be able to differentiate between various coordinate systems and know about Binary stars and their motions.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1,4.2	**UNIT – IV (BinariesandVariableStars)** 4.1, 4.2,4.3,4.4,4.5,4.6	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	1PH601.5. Student would be able to know about the characteristics of Sun.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1,5.2	**UNIT – V (The Sun)** 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12	

Curriculum Development Team

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AKS University
Faculty of Basic Science
Curriculum of B. Sc. (Honours / By Research) Program
(Revised as on 01 August 2023)

CourseTitle: **Solar Energy**

Pre-requisite: Thereisnoprerequisiteorco-requisiteforthiscourse.Butstudentsareexpectedtoknowbasicsemiconductorphysics.

Rationale: The students studying Physics should possess foundational understanding about historical background of solar energy.

CourseOutcomes:

2PH602**.1.**Theavailablesolarenergyandthecurrentsolarenergyconversionandutilizationprocesses,solarspectrum.

2PH602**.2.**Thefactorsthatinfluencetheuseofsolarradiationasanenergysource.

2PH602**.3.**The various active and passive technologies that are available for collectingsolar energy; have the ability to apply design principles to selection of an appropriatesolarenergyinstallationtomeetrequirements.

2PH602**.4.** How solar cells convert light into electricity, how solar cells are manufactured,howsolarcellsareevaluated.

2PH602**.5.**Toexaminethepotential&drawbacksofcurrentlymanufacturedtechnologies,aswellaspre-commercialtechnologies.Howtoenhancesolarcellperformanceandreducecost,andthemajorhurdles-technologicalandeconomic,towardswidespreadadoption.

SchemeofStudies:

Boardof Study	**Course Code**	**CourseTitle**	**Schemeofstudies(Hours/Week)**					**TotalCredits (C)**
			Cl	**LI**	**SW**	**SL**	**TotalStudyHours (CI+LI+SW+SL)**	
Program Core (PCC)	2PH602	**Solar Energy**	4	0	1	1	6	4

Legend: **CI:**ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial(T)andothers),
LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworkshop, field or other locations using different instructional strategies)
SW: SessionalWork(includesassignment,seminar,miniprojectetc.),
SL: SelfLearning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacher to ensure outcome of Learning.

SchemeofAssessment:

Theory

Board ofStudy	CouseCode	CourseTitle	SchemeofAssessment(Marks)							
			ProgressiveAssessment(PRA)						EndSemesterAssessment (ESA)	Total Marks (PRA+ ESA)
			Class/HomeAssignment5 number 3marks each (CA)	ClassTest2 (2bestout of3) 10marks each (CT)	Seminarone (SA)	Class Activityanyone (CAT)	ClassAttendance (AT)	TotalMarks (CA+CT+SA+CAT+AT)		
PCC	2PH602	**Solar Energy**	15	20	5	5	5	50	50	100

Course-CurriculumDetailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

2PH602.**1.Theavailablesolarenergyandthecurrentsolarenergyconversionandutilizationprocesses,solar spectrum.**

ApproximateHours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	1
Total	14

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**

SO1.1 To understand the radiation. **SO1.2**To learn about the absorption of solar radiation in the atmosphere.**SO1.3**To understand the global and diffused radiation, seasonal and daily variation. **SO1.4**To learn aboutsun tracking systems. **SO1.5** To learn about solar energy collector efficiency and its dependence on various parameters.	.	**UNIT – I (Solar Radiation)** 1.1 origin 1.2 solar constant 1.3 spectral distribution of solar radiation 1.4 absorption of solar radiation in the atmosphere 1.5 global and diffused radiation 1.6 seasonal and daily variation of solar radiation 1.7measurement of solar radiation 1.8 sun tracking systems 1.9 photo thermal conversion 1.10 solar energy collectors 1.11 collector efficiency and its dependence on various parameters (2)	2. Study about Radiation

SW-1SuggestedSessionalWork(SW):

d. Assignments:

i. Explain solar radiation and origin of radiation.

e. OtherActivities(Specify):

Present any one topic of this unit by power point presentation in front of departmental student and faculty.

2PH602**.2.Thefactorsthatinfluencetheuseofsolarradiationasanenergysource.**

ApproximateHours

Item	AppXHrs

Cl	12
LI	0
SW	1
SL	1
Total	14

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO2.1 To understand the solar energy. **SO2.2** To learn about storage of solar energy. **SO2.3**To learn about solar water heater and solar cooker. **SO2.4** To learn about solar fuels **SO2.5** Understand the principle of solar green houses.	.	**UNIT – II (Solarenergy)** 2.1 storage of solar energy 2.2 solar pond 2.3 solar water heater 2.4 solardistillation 2.5 solar cooker 2.6 solar green houses 2.7 solar dryers 2.8 absorptionairconditioning 2.9solarfuels 2.10 electrolysisofwater 2.11photoelectrochemicalsplittingofwater (2)	1. Learn about solar energy

SW-2 SuggestedSessionalWork(SW):

d. Assignments:

i. Explain solar cooker with principle, construction and working.
ii. Discuss aboutsolar dryers.

e. OtherActivities(Specify):

Present any one topic of this unit by power point presentation in front of departmental student and faculty.

2PH602**.3.The various active and passive technologies that are available for collectingsolar energy; have the ability to apply design principles to selection of an appropriatesolarenergyinstallationtomeetrequirements.**

ApproximateHours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	1
Total	14

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO3.1 To learn about Photovoltaiceffect. **SO3.2** To understand semiconductorproperties**.** **SO3.3** To learn about p-njunctionitscharacteristics. **SO3.4** To understandthermal equilibrium condition**.** **SO3.5** To understandSiliconbasedsolarcells:singlecrystal,polycrystallineandamorphoussiliconsolarcells.	.	**UNIT – III (Fundamentals of solar cells)** 3.1 Photovoltaiceffect 3.2semiconductorproperties 3.3energylevels 3.4 basicequations 3.5 p-njunctionitscharacteristics 3.6fabrication steps 3.7 thermal equilibrium condition 3.8 depletioncapacitance 3.9junctionbreakdown 3.10 heterojunction 3.11 Siliconbasedsolarcells:singlecrystal,polycrystallineandamorphoussiliconsolarcells (2)	1. fundamental of solar cells.

SW-3SuggestedSessionalWork(SW):

d. *Assignments:*

Explain p-njunction anditscharacteristics.

e. *OtherActivities(Specify):*

Present any one topic of this unit by power point presentation in front of departmental student and faculty.

2PH602**.4.** How solar cells convert light into electricity, how solar cells are manufactured,howsolarcellsareevaluated.

ApproximateHours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	1
Total	14

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO4.1T o u n d e r s t a n d Solarcelldevicestructures. **SO4.2**Learn about Solarcelldeviceconstruction. **SO4.3** Learn aboutsurfacestructuresformaximumlightabsorption**.** **SO4.4** Elementary treatment of currentvoltagecharacteristicsindarkandlight. **SO4.5** Understanding aboutchargecarriergenerationrecombinationandotherlosses.	.	**UNIT – IV (Devicephysics-I)** 4.1 Solarcelldevicestructures 4.2construction 4.3 outputpower,efficiency, fill factor and optimization for maximum power(4) 4.4 surfacestructuresformaximumlight absorption 4.5 currentvoltagecharacteristicsindarkandlight 4.6 operatingtemperaturevsconversion efficiency 4.7 chargecarriergeneration 4.8recombinationandotherlosses(2)	1. Learn about solar devices.

SW-4SuggestedSessionalWork(SW):

c. *Assignments:*

i. WriteSolarcelldevicestructures.
ii. Describebrieflyoperatingtemperaturevsconversionefficiency.

c) *OtherActivities(Specify):*

Present any one topic of this unit by power point presentation in front of departmental student and faculty.

2PH602.**5.Toexaminethepotential&drawbacksofcurrentlymanufacturedtechnologies,aswellaspre-commercialtechnologies.Howtoenhancesolarcellperformanceandreducecost,andthemajorhurdles-technologicalandeconomic,towardswidespreadadoption.**

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	1
Total	14

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO5.1 To understand Cadmiumtelluride solar cells. **SO5.2**Learn about copper indium galliumselenide solarcells. **SO5.3** Learn about organicsolarcells.**SO5.4** Learn about perovskitesolarcells. **SO5.5** To understand advancedconceptsinphotovoltaicresearch.		**UNIT – V (Devicephysics-II)** 5.1 Cadmiumtelluride solar cells 5.2copper indium galliumselenide solarcells 5.3 organicsolarcells 5.4perovskitesolarcells 5.5 Advancedconceptsinphotovoltaicresearch	2. Learn about solar devices.

SW-5SuggestedSessionalWork(SW):

d. *Assignments:*
   Explain Covariant four- dimensional formulation.

e. *OtherActivities(Specify):*
   Present any one topic of this unit by power point presentation in front of departmental student and faculty.

BriefofHourssuggestedfortheCourseOutcome

CourseOutcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Totalhour (Cl+SW+Sl)
2PH602.1.Theavailablesolarenergyandthecurrentsolarenergyconversionandutilizationprocesses,solarspectrum.	**12**	1	1	14
2PH602.2.Thefactorsthatinfluencetheuseofsolarradiationasanenergysource.	12	1	1	14
2PH602.3.The various active and passive technologies that are available for collectingsolar energy; have the ability to apply design principles to selection of an appropriatesolarenergyinstallationtomeetrequirements.	12	1	1	14
2PH602.4. How solar cells convert light into electricity, how solar cells are manufactured,howsolarcellsareevaluated.	12	1	1	14
2PH602.5.Toexaminethepotential&drawbacksofcurrentlymanufacturedtechnologies,aswellaspre-commercialtechnologies.Howtoenhancesolarcellperformanceandreducecost,andthemajorhurdles-technologicalandeconomic,towardswidespreadadoption.	12	1	1	**14**
TotalHours	**60**	**5**	**5**	**70**

SuggestionforEndSemesterAssessment

SuggestedSpecificationTable (ForESA)

CO	UnitTitles	Marks Distribution			Total Marks
		R	U	A	
CO-1	**Solar Radiation**	03	04	03	10
CO-2	**Solarenergy**	03	04	03	10
CO-3	**Fundamentals of solar cells**	03	04	03	10
CO-4	**Devicephysics-I**	03	04	03	10
CO-5	**Devicephysics-II**	03	04	03	10
Total		15	20	15	50

Legend: R:Remember, U:Understand, A:Apply

TheendofsemesterassessmentforIntroductiontoPortlandcementwillbeheldwithwritten examination of 50 marks

Note.DetailedAssessmentrubricneedtobepreparedbythecoursewiseteachersforabovetasks. Teacherscanalsodesigndifferenttasksasperrequirement,forendsemesterassessment.

SuggestedInstructional/ImplementationStrategies:

i. ImprovedLecture
ii. Tutorial
iii. CaseMethod
iv. GroupDiscussion
v. RolePlay
vi. Visittocementplant
vii. Demonstration
viii. ICT Based Teaching Learning (VideoDemonstration/Tutorials CBT, Blog,Facebook,Twitter, Whatsapp, Mobile, Online sources)
ix. Brainstorming

SuggestedLearningResources:

(a)Books:

S. No.	Title	Author	Publisher	Edition& Year
1	Solarenergyfundamentalsandapplications	HPGarg,JPrakash	TataMcGrawHillpublishingCo.Ltd	2006
2	PrinciplesofSolarEngineering	D.YogiGoswami,FrankKreith,JanF.Kreider	TaylorandFrancis	2000
3	SemiconductorDevices,BasicPrinciples	JaspritSingh	Wiley	2001
4	SolarCellDevicePhysics	StephenJ.Fonash	2ndedition,AcademicPress	2003
5	Lecturenoteprovidedby DepartmentofPhysics,AKSUniversity,Satna(M. P.)			

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Cos,POsandPSOsMapping

CourseTitle:B.Sc.

Course Code: 2PH602

CourseTitle:Solar Energy

CourseOutcomes	ProgramOutcomes												ProgramSpecificOutcome				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
	Engineering knowledge	Problem analysis	Design/development of solutions	Conductinvestigationsofcomplex problems	Modern tool usage	The engineer and society	Environment and sustainability:	Ethics	Individual andteamwork:	Communication:	Projectmanagement and finance:	Life-longlearning	Identify, formulate,andsolvePhysicsproblems.	Designandconductexperiments, aswellastoanalyseandinterpretdata.	Apply knowledge of Physics in a different stream of science and to communicate effectively.	Ability to use the techniques, skills, and modern physical tools in real world application.	Engage in life-long learning and will have recognition.
PH603.1.Theavailablesolarenergyandthecurrentsolarenergyconversionandutilizationprocesse	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1	1

s,solarspectrum.																	
PH603.2.The factorsthatinfluencetheuse ofsolarradiationasanenergysource.	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	1
PH603.3.The various active and passive technologies that are available for collectingsolar energy; have the ability to apply design principles to selection of an appropriatesolarenergyinstallationtomee	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**	2

trequirements.																	
PH603.4. How solar cells convert light into electricity, how solar cells are manufactured,howsolarcellsareevaluated.	3	2	2	2	3	2	3	2	2	1	2	3	3	3	3	2	2
PH603.5.Toexaminethepotential&drawbacksofcurrentlymanufacturedtechnologies,aswellaspre-commercialtechnologies.Howtoenhancesolarcellperformanceandreducecost,andthemajorhurdles-technologicalandeconomic	2	1	2	1	1	3	3	3	1	1	2	2	3	3	1	3	3

,towardswide spreadadopti on.																	

Legend:1–Low,2–Medium,3– High

CourseCurriculumMap:

POs&PSOs No.	COsNo.&Titles	SOsNo.	Laboratory Instruction(LI)	ClassroomInstruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	PH603.1.Theavailablesolarenergyandthecurrentsolarenergyconversionandutilizationprocesses,solarspectrum.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**UNIT – I (Solar Radiation)** 1.1,1.2,1.3,1.4,1.5, 1.6,1.7, 1.8, 1.9, 1.10, 1.11	Asmentionedin pagenumber 2to6
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	PH603.2.Thefactorsthatinfluencetheuseofsolarradiationasanenergysource.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**UNIT – II (Solar Energy)** 2.1,2.2,2.3,2.4,2.5, 2.6,2.7, 2.8,2.9,2.10, 2.11	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	PH603.3.The various active and passive technologies that are available for collectingsolar energy; have the ability to apply design principles to selection of an appropriatesolarenergyinstallationtomeetrequirements.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**UNIT – III (Fundamentals of solar cells)** 3.1, 3.2,3.3,3.4,3.5,3.6, 3.7,3.8, 3.9, 3.10, 3.11	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	PH603.4. How solar cells convert light into electricity, how solar cells are manufactured,howsolarcellsareevaluated.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**UNIT – IV (Devicephysics-I)** 4.1, 4.2,4.3,4.4,4.5,4.6, 4.7,4.8	

PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	PH603.5.Toexaminethepotential&drawbacksofcurrentlymanufacturedtechnologies,aswellaspre-commercialtechnologies.Howtoenhancesolarcellperformanceandreducecost,andthemajorhurdles-technologicalandeconomic,towardswidespreadadoption.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**UNIT – V (Devicephysics-II)** 5.1, 5.2, 5.3, 5.4, 5.5	

Curriculum Development Team

1. Dr. O .P. Tripathi, Head of the Department, of Physics, AKS University
2. Dr. C. P. Singh, Assistant Professor, Dept. of Physics
3. Dr. Lovely Singh, Assistant Professor, Dept. of Physics
4. Dr. Saket Kumar, Assistant Professor, Dept. of Physics
5. Mr. Manish Agrawal, Assistant Professor, Dept of Physics
6. Ms. Swati Kushwaha, Lab Assistant Dept. of Physics

CODE: 1CH601

COURSE NAME: Pharmaceutical and Medicinal Chemistry

Pre- requisite: To study this course the students must have the subject Chemistry in Diploma Course of B.Sc. or equivalent

Rationale: Pharmaceutical chemistry revolves around the design, synthesis, and development of new drugs. It involves the study of organic and medicinal chemistry principles to create compounds that can be used as pharmaceuticals. Medicinal chemists work on understanding the relationship between chemical structure and biological activity, aiming to create molecules that can specifically target diseases by interacting with biological targets like proteins, enzymes, or receptors in the body.

Course Outcomes:

After successfully competing this course module students will be able to:

1CH601.1- Understand importance of pharmaceutical chemistry and pharmacopeia.

1CH601.2- Learn intellectual property rights, patents trademark and copyright
1CH601-.3 Understand definition, classification of the drugs with examples and structures.

1CH601.4- Describe the structure activity relation of some important class of drugs.

1CH601.5- Describe the overall process of drug discovery and the role played by medicinal chemistry in this process.

UNIT-I

Pharmaceutical Chemistry: Introduction to pharmacy, career in pharmacy, codes of Pharmaceutical pharmaceutical ethics, importance of pharmaceutical Chemistry, , pharmacopeia and its history (IP, BP, USP, NF) Drug and cosmetic act with special reference to schedule M, GMP, GLP, GCP, USFDA, NDA, clinical trial. Concept of quality and total quality management, quality assurance and quality control, IPQA, IPQC. Documentation and maintenance of record, intellectual

Property rights, patents, trademark, copyright, patent act.

UNIT-II Pharmacognosy

Definition, history, scope and development of Pharmacognosy.
Classification and Sources of drugs: classification of drugs, sources and uses of natural drug products, biological (plants, animals and microbes), geographical, marine and mineral sources.
Drug Receptors: Introduction to drug receptors, nature of drug receptors, different bonding involved in drug- receptor interaction, drug receptor theories.
Drug absorption: routes of drug administration, absorption of drugs and factors affecting absorption.

UNIT-III

Molecular Modeling and Drug Design-

Drug design and development an overview, analogues and prodrugs structure and activity relationship between chemical (SAR), factors governing drug design. Approaches to drug design, receptor site theory. Introduction to combinatorial synthesis in drug discovery. Factors affecting bioactivity, QSAR-Free-Wilson analysis, structure a biological activity Hansch analysis, relationship between Free-Wilson analysis and Hansch analysis.

UNIT-IV

Antibiotics and Antibacterial

Introduction, Antibiotic B-Lactam Type Penicillin, Cephalosporins, Antitubercular Streptomycin, Broad Spectrum Antibiotics Tetracyclines, Anticancer Dactinomycin (Actinomycin D)

UNIT-V

Antifungal and Non-steroidal Anti- inflammatory

Antifungal: Polyenes, Antibacterial-Ciprofloxacin, Norfloxacin, Antiviral - Acyclovir

Antimalarials: Chemotherapy of MalariaSAR, Chloroquine, Chloroguanideand Mefloquine.

Non-steroidal: Anti-inflammatory Drugs: Diclofenac Sodium, Ibuprofen and Netopam..

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits(C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Progra mCore (PCC)	1CH601	Pharmaceutical and Medicinal Chemistry	4	4	1	1	6	6

Legend: (T) And others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop,field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacher to ensure outcome of Learning.

Scheme of Assessment: Theory

			Scheme of Assessment (Marks)

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Board of Study	Couse Code	Course Title	**Progressive Assessment (PRA)**					**End Semester Assessment**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Attendance (AT)	Total Marks (CA+CT+SA +AT)	**(ESA)**	(PRA + ESA)
PCC	**1CH601**	Pharmaceutical and Medicinal Chemistry	15	20	10	5	50	50	100

AKS University
Faculty of Basic Science
Curriculum of B. Sc. (Honours / By Research) Program
(Revised as on 01 August 2023)

Course-Curriculum Detailing:
This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.
1CH601.1-Understand importance of pharmaceutical chemistry and pharmacopeia.
.
Approximate Hours

Activity	Apex Hrs
Cl	12
LI	12
SW	2
SL	1
Total	28

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Understood development, design, and synthesis of drugs. SO1.2 Understood molecular structures, pharmacokinetics, drug interactions, and the latest advancements in the field. SO1.3 Understood the significance of drug development and how it contributes to society's well-being could be a source of pride. SO1.4 Understood broader vision of healthcare and scientific progress and values in the relationship. SO1.5 Understand and apply QA involves the planned and systematic activities implemented in a quality system and QC involves the operational techniques and activities used to fulfill quality requirements	Preparation of Pharmaceutical compounds a) Acetanilide b) Aromatic water c) Lotion d) Aspirin	**Unit-1 Pharmaceutical Chemistry** 1.1 Introduction to pharmacy, career in pharmacy, 1.2 codes of Pharmaceutical pharmaceutical ethics 1.3 importance of pharmaceutical Chemistry, , pharmacopeia 1.4 its history (IP, BP, USP, NF) 1.5 Drug and cosmetic act 1.6 Special reference to schedule GMP, GLP, 1.7 GCP, USFDA, NDA, 1.8 clinical trial. 1.9 Concept of quality 1.10 total quality management, quality assurance 1.11 Quality control, IPQA, IPQC. 1.12 Documentation and maintenance of record, intellectual	Concept of quality and total quality management

SW-1 Suggested Sessional Work (SW):

a. Assignments:

Introduction to pharmacy, career in pharmacy

b. Mini Project:

Concept of quality and total quality management, quality assurance and quality control, IPQA, IPQC

c. Other Activities (Specify):

Pharmacopeia and its history (IP, BP, USP, NF)

1CH601.2- Understand definition, classification of the drugs with examples and structures.

.

Activity	AppX Hrs
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Understood discovery of new drugs or developing natural-based products, contributing to innovations in the pharmaceutical and healthcare industries. SO2.2 Understood and explores natural products from plants, microbes, or other biological sources for their medicinal and therapeutic properties. SO2.3 Explain and apply drug receptors is fundamental in pharmacology and drug design. SO2.4 Understood the interaction between drugs and their receptors is crucial in drug development.	Preparation of pharmaceutical compound a)Tincture lodine b) Alum c)Ferrous Ammonium sulphate d)Antimony potassium tartrate	**Unit-2.0 Pharmacognosy** 2.1 Definition, history, scope 2.2 Development of Pharmacognosy. 2.3Classifications of drugs, 2.4 Sources and uses of natural drug products, 2.5 Biological (plants, animals and microbes), 2.6 Geographical, marine and mineral sources. 2.7 Drug Receptors: Introduction to drug receptors, 2.8Nature of drug receptors. 2.9Different bonding involved in drug- receptor interaction 2.10Drug receptor theories. 2.11Drug absorption: routes of drug administration, 2.12 Absorption of drugs and	classification of drugs, sources and uses of natural drug products

SO2.5 Understood drug absorption is critical in determining the dosage, frequency of administration, and overall efficacy of medications		factors affecting absorption.	

SW-2 Suggested Sessional Work (SW):
A .Assignments:
Discussion of classification of drugs, sources and uses of natural drug products.
b. Mini Project:
Drug- receptor interaction, drug receptor theories
c. Other Activities (Specify):
Write an essay on absorption of drugs and factors affecting absorption.

1CH601.3- Describe the structure activity relation of some important class of drugs.

Activity	AppX Hrs
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)

SO3.1 Understood, visualized and predict how drugs interact with biological targets at the molecular level **SO3.2** studied about target structure and interactions to create highly specific and effective medications. .**SO3.3** Understood about specific biological targets (proteins, receptors, enzymes) involved in diseases **SO3.4** S tudied about QSAR which helps in the rational design of new drugs by predicting the biological activities of novel compounds before their synthesis and experimental testing. **SO3.5** Understood about methods which are complementary and aid in optimizing drug design by guiding the synthesis of new compounds.	**3**. Isolation of caffeine from tea leaves. 4. Extraction of active constituents	**Unit-3.0 Molecular Modeling and Drug Design-** 3.1 Drug design and development. 3.2 an overview, analogues and prodrugs 3.3 structure and activity relationship between chemical (SAR) 3.4Fctors governing drug design. 3.5Approaches to drug design, 3.6 Receptor site theory. 3.7 Introduction to combinatorial synthesis in drug discovery. 3.8 Factors affecting bioactivity 3.9 QSAR-Free-Wilson analysis, 3.10 Sructure a biological activity Hansch analysis 3.11. Relationship between Free-Wilson analysis and 3.12 Hansch analysis.	Drug design, factors governing drug design.

SW-3 Suggested Sessional Work (SW):
a. Assignments:
Analogues and prodrugs structure and activity relationship between chemical (SAR)
b. Mini Project:
Drug design factors governing drug design. And approaches to drug design
c. Other Activities (Specify):
Explanatory note on QSAR analysis for drugs.

1CH601.4-Describe the overall process of drug discovery and the role played by medicinal chemistry in this process.

Activity	AppX Hrs
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 studied about Antibiotics are a class of medications used to treat bacterial infections by either killing bacteria (bactericidal) or inhibiting their growth (bacteriostatic). SO4.2 Understand Beta-lactam antibiotics have been fundamental used in treating bacterial infections . SO4.3 studied about Streptomycin which is an important antibiotic used in the treatment of tuberculosis (TB) SO4.4 Understood about Tetracyclines work by inhibiting bacterial protein synthesis. SO4.5 Understood about Dactinomycin which works by inhibiting DNA replication and transcription	5. Identification of crude drug. 6. Morphology of turmeric, ginger, Mentha.	Unit-4.0 Antibiotics and Antibacterial 4.1 Introduction, Antibiotics 4.2Types of Antibiotics Broad 4.3 Spectrum vs. Narrow Spectrum**.** **4.4** Development of New Antibiotics 4.5 B-Lactam Chemical Structure Beta-lactam antibiotics , 4.6 Type Penicillin**.** **4.7**Mechanism of Action 4.8 Cephalosporins, Antitubercular Streptomycin, 4.9 Usage in Tuberculosis Treatment 4.10Broad Spectrum Antibiotics Tetracyclines. 4.11Types and Examples, Mechanism of Action 4.12 Anticancer Dactinomycin (Actinomycin D)Mechanism of Action Clinical Uses, Administration and Side Effects	Introduction, Antibiotics Types of Antibiotics Broad

SW-4 Suggested Sessional Work (SW):

a. **Assignments:**

Antitubercular Streptomycin

b. Mini Project:

b. Broad Spectrum Antibiotics Tetracyclines

c. **Other Activities (Specify):**

Anticancer Dactinomycin (Actinomycin D)

1CH601.5- Related the structure and physical properties of drugs to their pharmacological activity. Explain physio-chemical properties related to QSAR.

Activity	AppX Hrs
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Understood - **Antifungal:** Polyenes, which are a class of antifungal medications primarily used to treat systemic fungal infections. **SO5.2** Understands that By blocking viral DNA synthesis, acyclovir helps reduce the severity and duration of herpes outbreaks. **SO5.3** Studied about SAR in antimalarial drug development involves a balance between potency, selectivity, pharmacokinetics, and safety profiles **SO5.4**Understood that efficacy of these drugs has been impacted by the development of drug-resistant strains of the malaria parasite. **SO5.5** studied about Anti-inflammatory drugs that are medications designed to reduce inflammation, alleviating pain, swelling, redness, and heat	. 7. Preparation of suspension, Emulsions, ointment. 8. Preparation of simple syrup as per IP and USP. 9. Preparation of pharmaceutical buffer and study of its theoretical and calculated PH. 10 Inorganic preparations of compounds like Zinc Oxide, calcium carbonate, Magnesium Carbonate.	**Unit-5. Antifungal and Non-steroidal Anti- inflammatory** **5.1** Antifungal**:-** Polyenes, 5.2 Antibacterial-Ciprofloxacin **5.3** Norfloxacin, Antiviral -Acyclovir **5.4** Antimalarials: Chemotherapy of Malaria 5.5 SAR structure-activity relationship 5.6 Quinoline-based drugs Resistance management **5.7** Chloroquine, 5.8 Chloroguanide and Mefloquine. 5.9 Quinoline methanols, prophylactic drug **5.10 Non-steroidal:** Anti-inflammatory Drugs: Diclofenac Sodium, 5.11 Ibuprofen and Netopam, Nonsteroidal 5.12 Anti-Inflammatory Drugs (NSAIDs	Mechanism of Norfloxacin and acyclovir both medications used to treat different types of infections.

associated with various conditions.		.	

SW-5 Suggested Sessional Work (SW):

a. **Assignments:**
   Antifungal: Polyenes, Antibacterial , Ciprofloxacin **.**
b. **Mini Project:**
   Chemotherapy of Malaria SAR

c. **Other Activities (Specify):**

   Non-steroidal: Anti-inflammatory Drugs

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+S
1CH601.1: Understand importance of pharmaceutical chemistry and pharmacopeia.	12	12	02	01	29
1CH601.2: Learn intellectual property rights, patents trademark and copyright .	12	12	02	01	27

1CH601.3- Understand definition, classification of the drugs with examples and structures.	12	12	02	01	27
1CH601.4-Describe the overall process of drug discovery and the role played by medicinal chemistry in this process.	12	12	02	01	27
1CH601.5- Related the structure and physical properties of drugs to their pharmacological activity. Explain physio-chemical properties related to QSAR.	12	12	02	01	27
Total Hours	60	60	15	05	100

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	**Pharmaceutical Chemistry**	03	01	01	05
CO-2	**Pharmacognosy**	02	06	02	10
CO-3	**Molecular Modeling and Drug Design-**	03	07	05	15
CO-4	**Antibiotics and Antibacterial**	-	10	05	15
CO-5	**Antifungal and Non-steroidal Anti-inflammatory**	03	02	-	05

Total		11	26	13	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Organic Chemistry I will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks.Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to NCL, CSIR laboratories
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT,Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	ORGANIC MEDICINAL AND PHARMACEUTICAL CHEMISTRY	John M. Beale	Wolters Kluwer Lippincott Williams & Wilkins	TWELFTH EDITION
2	TEXTBOOK OF PHARMACOGNOSY AND PHYTOCHEMISTRY	Biren N. Shah A.K. Seth	ELSEVIER	First Edition 2010
3	Molecular Modeling in Drug Design	Rebecca Wade and Outi Salo-Ahen ,	MDPI	March 2019

4	A Pharmacological Guide to Non-Steroidal Anti-Inflammatory Medications	Pugazhenthan Thangaraju	NOVA	2021
5	Antibiotic Basics for Clinicians	Alan R. Hauser	WOLTER KLUWERS	March 2012

Mode of Delivery: Lecture, demonstration, E-tutoring, discussion, assignments, quizzes, case study, power point;

LMS/ICT Tools: Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources.

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Course Title: Organic Chemistry I **Course Code : 1CH601**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
	Knowledge	**Research Aptitude**	**Communication**	**Problem Solving**	**Individual and Team Work**	Investigation of Problems	**Modern Tool usage**	**Science and Society**	**Life-Long Learning**	**Ethics**	**Project Management**	**Environment and sustainability**	**The detailed functional knowledge of theoretical concepts and experimental aspects of chemistry**	**To integrate the gained knowledge with various contemporary and evolving areas in chemical sciences like analytical, synthetic, pharmaceutical etc.**	**understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomenon-based problems in chemical sciences.**	**Provide opportunities to excel in academics, research or Industry by research based innovative knowledge for sustainable development in chemical science**
S3-CHEM2T 1: Understand importance of pharmaceutical chemistry and pharmacopeia.	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**

S3-CHEM2T 2: Learn intellectual property rights, patents trademark and copyright	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
S3-CHEM2T- Understand definition, classification of the drugs with examples and structures	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
S3-CHEM2T - Describe the overall process of drug discovery and the role played by medicinal chemistry in this process.	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
S3-CHEM2T- Related the structure and physical properties of drugs to their pharmacological	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

activity. Explain physio-chemical properties related to QSAR.																	

Legend:1–Low,2–Medium, 3–High

AKS University
Faculty of Basic Science
Curriculum of B. Sc. (Honours / By Research) Program
(Revised as on 01 August 2023)

CourseCurriculumMap:

POs &PSOsNo.	Cos No. &Titles	SOsNo.	Laboratory instruction(LI)	Classroom Instruction(CI)
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**1CH601.1:** Understand importance of pharmaceutical chemistry and pharmacopeia. .	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 Symmetry and Group Theory 1.1,1.2,1.3,1.4,1.5,1.6,1.7
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**1CH601.2**: Learn intellectual property rights, patents trademark and copyright	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2 **Vibrational Spectroscopy** 2.1,2.2,2.3,2.4,2.5,2.6, 2.7, 2.8,2.9
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**1CH601.3**Understand definition, classification of the drugs with examples and structures	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3 : **Mössbauer Spectroscopy** 3.1, 3.2,3.3,3.4,3.5,3.6,3.7
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**1CH601.4-** Understand definition, classification of the drugs with examples and structures**.**	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4 : : **Magnetic Resonance Spectroscopy** 4.1, 4.2,4.3,4.4,4.5,4.6,4.7
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**1CH601.5-**Describe the overall process of drug discovery and the role played by medicinal chemistry in this process	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit 5: X-ray Diffraction , Electro Diffraction** **Neutron Diffraction** 5.1,5.2,5.3,5.4,5.5,5.6,5.7

Curriculum Development Team:

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CoursesCODE:
2CH601

COURSE NAME: Polymer Chemistry

Pre-requisite: Students should have basic knowledge of Basic concepts : Monomers, repeat units, degree of polymerization Linear, branched and network polymers.

Rationale: The students studying polymer chemistry should possess foundational understanding about polymer chemistry, structure, reactions and application of organic and inorganic polymers . This will provide applicalbe knoweledge about classification of polymers. polymerization : condensation, addition/radical chain-ionic and co-ordination and copolymerization. polymerization conditions and polymer reactions. polymerization in homogeneous and heterogeneous systems.

Course Outcomes:

Afterthe completionofthiscourse, thelearner will

2CH601.1: Explain the Basic concepts of Monomers, repeat units, degree of polymerization Linear, branched and network polymers and Classification of polymers.

2CH601.2: Explain average molecular weight concept. Number, weight and viscosity averagemolecular weights. Polydispersity an molecular weight distribution

2CH601.3: Describe the analysis and testing of polymers Chemical and physical analysis of polymers

2CH601.4:Explain the structure, Properties and Applications of borazines, boranes and carboranes.

silicone's, polymetalloxanes and polymetallosiloxanes,

2CH601.5: Apply the knowledge of Polymers based on Phosphorous-Phosphazenes, Polyphosphates

Polymers based on Sulphure-Tetrasulphur tetranitride and related compounds

Polymer Chemistry

Unit - 1

Basics: Importance of polymers. Basic concepts : Monomers, repeat units, degree of polymerization Linear, branched and network polymers. Classification of polymers. Polymerization : condensation, addition/radical chain-ionic and co-ordination and copolymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems.

Unit - 2

Polymer Characterization: Polydispersion-average molecular weight concept. Number, weight and viscosity averagemolecular weights. Polydispersity an molecular weight distribution. The practical significance of molecular weight. Measurement of molecular-weights. End-group, viscosity, light scattering, osmotic and ultracentrifugation methods.

Unit - 3

Analysis and testing of polymers Chemical analysis of polymers, spectroscopic methods, X-ray diffraction study.Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, impact. Tearresistance, Hardness and abrasion resistance.

Unit - 4

Inorganic Polymers: A general survey and scope of Inorganic Polymers special characteristics, classification, homo and hetero atomic polymers. Structure, Properties and Applications of

a. Polymers based on boron-borazines, boranes and carboranes.
b. Polymers based on Silicon, silicone's polymetalloxanes and polymetallosiloxanes, silazanes.

Unit - 5

Structure, Properties and Application of

a. Polymers based on Phosphorous-Phosphazenes, Polyphosphates
b. Polymers based on Sulphure-Tetrasulphur tetranitride and related compounds.

Co-ordination and metal chelate polymers.

Scheme of Studies:

Board ofStudy	Course Code	CourseTitle	Scheme ofstudies(Hours/Week)					Total Credits(C)
			Cl	LI	SW	SL	Total Study Hours(CI+LI+SW+SL)	
ProgramCore(PCC)	2CH601	Polymer Chemistry	4	0	1	1	5	4

Legend: **CI:**Class room Instruction (Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial(T)andothers),
LI: Laboratory Instruction (Includes Practicalperformancesinlaboratoryworkshop,fieldorotherlocationsusingdifferentinstructionalstrategies)
SW: Sessional Work(includesassignment,seminar,miniprojectetc.),

SL: Self Learning,
C:Credits.

Note: SW&SL has to be planned andperformedunderthecontinuousguidanceandfeedbackofteacherto ensure outcome ofLearning.

Scheme of Assessment: Theory

Board ofStudy	Couse Code	CourseTitle	**SchemeofAssessment(Marks)**						
			ProgressiveAssessment(PRA)					**EndSemesterAssessment (ESA)**	**Total Marks** (PRA+ ESA)
			Class/HomeAssignment 5number 3 markseach (CA)	Class Test2 (2bestout of3) 10 marks each(CT)	Seminarone (SA)	ClassAttendance (AT)	TotalMarks (CA+CT+SA+AT)		
PCC	2CH601	Polymer Chemistry	15	20	10	5	50	50	100

Course-Curriculum Detailing:
This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

2CH601.1: Apply the concept of classification of polymers. Polymerization process of compound.
Approximate Hours

Activity	AppX Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction(CI)	Self Learning (SL)
SO1.1 understand importance of polymers. basic concepts : monomers, repeat units, degree of polymerization SO1.2 Apply linear, branched and network polymers. classification of polymers. SO1.3 Explain polymerization : condensation, addition/radical chain-ionic and co-ordination and copolymerization. SO1.4 Explain polymerization conditions and polymer reactions. SO1.5 Understand and apply Polymerization in homogeneous and heterogeneous systems.		**Unit-1.0 Basic Polymerisation** Importance of polymers. basic concepts Monomers, repeat units,degree of polymerization Linear, branched andnetwork polymers. Classification of polymers. Polymerization : condensation, addition/radicalchain-ionic. Co-ordination polymerization. Copolymerisation. Polymerization conditions 1.9 Polymer reactions. T1-Polymerization inhomogeneous. T2-Heterogeneous system T3- Mechanism of polymerization.	linear, branched and network polymers. classification of polymers.

SW-1Suggested Sessional Work(SW):

a.Assignments:

Discuss polymerization : condensation, addition/radical chain-ionic and co-ordination and copolymerization.

b.Mini Project:

polymerization conditions and polymer reactions.

c.Other Activities (Specify):

Note on applications of Polymerization in homogeneous and heterogeneous systems.

2CH601.2: Explain Polydispersion-average molecular weight concept. Number, weight and viscosityaveragemolecular weights.

Activity	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning(SL)
SO2.1 Understand and applypolydispersion-average molecular weight concept. **SO2.2** Explain number, weight and viscosity averagemolecular weights. **SO2.3** Explain polydispersityan molecular weight distribution. the practical **SO2.4** understand and apply significance of molecular weight. measurement of molecular-weights. **SO2.5** Explain End-group, viscosity,light scattering, osmotic and ultra centrifugation methods.		**Unit-2.0** Polymer Characterization 2.1Introduction of Polymer Characterization Property of PolymerCharacterization Introduction of Polydispersion2,4Mechanism of Polydispersion The practical significance ofmolecular weight. Properties of molecular weight. Measurement of molecular-weights. Concept of PDI. Average molecular weight concept.T1- Number, weight and viscosity. T2- Average molecular weights. T3-Polydispersity an molecular weightdistribution.	The practical significance of molecularweight.

SW-2 Suggested Sessional Work (SW):

a.Assignments:

apply polydispersion-average molecular weight concept. number, weight and viscosity averagemolecular weights.

b.Mini Project:

polydispersity an molecular weight distribution

c.Other Activities (Specify):

Write an eassy on Measurement of molecular-weights. End-group, viscosity, light scattering, osmotic and ultracentrifugation methods.

2CH601.3: describe analysis and testing of polymers chemical analysis of polymers, spectroscopic methods,x-ray diffraction study.microscopy.

Activity	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learnin g(SL)
SO3.1 Understand and apply Analysis and testing of polymers Chemical analysis of polymers **SO3.2** Explainspectroscopic methods, X-ray diffraction study.Microscopy. **SO3.3** explain thermal analysis and physical testing-tensile. so3.4 apply strength. fatigue, impact. tearresistance **SO3.5** explain and apply hardness and abrasion resistance		**Unit-3.0 Analysis and testing of polymers** Introduction of Analysis anTesting of polymers Mechanism of analysis an Testing of polymers. Propertiess of analysis and testing of polymers. Chemical analysis of polymers. Spectroscopic methods, 3.6 X-ray diffraction study. 3.7Microscopy method . Thermal analysis of polymer physical testing-tensile. T1-Strength and fatigue T2-Impact. tearresistance T3-Hardness and abrasion resistance.	spectroscopic methods, X-raydiffraction study.Microscopy.

SW-3 Suggested Sessional Work (SW):

a.Assignments:

analysis and testing of polymers chemical analysis of polymers

b.Mini Project:

spectroscopic methods, X-ray diffraction study.Microscopy.

c.Other Activities (Specify):

Tearresistance, Hardness and abrasion resistance.

2CH601.4: Explain a general survey and scope of inorganic polymers special characteristics, classification, homo and hetero atomic polymers.

Activity	AppX Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning(SL)
SO4.1 Explain and apply a general survey and scope of Inorganic Polymers special characteristics, **SO4.2** Explainclassification, homo and hetero atomic polymers **SO4.3** Explain Structure, Properties and Applications of Polymers based on boron-borazines, boranes and carboranes. **SO4.4**Explain and apply Structure, Properties and Applications of Polymers based on Silicon. **SO4.5** Explain and apply thesilicone's		**Unit-4.0 Inorganic Polymers** A general survey and scope of Inorganic Polymers special characteristics. classification of polymers. Introduction of homo polymers. Properties of homo Polymers. Introduction of hetero atomic polymers Properties of hetero atomic polymers. Structure, Properties and Applications of Polymers. Introduction of boron-borazines,.4.9Properties of boron-borazines,. T1-boranes and carboranes T2-.Structure, Properties and Applications of Polymers based on Silicon. T3-Explain and apply thesilicone's polymetalloxanes	Structure, Properties and Applications of Polymers based on boron-borazines, boranes and carboranes.

polymetalloxanes and polymetallosiloxanes, silazanes.		an dpolymetallosiloxanes, silazanes.	

*SW-4 Suggested Sessional Work (SW)***:**

a.Assignments:

Explain and apply A general survey and scope of Inorganic Polymers special characteristics,

b.Mini Project:

thesilicone's polymetalloxanes and polymetallosiloxanes, silazanes.

c.Other Activities (Specify):

Explain and apply thesilicone's polymetalloxanes and polymetallosiloxanes, silazanes.

2CH601.5: Apply the knowledge of the Structure, Properties and Application of Polymers based on Phosphorous-Phosphazenes, Polyphosphates.

Activity	AppX Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learnin g(SL)
SO5.1 Explain and apply the Polymers based on Phosphorous **SO5.2** Explain and apply the Polymers based on Phosphazenes, Phosphazenes, **SO5.3** Explain and apply Polymersbased on Polyphosphates **SO5.4** Explain and apply Polymersbased on Sulphure-Tetrasulphur tetranitride and related compounds. **SO5.5** Explain and apply The Co-ordination and metal chelate polymers.	.	**Unit-5.0:Structure, Propertiesand Application of polymer** Polymers based on Phosphorous. Polymers based on Phosphazenes. Introducton of Phosphazenes. Properties of Phosphazenes. Structure of Phosphazenes. Polymers based on Polyphosphates Introducton of Polyphosphates Properties of Polyphosphates. Polymers based on Sulphure. T1-Tetrasulphur tetranitride and related compounds. T2-The Co-ordination and metal chelate polymers. T3- Properties of The Co-ordination and metal chelate polymers.	Polymers based on Phosphazenes, Phosphazenes, Polymers based on Polyphosphates

*SW-5 Suggested Sessional Work (SW)**:***

a.Assignments:

Structure, Properties and Application of Polymers based on Phosphorous

a.Mini Project:

Structure, Properties and Application of Polymers based on Phosphazenes, Polyphosphates.

c.Other Activities (Specify):

Polymers based on Sulphure-Tetrasulphur tetranitride and related compounds

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning(Sl)	Total hour (Cl+SW+Sl)
2CH601.1: Apply the concept of Basics: Importance of polymers. Basic concepts : Monomers, repeat units, degree of polymerization Linear, branched and network polymers. Classification of polymers.	12	02	01	15
2CH601.2: Explain Polydispersion-average molecular weight concept. Number, weight and viscosity averagemolecular weights. Polydispersity an molecular weight distribution.	12	02	01	15
2CH601.3: Describe Analysis and testing of polymers Chemical analysis of polymers, spectroscopic methods, X-ray diffraction study.Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, impact. Tearresistance, Hardness and abrasion resistance.	12	02	01	15

2CH601.4:Explain A general survey and scope of Inorganic Polymers special characteristics, classification, homo and hetero atomic polymers. Structure, Properties and Applications of Polymers based on boron-borazines, boranes and carboranes.	12	02	01	15
2CH601.5: Apply the knowledge of the **Structure, Properties and Application of** a. Polymers based on Phosphorous-Phosphazenes, Polyphosphates b. Polymers based on Sulphure-Tetrasulphur tetranitride and related compounds. Co-ordination and metal chelate polymers.	12	02	01	15
Total Hours	60	10	05	75

Suggestion for End Semester Assessment
SuggestedSpecificationTable(ForESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Basics: Importance of polymers. Basic concepts	03	01	01	05
CO-2	Polymer Characterization	02	06	02	10
CO-3	Analysis and testing of polymers	03	07	05	15
CO-4	Inorganic Polymers	-	10	05	15
CO-5	Structure, Properties and Application of Polymers	03	02	-	05
Total		11	26	13	50

Legend: R:Remember, U:Understand, A:Apply

The end of semester assessment for Organic Chemistry I will be held with written examination of 50 marks

Note: Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks.Teachers can also design different tasks as per requirement,for end semester assessment.

Suggested Instructional/ImplementationStrategies:

1. ImprovedLecture
2. Tutorial
3. CaseMethod
4. GroupDiscussion
5. RolePlay
6. Visitto NCL, CSIR laboratories
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT, B log,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
9. Brainstorming

Suggested Learning Resources:

(j) Books:

S. No.	Title	Author	Publisher	Edition& Year
1	The Chemistry ofPolymers	John W Nicholson	Royal Society ofChemistry	Fourth edition 2015
2	Developments in Inorganic polymer Chemistry,	M.F. Lappert and G.J. Leigh.	Elsevier Pub. Co.	2007
3	Principles of PolymerSystems	Ferdinand Rodriguez, Claude Cohen, Christopher K. Ober, Lynden Archer	Taylor & Francis	Sixth edition 2014
4	Handbook of Polymer Synthesis	Graham Swift, Hans R. Kricheldorf, Oskar Nuyken	CRC Press	Revised edition 2004
5	Inorganic Chemistry	Gary Wulfsberg	University Science Books	Third edition 2000
6	**Textbook of Polymer Science**	Billmeyer	Wiley India Pvt.Limited	Third edition 2007

SuggestedWebSources:

35. https://nptel.ac.in/course.html
36. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5
37. https://swayam.gov.in/explorer?category=Chemistry

Mode of Delivery:Lecture,demonstration,E-tutoring,discussion,assignments,quizzes, case study, power point;

LMS/ICT Tools: Digital Classrooms, DLMS, ZOOM, G-Suite,MSPower-Point, Online Resources.

Title: Polymer Chemistry **Course Code : 2CH601**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Knowledge	Research Aptitude	Communication	Problem Solving	Individual and Team Work	Investigation of Problems	Modern Tool usage	Science and Society	Life - Long Learning	Ethics	Project Management	Environment and sustainability	The detailed functional knowledge of theoretical concepts and experimental aspects of chemistry	To integrate the gained knowledge with various contemporary and evolving areas in chemical sciences like analytical, synthetic, pharmaceutical etc.	understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomenon-based problems in chemical sciences.	Provide opportunities to excel in academics, research or Industry by research based innovative knowledge for sustainable development in chemical science

CO1: Apply the concept of Importance of polymers. Basic concepts : Monomers, repeat units, degree of polymerization Linear, branched and network polymers. Classification of polymers. Polymerization condensation, addition/radical chain-ionic and co-ordination and copolymerization.	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**
CO2: Explain Polydispersi on-average molecular weight concept. Number, weight and viscosity averagemolecular weights. Polydispersity an molecular weight. distribution.	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
CO3 : Describe Analysis and testing of polymers Chemical analysis of polymers, spectroscopic methods, X-ray diffraction study.Microscopy	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**

CO 4: ExplainA general survey and scope of Inorganic Polymers special characteristics, classification, homo and hetero atomic polymers. Structure, Properties and Applications of Polymers based on boron- borazines, boranes and carboranes.	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO 5: Apply the knowledge of the Structure, Properties and Application of Polymers.	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Course Curriculum Mapping

POs &PSOsNo.	**Cos No. & Titles**	**SOs No.**	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO-1 Apply the concept of Importance of polymers. Basic concepts : Monomers, repeat units, degree of polymerization Linear, branched and network polymers. Classification of polymers. Polymerization condensation, addition/radical chain-ionic and co-ordination and copolymerization.	SO1.1 SO1.2 S O1.3S O1.4 SO1.5		Unit-1.0 Basic importance of polymer 1.1,1	linear, branched and network polymers. classification of polymers.

				.2,1.3,1.4,1.5,1.6,1.7	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO 2 : Explain Polydispersion-average molecular weight concept. Number, weight and viscosity averagemolecular weights. Polydispersity an molecular weight. distribution.	SO2.1 SO2.2 S O2.3 SO 2.4 SO 2.5		Unit-2 Polymer Characterization 2.1,2.2,2.3,2.4,2.5,2.6, 2.7, 2.8,2.9	The practical significance of molecular weight.
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO3 Describe Analysis and testing of polymers Chemical analysis of polymers, spectroscopic methods, X-ray diffraction study.Microscopy	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3 : Analysi	spectroscopic methods, X-ray diffraction study.Microscopy. .

				s and testing of polymers 3.1, 3.2,3.3,3.4,3.5,		

				3.6,3.7	
PO1,2,3,4,5,6 7,8,9,10,11,12	CO 4: ExplainA general survey and scope of Inorganic Polymers special characteristics, classification, homo and hetero atomic	SO4.1 SO4.2 S O4.3S O4.4		Unit-4 : Inorganic Polymers 4.1, 4.2,4.3	boron-borazines, boranes

PSO 1,2, 3, 4	polymers. Structure, Properties and Applications of Polymers based on boron-borazines, boranes andcarboranes.	SO4.5		,4.4,4.5,4.6,4.7	andcarboranes.
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO 5: Apply the knowledge of the Structure, Properties and Application of Polymers**.**	SO5.1 SO5.2 S O5.3S O5.4 SO5.5		Unit 5: Structure, Properties and Application of Polymers 5.1,5.2,5.3,5	Polymers based on Polyphos phates

				.4,5.5,5.6,5.7	

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Code: 2CH602

Course Name: Bio Inorganic, Bio Physical, Bio Organic Chemistry

Pre-requisite: Students must have fundamental knowledge of bio-molecules such as enzymes, vitamins,carbohydrates, nucleotides etc to understand the concept of bio-inorganic, bio-physical, bio-organic chemistry.

Rationale: The students studying bio-inorganic, bio-physical, bio-organic chemistry should possess foundational understanding about basic knowledge of standard free energy change in biological processes, exergonic and endergonic reactions etc to understand the basic principle of reactions involving biochemical processes.

CourseOutcomes

After the completion of this course, the learner will able to

2CH602**.1**: Explain structure and function of metal complexes or metallo-proteins involved in storage &transportation of oxygen as well in transmission of energy.

2CH602**.2**: Explain structure and function of metalloproteins like cytochrome and iron-sulphur proteinsinvolved in electron transport processes and also describe various reactions calalysed by enzymes.

2CH602**.3**: Explain the concept of enzymes and apply its production, purification and applications in variousareas.

2CH602**.4**: Describe mechanisticdetails of chemical reactions of various co-enzymic form of vitamins and alsodescribe structure and function of proteins.

2CH602**.5:** Explain standard free energy change in biochemical reactions and apply the same concept tohydrolysis and synthesis of ATP.

Unit-I : Metal ions in Biological System

A] Structure and Function of hemoglobin, myoglobin, hemocyanins and hemerythrin,

B] Metal compexes in transmission of energy: chlorophylls, photosystem I and photosystem II in cleavage ofwater

Unit-II : Electron transfer in Biological System

Structure and function of metalloproteins in electron transport processes-cytochromes and ion-sulphur proteins

Kinds of Reactions Catalysed by Enzymes

Nucleophilic displacement on a phosphorus atom. Isomerization and rearrangement reactions, enolicintermediates in iomerization reactions. Enzyme catalyzed carboxylation and decarboxylation reaction.

Unit-III : Enzymes and their biotechnological applications

Introduction of bioorganic chemistry and Enzymes, coenzymes, prosthetic groups, apoenzymes. Properties of enzymes like catalytic power, specificity and regulation. Proximity effects and molecular adaptation. Transition- state theory and orientation

Nomenclature and classification of enzymes. Fischer's lock and key and Koshland's induced fit hypothesis.

Large-scale production and purification of enzymes, techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, enzymes and recombinant DNA technology.

Unit-IV : Co- Enzyme Chemistry and Biopolymer Interaction

A] Cofactors as derived from vitamins. Structure and biological functions of coenzyme A, thiamine pyrophosphate (TPP), pyridoxal phosphate, NAD+, NADP+ , FMN, FAD, lipoic acid, vitamin B12. Mechanisms of reactions catalyzed by the above cofatctors.

B] Biomimetic chemistry, crown ethers, cryptates.

C] Polypeptide and protein structures, introduction to protein folding problem. Forces involved in biopolymer interactions.

Unit-V : Cell membrane and transport of Ions

Structure and functions of biological cell membrane, ion transport through cell membrane, Structure andfunctions of DNA and RNA in living systems.

Bioenergetics

Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATPfrom ADP.

Biopolymer and their molecular weight

Evaluation of size, shape, molecular weight Methods for determination of molar mass of biopolymers (a) Viscositymethod (b) Sedimentation methods (c) Osmotic pressure methods

SchemeofStudies:

Board ofStudy	CourseCode	CourseTitle	Scheme ofstudies (Hours/Week)					Total Credits(C)
			Cl	LI	SW	SL	Total Study Hours(CI+LI+SW+SL)	
ProgramCore(PCC)	2CH602	Bioinorganic ,biophysical, bioorganic chemistry	4	0	1	1	6	4

AKS University
Faculty of Basic Science
Curriculum of B. Sc. (Honours / By Research) Program
(Revised as on 01 August 2023)

Legend : CI: Class room Instruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)andothers),**LI:**Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different in structional strategies)

W:Sessional Work(includesassignment,seminar,miniprojectetc.),
SL: Self Learning,
C: Credits.

Note:

SW&SLhastobeplannedandperformedunderthecontinuousguidanceandfeedbackofteacherto ensure outcome ofLearning.

SchemeofAssessment: Theory

Board ofStudy	CourseCode	CourseTitle	**SchemeofAssessment(Marks)**						
			ProgressiveAssessment(RA)					**EndSemester Assessment (ESA)**	**TotalMa (PRA+ES**
			Class/HomeAssignment5number 3 markseach (CA)	Class Test2 (2bestout of3) 10 markseach(CT)	Seminarone + Class activity	ClassAttendance (AT)	TotalMarks (CA+CT+SA+AT)		
PCC	2CH602	Bioinorganic, biophysical, bioorganic chemistry	15	20	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

Unit-I Metal ions in Biological System

A] Structure and Function of hemoglobin, myoglobin, hemocyanins and hemerythrin,
B] Metal compexes in transmission of energy: chlorophylls, photosystem I and photosystem II in cleavage of water

Activity	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**LI**	**CI**	**SL**
After the completion of topics students will be able to SO1.1 understand the function of metal or metal ions in biological system SO1.2 describe the structure and restate the functions of hemoglobin and myoglobin, SO1.3 describe the structure and restate the functions of hemocyanins and hemerythrin SO1.4 understand metal complexes in transmission of energy such as chlorophylls SO1.5 explain photosystem I and photosystem II in cleavage of water		**Unit-I** (76CH-304.1)**: Metal ions in Biological System** Introduction to m**etal ions in Biological System** Structure and Function of hemoglobin Structure and Function of myoglobin Structure and Function of hemocyanins Structure and Function of hemerythrin Metal compexes in transmission of energy Chlorophylls Chlorophylls Photosystem I Photosystem II in cleavage of water Class test Class test	• Chlorophyll a • Chlorophyll b

SW-1Suggested Sessional Work (SW):

Assignments: Structure and Function of hemoglobin

Mini Project:

Other Activities (Specify): Structure and Function of hemerythrin

Unit-II Electron transfer in Biological System

[A] Structure and function of metalloproteins in electron transport processes-cytochromes and ion-sulphur proteins [B] **Kinds of Reactions Catalysed by Enzymes:** Nucleophilic displacement on a phosphorus atom. Isomerization and rearrangement reactions, enolic intermediates in iomerization reactions. Enzyme catalyzed carboxylation and decarboxylation reaction.

Activity	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction(CI)**	**Self Learning (SL)**

SO2.1 describe the structure and function of metalloproteins **SO2.2** describe structure and function of metalloproteins in electron transport processes-cytochromes **SO2.3 explain s**tructure and function of metalloproteins in electron transport processes-ion-sulphur proteins **SO2.4** understand the kinds of reactions Catalysed by Enzymes such as nucleophilic displacement on a phosphorus atom **SO2.5** explain enzyme catalyzed carboxylation and		Electron transfer in Biological System Structure and function of metalloproteins in electron transport processes-cytochromes Structure and function of metalloproteins inelectron transport processes-ion-sulphur proteins Structure and function of metalloproteins inelectron transport processes-ion-sulphur proteins Kinds of Reactions Catalysed by Enzymes Nucleophilic displacement on a phosphorus atom Isomerization and rearrangement reactions enolic intermediates in iomerization reactions. Enzyme catalyzed carboxylation 2.10Enzyme catalyzed decarboxylation reaction2.11Test 2.12Test	

SW-2 Suggested Sessional Work (SW):

Assignments: ion-sulphur proteins

Mini Project:

Other Activities (Specify): Nucleophilic displacement on a phosphorus atom

Unit-III Enzymes and their biotechnological applications

Introduction of bioorganic chemistry and Enzymes, coenzymes, prosthetic groups, apoenzymes. Properties of enzymes like catalytic power, specificity and regulation. Proximity effects and molecular adaptation. Transition-state theory and orientation

Nomenclature and classification of enzymes. Fischer's lock and key and Koshland's induced fit hypothesis.

Large-scale production and purification of enzymes, techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, enzymes and recombinant DNA technology.

Activity	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction(LI)**	**Class room Instruction(CI)**	**Self Learning (SL)**
After the completion of topics students will be able to		**Unit-III** (76CH-304.**3): Enzymes and their biotechnological applications**	• Nucleotide • Nucleoside

SO3.1 understand bioorganic chemistry and its applications **SO3.2** understand the properties of enzymes and transition state **SO3.3** explain nomenclature and classification of enzymes. **SO3.4** describe production and purification of enzymes **SO3.5** describe recombinant DNAtechnology		understand bioorganic chemistry and its applications coenzymes, prosthetic groups, apoenzymes Properties of enzymes like catalytic power, specificity and regulation. Proximity effects and molecular adaptation. Transition-state theory and orientation Nomenclature and classification of enzymes. Fischer's lock and key and Koshland's induced fit hypothesis. Large-scale production and purification of enzymes Techniques and methods of immobilization of enzymes Effect of immobilization on enzymeactivity, enzymes Recombinant DNA technology. Test	• DNA

*SW-3 Suggested Sessional Work (SW)***:**
Assignments: recombinant DNA TechnologyMini Project:
Other Activities (Specify):

Unit-IV Co- Enzyme Chemistry and Biopolymer Interaction
A] Cofactors as derived from vitamins. Structure and biological functions of coenzyme A, thiamine pyrophosphate (TPP), pyridoxal phosphate, NAD+, NADP+ , FMN, FAD, lipoic acid, vitamin B12. Mechanisms of reactions catalyzed by the above cofatctors.
B] Biomimetic chemistry, crown ethers, cryptates.
C] Polypeptide and protein structures, introduction to protein folding problem. Forces involved in biopolymer interactions.

Activity	AppX Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes(SOs)	Laboratory Instruction(LI)	Class room Instruction(CI)	Self Learning (SL)
After the completion of topics		**Unit-IV** (76CH-304.**4): Co- Enzyme Chemistry and**	• Amino acid
students will be able to		**Biopolymer Interaction**	• Physic-

SO4.1 understand the terms of coenzyme and cofactors **SO4.2 explain structure** and biological functions of coenzyme A **SO4.3 explain structure** and biological functions of coenzyme of Vitamin B-complex **SO4.4** Biomimetic chemistry, crown ethers, cryptates. **SO4.5** Explain structure and functions of polypeptides and proteins structures			Cofactors as derived from vitamins Structure and biological functions of coenzyme A Structure and biological functions of coenzyme of Thiamine pyrophosphate (TPP) Structure and biological functions of coenzyme like pyridoxal phosphate Structure and biological functions of coenzyme like NAD+, NADP+ Structure and biological functions of coenzyme such as FMN, FAD Structure and biological functions of coenzyme lipoic acid and vitamin B12 Biomimetic chemistry crown ethers cryptates Structure and functions of polypeptideand protein Forces involved in biopolymerinteractions.	chemical properties • Vitamins

SW-4 Suggested Sessional Work (SW)Assignment: Vitamins and cofactors **Mini Project:**

Other Activities (Specify): Enzymes and coenzymes

Unit-V : Cell membrane and transport of Ions
Structure and functions of biological cell membrane, ion transport through cell membrane, Structure and functions of DNA and RNA in living systems.

Bioenergetics
Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.

Biopolymer and their molecular weight
Evaluation of size, shape, molecular weight Methods for determination of molar mass of biopolymers (a) Viscosity method (c) Sedimentation methods (c) Osmotic pressure methods

Activity	AppX Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction(CI)**	**Self Learning (SL)**
After the completion of topics students will be able to **SO5.**1 understand structure and functions of biological cell membrane and ion transportation through cell membrane **SO5.2** explains structure and functions of DNA and RNA in living systems **SO5.3** apply the concept of bioenergetics to describe the hydrolysis of ATP **SO5.**4 explains the viscosity and sedimentation methods to evaluate the the size, shape and molecular weight of biopolymers **SO5.5** explains the osmotic pressure methods to evaluate the the size, shape and molecular weight of biopolymers	.	**Unit-V** (76CH-304**.5): Cell membrane and transport of Ions** Structure and functions of biological cellmembrane ion transport through cell membrane Structure and functions of DNA and RNA inliving systems **Bioenergetics** Standard free energy change in biochemicalreactions Exergonic and endergonic Hydrolysis of ATP synthesis of ATP from ADP **Biopolymer and their molecular weight** Evaluation of size, shape, molecular weight Methods for determination of molar mass of biopolymers by Viscosity method By sedimentation methods By osmotic pressure methods	• Molar mass • Gibbs free energy

*SW-5 Suggested Sessional Work (SW)***:**

Assignments: Structure and functions of DNA and RNA in living systems.

Mini Project:

Other Activities (Specify): Synthesis of ATP from ADP.

Brief of Hours suggested for the Course Outcome

Course Outcomes	**Class Lecture(Cl)**	**Sessional Work(SW)**	**Self Learning (Sl)**	**Total hour(Cl+SW+Sl)**
2CH602**.1**: explain structure and function of metal complexes or metallo-proteins involved in storage & transportation of oxygen as well in transmission of energy.	12	02	01	15
2CH602**.2**: explain structure and function of metalloproteins like cytochrome and iron-sulphur proteins involved in electron transport processes and also describe various reactions calalysed by enzymes.	12	02	01	15

2CH602.**3**: understand the concept of enzymes and describe its production, purification and applications in various areas.	12	02	01	15
2CH602.**4**:Describe mechanisticdetails of chemical reactions of various co-enzymic form of vitamins and also describe structure and function of proteins.	12	02	01	15
2CH602.**5:** Explain standard free energy change in biochemical reactions and apply the same concept to hydrolysis and synthesis of ATP.	12	02	01	15
Total Hours	60	10	05	75

Suggestion for End Semester Assessment
Suggested Specification Table(ForESA)

CO	UnitTitles	MarksDistribution			TotalMarks
		R	U	A	
CO-1	**Metal ions in Biological System**	03	01	01	05
CO-2	**Electron transfer in Biological System**	02	06	02	10
CO-3	**Enzymes and their biotechnological applications**	03	07	05	15
CO-4	**Co- Enzyme Chemistry and Biopolymer Interaction**	-	10	05	15
CO-5	**Cell membrane and transport of Ions**	03	02	-	05
Total		11	26	13	50

Legend: R:Remember, U:Understand, A:Apply

The written examination of 50 marks will be held at theendofsemesterfor Inorganic Chemistry

Note.Detailed Assessmentrubricneedtobepreparedbythecoursewiseteachersforabovetasks. Teacherscanalsodesigndifferenttasksasperrequirement,forendsemesterassessment.

SuggestedInstructional/ImplementationStrategies:

19. ImprovedLecture
20. Tutorial
21. CaseMethod
22. GroupDiscussion
23. RolePlay
24. Visitto NCL, CSIR laboratories
25. Demonstration
26. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog, Fa cebook,Twitter,Whatsapp,Mobile,Onlinesources)
27. Brainstorming

SuggestedLearningResources:

(j) Books:

S. No.	Title	Author	Publisher	Edition& Year
1	Principles of Biochemistry,	A.L. Lehninger	Worth Publishers	4th edition
2	Principles of Bioinorganic Chemistry	S. J Lippard	Paperback	2nd edition
3	Biochemistry	L. Stryer, W.H.Freeman.	Universities Press	First Edition (1 January 2010)

SuggestedWebSources:

27. https://celqusb.files.wordpress.com/2017/12/inorganic-chemistry-g-l-miessler-2014.pdf
28. https://www.slideshare.net/MANISHSAHU106/inert-and-labile-complexes
29. https://swayam.gov.in/explorer?category=Chemistry

ModeofDelivery:Lecture,demonstration,E-tutoring,discussion,assignments,quizzes, case study, power point;

LMS/ICT Tools: Digital Classrooms, DLMS, ZOOM, G-Suite,MSPower-Point, Online Resources

Course Title: Bioinorganic **Course Code : 2CH602**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
Course Outcomes		**Research Aptitude**	**Communication**	**Problem Solving**	**Individual and Team Work**	Investigation of Problems	**Modern Tool usage**	**Science and Society**	**Life-Long Learning**	**Ethics**	**Project Management**	**Environment and sustainability**	**The detailed functional knowledge of theoretical concepts and experimental aspects of chemistry**	**To integrate the gained knowledge with various contemporary and evolving areas in chemical sciences like analytical, synthetic, pharmaceutical etc.**	**understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomenon-based problems in chemical sciences.**	**Provide opportunities to excel in academics, research or Industry by research based innovative knowledge for sustainable development in chemical science**
CO1: explain structure and function of metal complexes or metallo-proteins involved in storage & transportation of oxygen as well in transmission of energy.	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**

CO2:explain structure and function of metalloproteins like cytochrome and iron-sulphur proteins involved in electron transport processes and also describe various reactions calalysed by enzymes.	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
CO3:understand the concept of enzymes and describe its production, purification and applications in various areas.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO4: Describe mechanisticdetails of chemical reactions of various co-enzymic form of vitamins and also describe structure and function of proteins.	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO5: Explain standard free energy change in biochemical reactions and apply the same concept to hydrolysis and synthesis of ATP.	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: **1–Low,** **2–Medium,** **3–HigH**

Curriculum Map:

POs &PSOsNo.	Cos No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (C
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO-1: explain structure and function of metal complexes or metallo-proteins involved in storage & transportation of oxygen as well in transmission of energy.	SO1.1 SO 1.2SO 1.3 SO1.4 SO1.5		Unit-1.**Metal ions in Biologic** 1.1,1.2,1.3,1.4,1.5,1.6
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO2: explain structure and function of metalloproteins like cytochrome and iron- sulphur proteins involved in electron transport processes and also describe various reactions calalysed by enzymes.	SO2.1 SO 2.2SO 2.3 SO2.4 SO2.5		Unit-2 **Electron transfer in System** 2.1,2.2,2.3,2.4,2.5,2.6, 2.7, 2.
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO3: understand the concept of enzymes and describe its production, purification and applications in various areas.	SO3.1SO3 .2 SO3.3 SO3.4 SO3.5		Unit-3 :**Enzymes and their biotechnological applicatio** 3.1, 3.2,3.3,3.4,3.5,3.6,3.7
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO 4: Describe mechanisticdetails of chemical reactions of various co-enzymic form of vitamins and also describe structure and function of proteins.	SO4.1 SO 4.2SO 4.3 SO4.4 SO4.5		Unit-4 : **Co- Enzyme Chem Biopolymer Interac** 4.1, 4.2,4.3,4.4,4.5,4.6,4.7
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO 5: Explain standard free energy change in biochemical reactions and apply the same concept to hydrolysis and synthesis of ATP.	SO5.1 SO 5.2SO 5.3 SO5.4 SO5.5		Unit 5: **Cell membrane and Ions** 5.1,5.2,5.3,5.4,5.5,5.6,5.7

Curriculum Development Team:

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Course Code: 1GO601

Course Title: Economic Geology

Pre-requisite: Student should have basic knowledge of scope and purpose of geology, Rocks, Minerals, various methods of age determination of rock and minerals.

Rationale: The students studying Economic geology should possess knowledge of mineralogy, Igneous , Metamorphic and sedimentary petrology as well as mining geology, Processes of mineral prospecting and exploration methods .They must have knowledge of economic value of minerals..

Course Outcomes:

1GO601.1: Develop an understanding of the natural processes associated with the formation of mineral deposits.
1GO601.2: Students will learn processes of of ore formation specially sedimentary and metamorphic deposits.
1GO601.3: Students will learn about metallic mineral resources of India, their origin and occurrences.
1GO601.4: Explain origin of coal and analysis of coal and physical and chemical constituents and distribution of coal.
1GO601.5: Explain and describe process of formation of petroleum, accumulation traps and Petroliferous basin and distribution of petroleum in India.

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies(Hours/Week)						
			CI	LI	T	SW	SL	Total Study Hours(CI+LI+SW+SL)	Total Credits (C)
Program Core (PCC)	1GO601	Economic Geology	3	2	1	1	1	8	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T)and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory, workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

AKS University
Faculty of Basic Science
Curriculum of B. Sc. (Honours / By Research) Program
(Revised as on 01 August 2023)

Board of Study	Course Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	**(ESA)**	(PRA + ESA)
PCC	1GO 601	Economic Geology	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:
This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1GO601.1: Develop an understanding of the natural processes associated with the formation of mineral deposits.
Approximate Hours

Item	Approx. Hrs
CI	9
LI	6
T	3
SW	2
SL	1
Total	21

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 Introduction to Economic Geology. **SO1.2** Processes of mineral deposit Formation. **SO1.3** Magmatic concentration	1.1 Physical identification of mineral on the basis of physical properties of following economic minerals; Magnetite, Hematite, Limonite, Goethite, Siderite, Pyrite. 1.2 Physical	**Unit-1:**Elementary idea about the processes of mineral deposit formation: 1.1 Introduction to Economic Geology. 1.2 Classification of mineral deposits. 1.3 Magmatic processes of ore formation. 1.4 Classification of Magmatic processes of ore formation. 1.5 Hydrothermal processes.	3. Find out India biggest magmatic deposits study their geological conditions.

processes. **SO1.4** Hydrothermal processes. **SO1.5** Contact metasomatic replacement processes.	identification of mineral on the basis of physical properties of following minerals; Ilmenite, Pyrolusite, Psilomelane, Braunite, Chromite	Classification of 1.6 Hydrothermal deposits. 1.7 Cavity filling deposits. 1.8 Contact metasomatic 1.9 Replacement processes. **Tutorial** 1.1 Classification of Magmatic processes of ore formation. 1.2 Hydrothermal deposits. 1.3 Contact metasomatic deposits.	

SW-1 Suggested Sessional Work (SW):

A. **Assignments:**
   1. Discuss hydrothermal deposits and its types in Detail.
   2. Discuss the process of ore formation of economic minerals.

B. **Mini Project:**
   1. Show economic minerals zones in India map.

C. **Other Activities (Specify):**
   1. Make a flow chart of classification of magmatic ore deposit.

1GO601.2: Students will learn processes of of ore formation specially sedimentary and metamorphic deposits.

Approximate Hours

Item	Approx. Hrs
Cl	9
LI	6
T	3
SW	2
SL	1
Total	21

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 Sedimentary ore Deposit Formation. **SO2.2** Oxidation and Supergene Sulphide Enrichment processes. **SO2.3** Mechanical concentration processes. **SO2.4** Residual processes ore formation. **SO2.5** Metamarphic	2.1 Physical identification of mineral on the basis of physical properties of following economic minerals; Chalcopyrite, Covellite, Bornite, Malachite, Azurite, Cuprite, Bauxite, Galena, Sphalerite, 2.2 Physical identification of mineral on the basis of physical properties of following economic minerals;	**Unit-2:**Elementary idea about the processes of mineral deposit formation (continued): 2.1 Sedimentary ore Deposit Formation. 2.2 Oxidation and Supergene Sulphide Enrichment processes. 2.3 Reaction involved in Oxidation and Supergene Sulphide Enrichment processes. 2.4 Gossans and Box work structure. 2.5 Mechanical concentration processes. 2.6 Placer Deposits. 2.7 Residual processes of ore formation. 2.8 Metamorphic Ore Deposits. 2.9 Classification of metamorphic ore	1. Study bauxite deposits of Madhya Pradesh and also find out role of climate in formation of Bauxite.

Ore Deposits.	Cassiterite, Wolframite, Molybdenite, Stibnite, Orphiment, Realgar.	Deposits. **Tutorial** 2.1 Gossans and Box work structure. 2.2 Mechanical concentration processes. 2.3 Metamorphic Ore Deposits.	

SW-2 Suggested Sessional Work (SW):

A. Assignments:

1. Discuss the sedimentary process of ore formation of economic minerals.
2. Discuss the Residual ore deposits.

B. **Mini Project:**

1. Show economic minerals zones in India map.

C. **Other Activities (Specify):**

1. Make a power point presentation on Mechanical concentration of ore deposit.

1GO601.3: Students will learn about metallic mineral resources of India, their origin and occurrences.

Approximate Hours

Item	Approx. Hrs
Cl	9
LI	6
T	3
SW	2
SL	1
Total	21

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**

SO3.1 With reference to their mode of occurrences, ore minerals and chemical composition, geographic distribution and economic uses , Evaluate about aluminum **SO3.2** Evaluate about Manganese. **SO3.3** Evaluate about Gold and Copper. **SO3.4** Evaluate about Iron deposits **SO3.5** Assess Origin and occurrence of Lead and Zinc deposits..	3.1Identification of hand specimen of non metallic minerals like Asbestos, Barite, Calcite, China-clay, Corundum, 3.2Identification of hand specimen of non metallic minerals Fluorite, Graphite, Gypsum, Garnet,	**Unit-3:** metallic mineral resources of India. 3.1 Aluminium ore mineral, occurrences and deposit. 3.2 Aluminium ore deposits classification 3.3 Chromium ore deposit. 3.4 Sukinda-Naushahi ore deposits and its genesis. 3.5 Copper ore deposit 3.6 Gold ore deposit. 3.7 Lead ore deposit. 3.8 Zinc ore deposit. 3.9 Lead Zinc ore deposit distribution in India. **Tutorial** 3.1 Gold ore deposit. 3.2 Lead ore deposit. 3.3 Zinc ore deposit.	1. Study of porphyry copper ore deposit of world with reference to origin.

SW-3 Suggested Sessional Work (SW):

A. Assignments:

1. Discuss about Iron ore minerals and its deposit in India.
2. Discuss about Lead and Zinc minerals, Occurrences and deposits in India.

B. **Mini Project:**

1. Study about kolar gold field and prepare a short report on it.

C. Other Activities (Specify):

1. Power Point Presentation on Mineral wealth of Madhya Pradesh.

1GO601.4: Explain origin of coal and analysis of coal and physical and chemical constituents and distribution of coal.

Approximate Hours

Item	Approx. Hrs
Cl	9
LI	6
T	3
SW	2
SL	1
Total	21

Session	**Laborator**	**Classroom Instruction (CI)**	**Self Learning (SL)**

Outcomes (SOs)	y Instruction (LI)		
SO4.1 Physico-Chemical Characterization of coal **SO4.2** Macroscopic and Microscopic constituents (Lithotypes, Maceral, Microlithotypes). **SO4.3** Indian and international classification of coal. **SO4.4** Origin of coal.	4.1. Identification of hand specimen of non metallic minerals like Apatite, Quartz, Sillimanite, Wollastonite, Talc, Magnesite, Fireclay, Kyanite, Mica. 4.2 Distribution of economic minerals in the outline map of India.	**Unit-4:** Coal geology 4.1 Origin of coal 4.2 Coal bed methane. 4.3 Physico-Chemical Characterization of coal 4.4 Proximate and Ultimate analysis. 4.5 Macroscopic constituents (Lithotypes). 4.6 Microscopic constituents (Macerals). 4.7 Rank of Coal. 4.8 Types and grade of coal. 4.9 Indian and international classification of coal. **Tutorial** 4.1 hysico-Chemical Characterization of coal. 4.2 Types and grade of coal. 4.3 Proximate and Ultimate analysis.	1. ead about stratigraphy of Gondwana super group.

SO4.5 Distribution of Coal.			

SW-4 Suggested Sessional Work (SW):

A. Assignments:

1. Explain Origin of coal.
2. Explain Physico-Chemical Characterization of coal, Proximate and Ultimate analysis.

B. **Mini Project:**

1. **Note on Indian and international classification of coal.**

C. Other Activities (Specify):

1. Make a power point presentation on Geology and Structure of important coal fields in India.

1GO601.5: Explain and describe process of formation of petroleum, accumulation traps and Petroliferous basin and distribution of petroleum in India.

Approximate Hours

Item	Approx. Hrs
CI	9
LI	6
T	3
SW	2
SL	1
Total	21

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO5.1 Origin of Petroleum **SO5.2** Migration of Petroleum **SO5.3** Reservoir rocks-their characteristics. Characteristics of cap rocks. **SO5.4** Accumulations (Trap) of Hydrocarbons – structural traps, structural traps, and	5.1 Distribution of Coal and Lignite in the outline map of India. 5.2 Distribution of petroliferous basins and Refineries in the outline map of India.	**Unit-4:** Petroleum geology 5.1 Introductions to physical properties of petroleum. 5.2 Chemical composition of Petroleum. 5.3 Origin of natural Gas and Hydrocarbons (oil). 5.4 Kerogene origin. 5.5 Maturation and thermal cracking. 5.6 Migration of Petroleum and gas. 5.7 Source rocks- their characteristics. 5.8 Reservoir rocks-their characteristics. 5.9 Characteristics of cap rocks.	1.1 study geology of Assam basin/Bombay High of petroleum in India.

combination traps **SO5.5** Petroliferous Basin in India.		**Tutorial** 5.1 Introductions to physical properties of petroleum. 5.2 Chemical composition of Petroleum. 5.3 Origin of natural Gas and Hydrocarbons (oil).	

SW-5 Suggested Sessional Work (SW):

A. Assignments:

1. Make assignments on petroleum accumulations and trap.
2. Discuss Migration of Petroleum and gas, reservoir rocks-their characteristics.

B. **Mini Project:**

1. Prepare a report and map of petroliferous basin of India.

C. Other Activities (Specify):

1. Make power point presentation on Geology and Structure of important petroleum and Gas fields in India.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Tutorial (T)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
1GO601.1: Develop an understanding of the natural processes associated with the formation of mineral deposits.	9	6	3	2	1	21
1GO601.2: Students will learn processes of of ore formation specially sedimentary and metamorphic deposits.	9	6	3	2	1	21
1GO601.3: Students will learn about metallic mineral resources of India, their origin and occurrences.	9	6	3	2	1	21
1GO601.4: Explain origin of coal and analysis of coal and physical and chemical constituents and distribution of coal.	9	6	3	2	1	21
1GO601.5: Explain and describe process of formation of petroleum, accumulation traps and Petroliferous basin and distribution of petroleum in India.	9	6	3	2	1	21

Total Hours	45	30	15	10	5	105

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	**U**	**A**	
CO-1	**Unit-1:** Elementary idea about the processes of mineral deposit formation.	03	01	01	05
CO-2	**Unit-2:** Elementary idea about the processes of mineral deposit formation (continued):	02	06	02	10
CO-3	**Unit-3:** metallic mineral resources of India.	03	07	05	15
CO-4	**Unit-4:** Coal geology	-	10	05	15
CO-5	**Unit-5**: Petroleum Geology	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Mining Geology-II will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
9. Brainstorming

Suggested Learning Resources:

Suggested Readings

1. Arogyaswamy, R.N.P. courses in mining geology. Oxford and IBH publishing company, 4th edition,2017.
2. Deb, S. Industrial Minerals and Rocks of India, Allied Publishers Pvt, Ltd.,1980.
3. Lal, J.K., Ore Geology and Mining Geology; Anmol Publications Pvt, Ltd., 2013.
4. Hartman Howard L., Jan M. Mutmansky; Introductory Mining Engineering, 2nd ED, Wiley India ED.,2002.

Digital platform web link

1. https://mines.gov.in/UserView?mid=1319
2. https://www.mines.ap.gov.in/miningportal/Downloads/NewDocs/National%20mineral%20Policy.pdf
3. https://ibm.gov.in/writereaddata/files/03202018150002PNG_AR_2017. pdf [for the petroleum and natural gas occurrences in India,2018]
4. https://ibm.gov.in/writereaddata/files/10192020104607 Coal_2019

Cos, Pos and PSOs Mapping

Program Title: B. Sc (Geology Hons)

Course Code: 1GO601

Course Title: Economic Geology

Course Outcomes	**Program Outcomes**												**Program Specific Outcome**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
	Knowledge.	Research aptitude.	Communication.	Problem solving.	Individual and team work.	Investigation of Problem.	Modern tool usage	Science and Society.	Life-long learning	Ethics	Project management and finance:	Environment and sustainability.	The detailed functional knowledge of Theoretical concepts and experimental concepts of Fuel geology.	Ability Word skills and advanced GIS, statistics, databases, spreadsheets, digital drawing through online workbooks and workshops	Develop a research design, which has an appropriate problem related to earth sciences but may incorporate some scientific methods, ability	Provide an excellent preparation for a career in professional practice in industrial or environmental Earth Sciences, research in Geosciences, and specialist
CO-1 Develop an understanding of the natural processes associated with the formation of mineral deposits.	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**

CO-2 Students will learn processes of of ore formation specially sedimentary and metamorphic deposits.	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
CO-3 Students will learn about metallic mineral resources of India, their origin and occurrences.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO-4 Explain origin of coal and analysis of coal and physical and chemical constituents and distribution of coal.	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO-5 Explain and describe process of formation of petroleum, accumulation traps and Petroliferous basin and distribution of petroleum in India.	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend:1–Low,2–Medium,3–High

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Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning (SL)
PO1,2,3,4,5,67,8,9,10,11,12 PSO1,2,3,4	CO-1 Develop an understanding of the natural processes associated with the formation of mineral deposits.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1 1.2	**Unit-1:** Elementary idea about the processes of mineral deposit formation. 1.1,1.2,1.3,1.4,1.5,1.6, 1.7, 1.8, 1.9 Tutorial 1.1, 1.2, 1.3	As mentioned in Page number 2 to 6
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-2 Students will learn processes of ore formation specially sedimentary and metamorphic deposits.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1 2.2	**Unit-2:** Elementary idea about the processes of mineral deposit formation (continued): 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9 Tutorial 2.1, 2.2, 2.3	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-3 Students will learn about metallic mineral resources of India, their origin and occurrences.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1 3.2	**Unit-3 :** metallic mineral resources of India. 3.1,3.2,3.3,3.4,3.5, 3.6, 3.7, 3.8, 3.9 Tutorial 3.1, 3.2, 3.3	
PO1,2,3,4,5,6	CO-4 Explain origin of	SO4.1		**Unit-4:** Coal geology	

7,8,9,10,11,12 PSO1,2,3,4	coal and analysis of coal and physical and chemical constituents and distribution of coal.	SO4.2 SO4.3 SO4.4 SO4.5	4.1 4.2	4.1,4.2,4.3,4.4,4.5,4.6,4.7, 4.8, 4.9 Tutorial 4.1,4.2,4.3	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-5 Explain and describe process of formation of petroleum, accumulation traps and Petroliferous basin and distribution of petroleum in India.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1 5.2	**Unit-5**: Petroleum Geology 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9 Tutorial 5.1,5.2,5.3	

Curriculum Development Team:

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Course Code: 2GO601

Course Title: Fuel Geology

Pre-requisite: Student should have basic knowledge of scope and purpose of geology, Rocks, Minerals, various methods of age determination of rock and minerals.

Rationale: The students studying fuel geology should possess foundational understanding about principles of Stratigraphy, structuregeology, sedimentary petrology, mineral resource distribution. They must have knowledge of economic value of Fuel They should be able to prospect the coal through various methods.

Course Outcomes:

2GO601.1: Explain origin of coal and analysis of coal and physical and chemical constituents of coal.
2GO601.2: Explain and Describe washing and briquetting of coal, methods of coal prospecting and distribution of coal in India.
2GO601.3: Explain physical properties, processes of occurrence of petroleum.
2GO601.4: Explain and describe process of petroleum accumulation traps and Petroliferous basin and distribution of petroleum in India.
2GO601.5: Explain and describe atomic energy sources of India.

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies(Hours/Week)				
			Cl	SW	SL	Total Study Hours(CI+LI+SW+SL)	Total Credits (C)
Program Core (PCC)	2GO601	Fuel Geology	3	1	1	9	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory, workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

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(Revised as on 01 August 2023)

Theory

Board of Study	Course Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	**(ESA)**	(PRA + ESA)
PCC	2GO 601	Fuel Geology	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:
This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

2GO601.1: Explain origin of coal and analysis of coal and physical and chemical constituents of coal.

Approximate Hours

Item	Approx. Hrs
CI	9
SW	2
SL	1
Total	12

Session Outcomes (SOs)	**Classroom Instruction (CI)**	**Self Learning (SL)**

SO1.1 Origin of coal, Coal bed methane. **SO1.2** Physico-Chemical Characterization of coal **SO1.3** Macroscopic and Microscopic constituents **SO1.4** Rank of coal and types of coal **SO1.5** Indian and international classification of coal.	**Unit-1: Coal Geology-1** 1.1 Origin of coal 1.2 Coal bed methane. 1.3 Physico-Chemical Characterization of coal 1.4 Proximate and Ultimate analysis. 1.5 Macroscopic constituents (Lithotypes). 1.6 Microscopic constituents (Macerals). 1.7 Rank of Coal. 1.8 Types and grade of coal. 1.9 Indian and international classification of coal.	1.1 read about stratigraphy of Gondwana super group.

SW-1 Suggested Sessional Work (SW):

3. **Assignments:**
3. Explain Origin of coal.
4. Explain Physico-Chemical Characterization of coal, Proximate and Ultimate analysis.
4. **Mini Project:**
2. **Note on Indian and international classification of coal.**
5. **Other Activities (Specify):**
1. Make a power point presentation on Coal bed methane.

2GO601.2: Explain and Describe washing and briquetting of coal, methods of coal prospecting and distribution of coal in India.

Approximate Hours

Item	Approx. Hrs
CI	9
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 Washing of coal. **SO2.2** Carbonization, Gasification and Hydrogenation of coal. **SO2.3** Methods of coal prospecting. **SO2.4** Geology and Structure of important coal fields in India. **SO2.5** Geology and Structure of important lignite fields in India.	**Unit-2: Coal Geology-2** 2.1 Washing of coal. 2.2 Briquetting of coal. 2.3 Carbonization, Gasification. 2.4 Hydrogenation of coal. 2.5 Methods of coal prospecting. 2.6 Geology and Structure of important coal fields in India. 2.7 Important coal fields in India. 2.8 Geology and Structure of important lignite fields in India. 2.9 Important lignite fields in India.	1.1 studies about coal production in India.

SW-2 Suggested Sessional Work (SW):

a. **Assignments:**
1. Discuss the process of Carbonization, Gasification and Hydrogenation of coal.
2. Methods of coal prospecting.

b. **Mini Project:**
1. Make a poster of important coal fields in India.

c. **Other Activities (Specify):**
2. Make a power point presentation on Geology and Structure of important coal fields in India.

2GO601.3: Explain physical properties, processes of occurrence of petroleum.

Approximate Hours

Item	Approx. Hrs
CI	9
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 Introduction to physical properties and Chemical composition of Petroleum. **SO3.2** Origin of natural Gas and Hydrocarbons(oil) **SO3.3** Kerogen-Origin, Maturation and Thermal cracking.	**Unit-3 : Petroleum Geology-1** 3.1 Introduction to physical properties of petroleum. 3.2 Chemical composition of Petroleum. 3.3 Origin of natural Gas and Hydrocarbons (oil). 3.4 Kerogene origin. 3.5 Maturation and thermal cracking.	1.1 study geology of Assam basin/Bombay High of petroleum in India.

SO3.4 Migration of Petroleum and gas. Reservoir rocks-their characteristics. **SO3.5** Characteristics of cap rocks.	3.6 Migration of Petroleum and gas. 3.7 Source rocks- their characteristics. 3.8 Reservoir rocks-their characteristics. 3.9 Characteristics of cap rocks.	

SW-3 Suggested Sessional Work (SW):

i. Assignments:

1. Discuss Migration of Petroleum and gas, reservoir rocks-their characteristics.
2. Origin and occurrence origin of natural Gas and Hydrocarbons(oil)

j. **Mini Project:**

1. Prepare a report on petroleum production in India.

k. Other Activities (Specify):

1. Make a power point presentation on Kerogen-Origin, Maturation and Thermal cracking.

2GO601.4: Explain and describe process of petroleum accumulation traps and Petroliferous basin and distribution of petroleum in India.

Approximate Hours

Item	Approx. Hrs
CI	9
SW	2
SL	1
Total	12

Session Outcomes (SOs)	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4.1 Accumulations (Trap) of Hydrocarbons – structural traps, structural traps, and combination traps. **SO4.2** Petroliferous Basin in India. **SO4.3** Geology and Structure of important petroleum and Gas fields in India. **SO4.4** Elementary idea about non conventional hydrocarbon sources like gas and oil-shale, gas-hydrates, heavy oils.	**Unit-4: Petroleum Geology-2** 4.1 Accumulations (Trap) of Hydrocarbons 4.2 structural traps, 4.3 structural traps, 4.4 combination traps. 4.5 Petroleum accumulation traps. 4.6 Fossil fuel distribution in sedimentary basins of India 4.7 Petroliferous Basin in India. 4.8 Petroleum and Gas fields in India. 4.9 Non conventional hydrocarbon sources like gas and oil-shale, gas-hydrates, heavy oils.	i. istory of petroleum exploration in India.

SW-4 Suggested Sessional Work (SW):

d. Assignments:

3. Make assignments on petroleum accumulations and trap.

4. Make assignments on Geology and Structure of important petroleum and Gas fields in India.

e. Mini Project:

2. Prepare a report and map of petroliferous basin of India.

f. Other Activities (Specify):

1. Power Point Presentation on about non conventional hydrocarbon sources like gas and oil-shale, gas-hydrates, heavy oils.

2GO601.5: Explain and describe atomic energy sources of India.

Approximate Hours

Item	Approx. Hrs
CI	9
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Classroom Instruction (CI)	Self Learning (SL)
SO5.1 Mode of occurrences, association and distribution of Uranium and Thorium deposits in India. **SO5.2** Methods of Prospecting. **SO5.3** Productive Horizons in India. **SO5.4** Nuclear Power Stations of India and Future Prospects.	**Unit 5: Atomic Energy** 5.1 Mode of occurrences, association and distribution of Uranium deposits. 5.2 Mode of occurrences, association and distribution of Thorium deposits. 5.3 Uranium deposits in India. 5.4 Thorium deposits in India. 5.5 Methods of Prospecting. 5.6 Methods of prospecting of Uranium and Thorium. 5.7 Productive Horizons in India. 5.8 Nuclear Power Stations of India. 5.9 Nuclear Power Stations of India and Future Prospects.	1.1 Study about other radioactive minerals.

SW-5 Suggested Sessional Work (SW):

4. **Assignments:**

1. Mode of occurrences, association and distribution of Uranium

2. On prospecting methods of hydrocarbons.

5. **Mini Project:**

1. Prepare power point presentation of Nuclear Power Stations of India and Future Prospects.

6. **Other Activities(Specify):**

1. Make a report on how atomic energy affects in country developments.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
2GO601.1: Explain origin of coal and analysis of coal and physical and chemical constituents of coal.	9	2	1	12
2GO601.2: Explain and Describe washing and briquetting of coal, methods of coal prospecting and distribution of coal in India.	9	2	1	12
2GO601.3: Explain physical properties, processes of occurrence of petroleum.	9	2	1	12
2GO601.4: Explain and describe process of petroleum accumulation traps and Petroliferous basin and distribution of petroleum in India.	9	2	1	12
2GO601.5: Explain and describe atomic energy sources of India.	9	2	1	12
Total Hours	45	10	5	60

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Coal Geology-1	03	01	01	05
CO-2	Coal Geology-2	02	06	02	10
CO-3	Petroleum Geology-1	03	07	05	15
CO-4	Petroleum Geology-2	-	10	05	15
CO-5	Atomic Energy	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U:Understand, A:Apply

The end of semester assessment for Mining Geology-II will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

10. Improved Lecture
11. Tutorial
12. Case Method
13. Group Discussion
14. Role Play
15. Visit to cement plant
16. Demonstration
17. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
18. Brainstorming

Suggested Learning Resources:

Suggested Readings

5. Arogyaswamy, R.N.P. courses in mining geology. Oxford and IBH publishing company, 4th edition,2017.
6. Deb, S. Industrial Minerals and Rocks of India, Allied Publishers Pvt, Ltd.,1980.
7. Lal, J.K., Ore Geology and Mining Geology; Anmol Publications Pvt, Ltd., 2013.
8. Hartman Howard L., Jan M. Mutmansky; Introductory Mining Engineering, 2nd ED, Wiley India ED.,2002.

Digital platform web link

5. https://mines.gov.in/UserView?mid=1319
6. https://www.mines.ap.gov.in/miningportal/Downloads/NewDocs/National%20mineral%20Policy.pdf
7. https://ibm.gov.in/writereaddata/files/03202018150002PNG_AR_2017. pdf [for the petroleum and natural gas occurrences in India,2018]
8. https://ibm.gov.in/writereaddata/files/10192020104607 Coal_2019

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

<u>Cos, Pos and PSOs Mapping</u>

Program Title: B. Sc (Geology Hons)

Course Code: 2GO601

Course Title: Fuel Geology

Course Outcomes	**Program Outcomes**												**Program Specific Outcome**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
	Knowledge.	Research aptitude.	Communication.	Problem solving.	Individual and team work.	Investigation of Problem.	Modern tool usage	Science and Society.	Life-long learning	Ethics	Project management and finance:	Environment and sustainability.	The detailed functional knowledge of Theoretical concepts and experimental concepts of Fuel geology.	Ability Word skills and advanced GIS, statistics, databases, spreadsheets, digital drawing through online	Develop a research design, which has an appropriate problem related to earth sciences but may incorporate some scientific methods, ability to plan and write a research	Provide an excellent preparation for a career in professional practice in industrial or environmental Earth Sciences, research in Geosciences, and specialist
CO-1Explain origin of coal and analysis of coal and physical and chemical constituents of coal.	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**
CO-2 Explain and Describe washing and briquetting of coal, methods of coal prospecting and distribution of coal in India.	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**

CO-3 Explain physical properties, processes of occurrence of petroleum.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO-4 Explain and describe process of petroleum accumulation traps and Petroliferous basin and distribution of petroleum in India.	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO-5 Explain and describe atomic energy sources of India.	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend:1–Low,2–Medium,3–High

AKS University
Faculty of Basic Science
Curriculum of B. Sc. (Honours / By Research) Program
(Revised as on 01 August 2023)

Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,67,8,9, 10,11,12 PSO1,2,3,4	CO-1 Explain origin of coal and analysis of coal and physical and chemical constituents of coal	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	Unit-1: Coal Geology-1 1.1,1.2,1.3,1.4,1.5,1.6,1.7, 1.8, 1.9	As mentioned in Page number 2to6
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-2 Explain and Describe washing and briquetting of coal, methods of coal prospecting and distribution of coal in India.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	Unit-2: Coal Geology-2 2.1,2.2,2.3,2.4,2.5,2.6, 2.7, 2.8, 2.9	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-3 Explain physical properties, processes of occurrence of petroleum.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	Unit-3 : Petroleum Geology-1 3.1,3.2,3.3,3.4,3.5, 3.6, 3.7, 3.8, 3.9	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-4 Explain and describe process of petroleum accumulation traps and Petroliferous basin and distribution of petroleum in India.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	Unit-4: Petroleum Geology-2 4.1,4.2,4.3,4.4,4.5,4.6, 4.7, 4.8,4.9	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO -5 Explain and describe atomic energy sources of India.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	Unit 5: Atomic Energy 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9.	

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Course Code: 2GO602

Course Title: Groundwater hydrogeology

Pre-requisite: To study this course a student must have had the knowledge of basic geology along with geomorphology, petrology, stratigraphy and other geology subject.

Rationale: The course definitely provides better capability to transform the processes and principles involved under Groundwater Hydrology.

Course Outcomes:

2GO602.1: Introduction and basic concepts Scope of hydrogeology
2GO602.2: Describe and explain theory of well hydraulics and its utility to understand groundwater hydrogeology.
2GO602.3: explain the whole processes of well development and its stages.
2GO602.4: Describe the quality of groundwater its characteristics and causes and parameters.
2GO602.5: Explain concept of groundwater management, developments as a conjunctive use of both surface water and groundwater.

Scheme of Studies:

Board of Study	Course Code	Course Title	CI	SW	SL	Total Study Hours(CI+LI+T+SW+SL)	Total Credits (C)
Program Core (PCC)	2GO602	Groundwater hydrogeology	3	2	1	6	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory, workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Board of Study	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA + ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
PCC	2GO602	Ground water hydrogeology	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:
This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.
2GO602.1: Introduction and basic concepts Scope of hydrogeology

Approximate Hours

Item	Approx. Hrs
CI	9
SW	2
SL	1
Total	12

Session Outcomes (SOs)	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 Introduction to hydrogeology. **SO1.2** Vertical distribution of groundwater, **SO1.3** Darcy's Law and its range of validity **SO1.4.** Hydrological properties of water bearing material **SO1.5** Types of aquifer.	**Unit- Introduction and basic concepts Scope of hydrogeology** 1.1 ntroduction to hydrogeology 1.2 he hydrologic cycle. 1.3 ccurrence, movements and origin of groundwater. 1.4 ertical distribution of groundwater, 1.5 arcy's Law and its range of validity. 1.6 ydrological properties of water bearing material 1.7 ermeability, hydraulic conductivity 1.8 ransmissivity, storativity, specific yield, specific retention, 1.9 ydrostatic pressure, water table slope or hydraulic gradient.	1. Read about knowledge of surface water bodies of your area.

SW-1 Suggested Sessional Work (SW):

A. Assignments:

1. Make a assignments on vertical distribution of groundwater.

2. Write assignments on Hydrological properties of water bearing material

B. Mini Project:

1. Make a poster on hydro geological cycle.

C. Other activities:

1. Make a flow diagram of occurrence of groundwater.

2GO602.2: Describe and explain theory of well hydraulics and its utility to understand groundwater hydrogeology.

Approximate Hours

Item	Approx. Hrs
CI	9
SW	2
SL	1
Total	12

Session Outcomes	**Classroom Instruction**	**Self Learning**

(SOs)	(CI)	(SL)
SO2.1 The water table- **SO2.2** water table maps and pressure surface maps. **SO2.3** groundwater basin, mounds, trenches and cascades **SO2.4** Groundwater and well hydraulics **SO2.5** discharging well method, drawdown method:	**Unit-2: Well hydraulics** 2.1 The water table-definition. 2.2 water table maps and 2.3 pressure surface maps, 2.4 groundwater basin, 2.5 mounds, trenches and cascades 2.6 Permeability methods. 2.7 Laboratory methods. 2.8 Equilibrium method, 2.9 Non-equilibrium methods .	1. Try to understand mound, trenches and cascade with the help of toposheet reading.

SW-2 Suggested Sessional Work (SW):

d. Assignments:

5.1. Equilibrium method of well hydraulics
5.2. Non-equilibrium methods of well hydraulics.

e. **Mini Project:**

1. Explain water table map and pressure surface map.

f. **Other Activities (Specify):**

1. Make a poster on type of aquifer.

2GO602.3: explain the whole processes of well development and its stages.

Approximate Hours

Item	Approx. Hrs
CI	9
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 The construction of water well **SO3.2** Types of wells **SO3.3** Development of wells. **SO3.4** specific capacity of wells and efficiency of well.	**Unit-3 Water well construction, development and completion.** 3.1 shallow well and deep wells. 3.2 inverted wells, recharge wells, radial wells, 3.3 drill wells, dug wells dug cum bore wells and open wells 3.4 infiltration galleries, collector wells.	1.1 Read about ancient water resources and condition of water availability.

SO3.5 The completion of wells or design of wells	3.5 - Different methods of development of wells, 3.6 specific capacity of wells and efficiency 3.7 Gravel treatment of wells 3.8 Testing wells for yield 3.9 protections of wells.	

SW-3 Suggested Sessional Work (SW):

l. **Assignments:**
1. On method for construction of well both boring well and dug well.
2. On specific capacity and efficiency of well and explain role of these in well development.

m. **Mini Project:**
1. Prepare a flow chart of construction of well.

n. **Other Activities (Specify):**
1. Try to collect data of water table of your area.

2GO602.4: Describe the quality of groundwater its characteristics and causes and parameters.

Approximate Hours

Item	Approx. Hrs
CI	9
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Classroom Instruction (CI)	Self Learning (SL)
SO4.1 Impurities and treatment of natural water. **SO4.2** Quality of groundwater **SO4.3** Monitoring of ground water quality **SO4.4** Groundwater pollution their sources and causes. **SO4.5** removal of dissolved material. Saline water	**Unit-4: Quality of Groundwater.** 4.1 origin of impurities in natural water 4.2 physical, chemical, biological and radiological characteristics. 4.3 Importance of quality in ground water. 4.4 Ground water suitability for drinking, irrigation and industrial purposes. 4.5 Groundwater pollution their sources and causes 4.6 causes, treatment of ground water. 4.7 increasing and decreasing hardness removal of impurities chlorination. 4.8 removal of dissolved material. Saline water intrusion in aquifers.	1. ffect of geology in groundwater pollution.

intrusion in aquifers.	4.9 Salt water intrusion problem in India.	

SW-4 Suggested Sessional Work (SW):

g. **Assignments:**
1. On groundwater quality and its parameter.
2. On pollution its sources, types and causes and its remedies.

h. **Mini Project:**
1. Prepare a chart of sources of groundwater pollution in your area

i. **Other Activities (Specify):**
1. Presentation on saline water intrusion.

2GO602.5: Explain concept of groundwater management, developments as a conjunctive use of both surface water and groundwater.

Approximate Hours

Item	Approx. Hrs
CI	9
SW	2
SL	1
Total	12

Session Outcomes (SOs)	**Classroom Instruction (CI)**	**Self Learning (SL)**

SO5.1 Radio isotopes and hydro-geological studies. **SO5.2** Groundwater development **SO5.3** Groundwater modelling. .**SO5.4** problems of groundwater in India **SO5.5** groundwater legislation.	**Unit 5:** Groundwater management. 5.1 Radio isotopes and hydro-geological studies. 5.2 Basin wide groundwater development, 5.3 conjunctive uses of surface and ground water. 5.4 Groundwater development assessment and management. 5.5Groundwater modelling. 5.6 Artificial recharge of ground waters, 5.7 problems of over exploitation, 5.8 groundwater legislation. 5.9 Role of field in hydrogeology.	1.1 studies about overexploitation of groundwater**.**

SW-5 Suggested Sessional Work (SW):

7. **Assignments:**
   1. Make assignment on conjunctive use of surface and groundwater.
   2. Make assignment on problem of over exploitation.
8. **Mini Project:**
   1. Prepare a chart on artificial recharge methods.
9. **Other activities.**
   1. Prepare a power point presentation on role of field in hydrogeology.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
2GO602.1: Introduction and basic concepts Scope of hydrogeology	9	2	1	12
2GO602.2: Describe and explain theory of well hydraulics and its utility to understand groundwater hydrogeology.	9	2	1	12

2GO602.3: explain the whole processes of well development and its stages.	9	2	1	12
2GO602.4: Describe the quality of groundwater its characteristics and causes and parameters.	9	2	1	12
2GO602.5: Explain concept of groundwater management, developments as a conjunctive use of both surface water and groundwater.	9	2	1	12
Total Hours	45	10	5	60

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Introduction and basic concepts Scope of hydrogeology	03	01	01	05
CO-2	Well hydraulics	02	06	02	10
CO-3	Water well construction, development and completion.	03	07	05	15
CO-4	Quality of Groundwater.	-	10	05	15
CO-5	Groundwater management. .	03	02	-	05
Total		11	26	13	50

Legend: **R: Remember,** **U: Understand,** **A: Apply**

The end of semester assessment for Physical Geology will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
9. Brainstorming

Suggested Learning Resources:

1. Tolman, C.F. (1937): Groundwater, Mcgraw Hills Book co inc. New York and London
2. Todd, D.K. (1980): Groundwater hydrology, Toppan Co. ltd., Tokiyo, Japan
3. Ramakrishnan, S. (1998): Groundwater
4. Freeze, R. A. and Cherry, J. A.(1979): Groundwater. Prentice Hall.
5. Patrick, A.(1972):Concepts and models in groundwater hydrology. McGraw Hills
6. Sharma, R.K.(1979): A text book of hydrology & water resources, Dhanpatrai & Sons.
7. Walton,W.C.(1970):Ground water resource evaluation McGraw Hills Book Co.

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

<u>Cos, Pos and PSOs Mapping</u>

Program Title: B.Sc geology

Course Code: 2GO602

Course Title: B. Sc (Geology Hons)

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Knowledge.	Research aptitude.	Communication.	Problem solving.	Individual and team work.	Investigation of Problem.	Modern tool usage	Science and Society.	Life-long learning	Ethics	Project management and finance:	Environment and sustainability.	The detailed functional knowledge of Theoretical concepts and experimental concepts of hydrogeology	Ability Word skills and advanced GIS, statistics, databases, spreadsheets, digital drawing through online workbooks and	Develop a research design, which has an appropriate problem related to earth sciences but may incorporate some scientific methods, ability to plan and write a	Provide an excellent preparation for a career in professional practice in industrial or environmental Earth Sciences, research in Geosciences, and
CO-1 Introduction and basic concepts Scope of hydrogeology	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**
CO-2 Describe and explain theory of well hydraulics and its utility to understand	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**

CO-3 Explain the whole processes of well development and its stages.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO-4 Describe the quality of groundwater its characteristics and causes and parameters.	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO-5 Explain concept of groundwater management, developments as a conjunctive use of both surface water and groundwater.	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,67,8,9,10,11,12 PSO1,2,3,4	CO-1 Introduction and basic concepts Scope of hydrogeology	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	Unit-1.0 Dynamic Earth 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	As mention in page number 2 to 6
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-2 Describe and explain theory of well hydraulics and its utility to understand groundwater hydrogeology.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	Unit-2 Dynamic Earth 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-3 explains the whole processes of well development and its stages.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	Unit-3 : Geomorphic processes 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-4 Describe the quality of groundwater its characteristics and causes and parameters.	SO4.1 SO4.2 SO4.3 SO4.4	Unit-4: Geological works 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	

		SO4.5		
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-5 Explain concept of groundwater management, developments as a conjunctive use of both surface water and groundwater.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	Unit5: 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9	

Curriculum Development Team:

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Course Code: **1CS701**

Course Title : **Basic knowledge of HTML, CSS and JAVASCRIPT**

Pre-requisite: . Current trends and technology

Rationale: Studying this subject will help students develop an understanding of current technologies such as Block chains, React JS, Node JS, Express, and Mongo DB. By learning about these technologies, students will gain insights into how various industries are using them for their products and what the current demand is. As industries are seeking full-stack developers in this era of rapid technological advancement, this study will help students become industry-ready.

Course Outcomes:

1CS701.1: Understand Concepts of Block chain, basic crypto currency, crypto currency benefits and Cryptographic use in crypto currency.
1CS701.2: Use of JAVA Script knowledge to learn different types of new Frameworks available in a market that are also current industry need.
1CS701.3:Develop client-server connectivity with the use of Node JS and use of Express frameworks.
1CS701.4: Develop algorithms for text processing applications and Dynamic programming Applications.
1CS701.5: Design Web applications using Mongo DB database with Node JS Technology in Backend.

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Program Core (PCC)	1CS701	Current trends and technology	4	4	2	2	12	6

Legend: **CI:** Class room Instruction (Includes different in structional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different in structional strategies)
SW: Seasonal Work (includes assignment, seminar, mini-project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback teachers ensure outcome of Learning.

Scheme of Assessment:

Theory

Board of Study	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			e Assignment 5 number 3 marks each	2 (2 best out of 3) 10 marks each	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Marks (CA+CT+SA+CAT+A		
PCC	1CS701	Current trends and technology	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self-Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1CS701.1: Understand Concepts of Block chain, basic cryptocurrency, cryptocurrency benefits, and cryptographic use in cryptocurrency.

Approximate Hours

Item	Appx. Hrs.
Cl	12
LI	6
SW SL	3 2
Total	23

ssion Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Remember basics of Blockchain concepts. **SO1.2**Explain Bitcoin and understanding of smart contracts **SO1.3**Differentiate between public and private Blockchain. **SO1.4**Discuss cryptocurrency and the permission model of Blockchain. **SO1.5**Name Security Measures in Blockchain.	**LI01.** Create a simple block chain in JavaScript. Implement the data structure for blocks and the hashing function for blocks. **LI02.** Implement a basic cryptocurrency transaction in a block chain. Create a transaction class and include it in your blockchain. **LI03.** Implement a basic cryptocurrency transaction in a blockchain. Create a transaction class and include it in your blockchain. 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 1.10 1.11 1.12 1.13 1.14 1.15 1.16 1.17 1.18 1.19 1.20 1.21	**Unit-1.0 : Blockchain Technology** 1.22 Introduction to 1.23 Block chain, 1.24 Public Ledgers. 1.25 Bitcoin, Smart 1.26 Contracts, Block 1.27 in a Block chain 1.28 Transactions, 1.29 Distributed 1.30 Consensus, 1.31 Public vs Private 1.32 Block chain. 1.33 Understanding 1.34 Cryptocurrency 1.35 to Block chain, 1.36 Permissioned 1.37 Model of Block 1.38 chain 1.39 Overview of 1.40 Security aspects of 1.41 Block chain; Basic 1.42 Crypto Primitives. 1.43 Cryptographic 1.44 Hash Function, 1.45 Properties of a hash 1.46 function 1.47 Hash pointer and 1.48 Merkle tree. 1.49 Digital 1.50 Signature. 1.51 Public Key 1.52 cryptography 1.53 Basic	1. Difference between public and private Blockchain 2. Learning of different cryptographic models used in Blockchain

		1.54 cryptocurrency	

SW-1 Suggested Sessional Work (SW):

a. Assignments:

1. Discuss Public ledgers.
2. Discuss basic cryptocurrency and its types.
3. Explain cryptographic hash function.

b. Other Activities (Specify):

Seminar and Tutorial

1CS701.2: Use of JAVAScript knowledge to learn different types of new Frameworks available in market that are also current industry need.

Approximate Hours

Item	Appx. Hrs.
Cl	13
LI	6
SW	3
SL	2
Total	24

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 To Understand the basics of JavaScript and role of JavaScript in web world. **SO2.2** Recall data types and variables in JavaScript **SO2.3** Understand and recall JavaScript operators and JavaScript conditional and loop statements **SO2.4** Use of functions in JavaScript. Learning of Arrow functions **SO2.5** Understanding of classes and objects in JavaScript	**LI01**. Write a calculator program in JAVASCRIPT. **LI02.** Write a program using event in JavaScript. **LI03**. Write a program to implement dropdown in webpage using JAVASCRIPT	**Unit-2: Introduction to JavaScript** 2.1. Basics of JavaScript 2.2. JavaScript DataTypes and 2.3. Variables, constant 2.4. JavaScript Operators, 2.5. JavaScript statements conditional 2.6. Looping statements 2.7. 2.4 JavaScript Functions 2.8. simple function and 2.9. arrow functions 2.10. classes, objects and 2.11. constructers in JavaScript 2.12. Document Object Model (DOM) 2.13. Event Handling inJavaScript	1. Study of applications where JavaScript concepts are used 2.Study of different operators and loop statements

SW-2 Suggested Sessional Work (SW):

a. Assignments:

1. Discuss JavaScript features and applications in Real world.
2. Explain Event handling in JavaScript.

3. Explain DOM.

b. Other Activities(Specify):

Seminar and Tutorial

1CS701.3: Apply the knowledge of JAVASCRIPT in the ReactJS framework to create front end of dynamic webpages.

Approximate Hours

Item	Appx. Hrs.
Cl	12
LI	6
SW	3
SL	2
Total	23

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1. Recall the basics of ReactJS **SO3.2.** Differentiate DOM and Virtual DOM **SO3.3.** Illustrate rendering of element **SO3.4.** Explain class component and functional component **SO3.5.** Develop basic applications of React	**LI01**. Create a component called "Fruit List" that receives an array of fruit names as a prop and displays them as a list. **LI02.** Create a functional component called "Greeting" that takes a "name" prop and displays a personalized greeting. **LI03**. Refactor the "HelloWorld" component to use React Hooks for state management instead of a class component.	**Unit-3 :ReactJS** 3.1 Introduction to react, features of React JS, Component based programming 3.2 3.2 Virtual DOM, JSX 3.3 Basic program in React JS 3.4 Rendering elements 3.5 Components: class components and 3.6 functional components 3.7 State management, 3.8 Lifecycle methods 3.9 Event handling in React 3.10 Conditional rendering 3.11 List and keys 3.12 Basic form handling in React	1. Practice Basic programs based on React concept 2.Study of list and keys

SW-3 Suggested Sessional Work (SW):

a. Assignments:

1. Design a Web page to explain props and state management.
2. Explain list and keys.
3. Explain Form handling in React.

b. Other Activities(Specify):

Seminar and Tutorial

1CS701.4: Develop client-server connectivity with the use of Node JS and use of Express Frameworks.

Approximate Hours

Item	Appx. Hrs.
Cl	11
LI	6
SW	3
SL	2
Total	22

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 Recall features of NodeJS and its applicatons **SO4.2** Explain importance of MERN stack. **SO4.3** Create a web page where callbacks and errors handled. **SO4.4** Explore the concept of Modules in NodeJs. **SO4.5** Use of Export and Require in NodeJS.	**LI01**. Write a Node.js program that reads a user's name from the command line and greets them with "Hello, [Name]!" **LI02**. Create a simple Node.js server that listens on port 3000 and responds with "Hello, Server!" when accessed in a web browser. **LI03.** Write a Node.js program that reads and prints the contents of a text file named "sample.txt".	**Unit-4:NodeJS** 4.1. Introduction of NodeJS 4.2. installation of NodeJS and 4.3. Features of NodeJS 4.4. Importance of MERN Stack 4.5. Node JS basics: 4.6. understanding the flow of request 4.7. Callbacks and 4.8. error Handling 4.9. Understanding Modules. 4.10. Export and RequireEvents in NodeJS 4.11. Eventemitter class	1. Study different event use in NodeJS 2.Study Event Emitter class and its functions

SW-4 Suggested Sessional Work(SW):

a. Assignments:
1. Discuss the advantages and features of NodeJS.
2. Discuss different Modules in NodeJs.
3. Discuss callbacks and error handling.

b.Other Activities(Specify):
Seminar and Tutorial

1CS701.5: Design Web applications using MongoDB database with NodeJS Technology inBackend.

Approximate Hours

Item	Appx. Hrs.
Cl	13
LI	6
SW	3
SL	2
Total	24

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1.Recall the basics of Express and its features **SO5.2** Role of sequencingresponse by routers **SO5.3**Createa Web application based onRest API **SO5.4** Use of static files and middleware. **SO5.5** Setup of MongoDBAndits use in advance web development	**LI01.**Installation and Setup of MongoDB and start the MongoDB server. **LI02.** How can you connect to a MongoDB database using the MongoDB shell? **LI03.** How do you create a new database in MongoDB?	**Unit 5: Express & MongoDB** 5.1. Basics of Express 5.2. Installation ofMongoDB 5.3. Creating Routes and 5.4. Responding. 5.5. Sequencing response By routes. 5.6. A Rest API Example 5.7. 5.5 Static files and middleware 5.8. Mongo DB Introduction 5.9. Set up MangoDB, Install Mongo client 5.10.MongoDB queries 5.11.install mongoose for node JS 5.12.The rest API example to use database	1. Study different types of trees application. 2. Explore computational geometry methods

SW-5 Suggested Sessional Work (SW):

a. Assignments:

1. Discuss the importance of Express.
2. Explain the different types of APIs used in Web development

3.Write steps to install MongoDB.

b. **Other Activities(Specify):**

Seminar and Tutorial

Brief of Hours Suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
1CS701.1: Understand Blockchain concepts, basic cryptocurrency, cryptocurrency benefits and cryptographic use in cryptocurrency.	12	6	3	2	23
1CS701.2: Use of JAVAScript knowledge to learn different types of new Frameworks available in market that are also current industry need.	13	6	3	2	24
1CS701.3: Apply the knowledge of JAVASCRIPT in ReactJS framework to create front end of dynamic webpages.	12	6	3	2	23
1CS701.4: Develop client server connectivity with the use of Node JS and use of Express frameworks.	11	6	3	2	22
1CS701.5: Design Web applications using MongoDB database with NodeJS Technology in Backend.	12	6	3	2	23
Total Hours	60	30	15	10	115

Suggestion for End Semester Assessment

Suggested Specification Table(ForESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
1CS701.1	Blockchain Technology	4	3	3	10
1CS701.2	Introduction to JavaScript	3	4	3	10
1CS701.3	ReactJS	3	3	4	10
1CS701.4	NodeJS	2	3	5	10
1CS701.5	Express & MongoDB	-	3	7	10
Total		12	16	22	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Current trends &Technology will be held with written examination of 50 marks.

Suggested Learning Resources:

a. Books:

S. No.	Title	Author	Publisher	Edition &Year
1	The Road to Learn React: Your journey to master plain yet pragmatic React.js	By Robin Wieruch.		Kindle edition & 2018
2	Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node.js,	by Shama Hoque		2nd Edition
3	Melanie Swan, "Block Chain: Blueprint for a New Economy".	O'Reilly	NationalCouncil forCementandBuildingMaterials	2015

COs, POs and PSOs Mapping

Program: B.Sc. IT
Course Code: *1CS701*
Course Title: ***Basic knowledge of HTML, CSS and JAVASCRIPT***

CourseOutcomes	ProgramOutcomes												ProgramSpecificOutcome			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct studies of difficult problems	Utilization of modern tools	Engineers and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-longlearning				
OEC-E01 - B.1: Understand Concepts of Blockchain, basic cryptocurrency, cryptocurrency benefits and cryptographic use in cryptocurrency.	1	1	2	2	3	2	3	1	2	1	3	2	2	3	1	2
OEC-E01 - B.1.2: Use of JAVAScript knowledge to learn different types of new Frameworks available in market that are also current industry need	2	1	2	2	1	2	3	1	1	1	2	2	2	2	2	2
OEC-E01 - B.3: Apply the knowledge of	2	2	1	1	1	2	2	1	1	2	3	3	1	1	2	2

JAVASCRIPT in ReactJS framework to create front end of dynamic webpages.																
OEC-E01 - B.4: Develop client server connectivity with the use of Node JS and use of Express frameworks.	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**1**	**2**	**1**	**3**	**3**	**2**	**3**	**1**	**2**
OEC-E01 - B.5:Design Web applications using MongoDB database with NodeJS Technology in Backend.	**2**	**2**	**2**	**1**	**1**	**3**	**3**	**1**	**1**	**1**	**2**	**2**	**2**	**3**	**1**	**1**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map

POs&PSOsNo.	COsNo.&Titles	Laboratory Instruction(LI)	SOsNo.	Classroom Instruction(CI)	Self-Learning (SL)
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4	CO1: Understand Concepts of Blockchain, basic cryptocurrency, cryptocurrency benefits and cryptographic use in cryptocurrency.	LI01.1,LI01. 2,LI01.3	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	Unit-1 : Block chain Technology 1.1,1.2,1.3,1.4,1.5,1.6,1. 7,1.8,1.9,1.10,1.11,1.12	
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4	CO2: Use of JAVAScript knowledge to learn different types of new Frameworks available in market that are also current industry need	LI02.1,LI02. 2,LI02.3	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	Unit-2 : Introduction to JavaScript .1,2.2,2.3,2.4,2.5,2.6, 2.7,2.8,2.9,2.10,2.11,2.12 ,2.13	
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4	CO3: Apply the knowledge of JAVASCRIPT in ReactJS framework to create front end of dynamic webpages.	LI03.1,LI03 .2,LI31.3	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	Unit-3 :ReactJS 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3 .8,3.9,3.10,3.11,3.12	Asmentioned above
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4	CO4: Develop client server connectivity with the use of Node JS and use of Express frameworks.	LI04.1,LI04. 2,LI04.3	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	Unit-4:NodeJS 4.1,4.2,4.3,4.4,4.5,4.6,4. 7,4.8,4.9,4.10,4.11,	
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4	CO5:Design Web applications using MongoDB database with NodeJS Technology in Backend.	LI05.1,LI05. 2,LI05.3	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	Unit-5:Express & MongoDB 5.1,5.2,5.3,5.4,5.5,5.6,5. 7,5.8,5.9,5.10,5.11,5.12	

Curriculum Development Team

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Course Code: **2CS701**

Course Title : **AI for Everyone**

Pre-requisite: Student should have good knowledge of mathematics, analytical skills, programming language and ability to understand complex algorithm.

Rationale: Artificial intelligence (AI) has the potential to revolutionize education by providing students with personalized learning experiences, real-time feedback, and access to a wealth of educational resources.

Course Outcomes: After completionofcourse,studentswillableto

2CS701.1 UnderstandthebasicconceptsofAIandmachine learning.
2CS701.2 Understandtheworkingofself-drivingsystems.
2CS701.3 UnderstandhowtobuilddifferentAIprojects.
2CS701.4 Evaluate the impact of AI on society.
2CS701.5 ApplyAItechniquesto anyapplication domain.

SchemeofStudies:

Board ofStudy	CourseCode	CourseTitle	Scheme of studies(Hours/Week)					TotalCredits (C)
			Cl	LI	SW	SL	Total StudyHours(CI+LI+SW+SL)	
CS	2CS701	AI for everyone	4	0	2	1	6	4

Legend:

CI: ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)andothers),
LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworkshop, field or other locations using different instructional strategies)
SW: Sessional Work(includesassignment, seminar, miniprojectetc.),
SL: SelfLearning,
C:Credits.

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Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacherto ensureoutcomeofLearning.

SchemeofAssessment:

Theory

Board of Study	Couse Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks (PRA+ ESA)**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
CS	2CS701	AI for every one	15	20	5	5	5	50	50	100

Course-CurriculumDetailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

2CS701.1 UnderstandthebasicconceptsofAIandmachine learning.

Approximate Hours

Item	AppX Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

SessionOutcomes (SOs)	LaboratoryInstruction (LI)	ClassroomInstruction (CI)	SelfLearning (SL)

SO1.1 Understand the concept of machine learning. **SO1.2** Explanation of various terminologies of AI **SO1.3** Understand non technical explanation of deep learning. **SO1.4** Understand Basics of neural network. **SO1.5** Examples and application domains of AI. .		**Unit-1.0 Introduction to Artificial Intelligence.** 1.1. Understanding definition and role of data in machine learning. 1.2. Overview of machine learning. 1.3. Learning various terminologies like deep learning, machine learning and artificial intelligence. 1.4. What do we need to establish an AI company. 1.5. What Machine Learning Can and Cannot Do. 1.6. Understanding basics of neural network like – Neurons, Layers, 1.7. Weights and Biases etc. 1.8. Learning about examples of AI like virtual assistance, 1.9. Recommendation system, 1.10. Image recognition 1.11. Natural language processing etc. 1.12. Understanding use of AI in various application domain.	1. Understand how to manipulate and prepare data for machine learning.

SW-1 SuggestedSessionalWork(SW):

b. Assignments:

i) Explore the application of AI in processing and understanding human language.
ii) Explore the societal impacts and ethical considerations of AI.

c. MiniProject:

i) Choose a dataset (e.g., from Kaggle) and load it using a Python library like Pandas. Explore the data, handle missing values, and perform basic preprocessing.

OtherActivities(Specify):

Write a short essay or create a presentation discussing the ethical considerations in AI. Address topics like bias, transparency, and accountability.

2CS701.2 Understandtheworkingofself-drivingsystems.

Approximate Hours

Item	AppX Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

SessionOutcomes (SOs)	LaboratoryInstruction (LI)	ClassroomInstruction (CI)	SelfLearning (SL)
SO2.1 To Understand the work flow in machine learning and data science projects. **SO2.2** To learn data cleaning, preprocessing,		**Unit-2 Building AI project** 2.1. Workflow of a machine learning project. 2.2. Workflow of a data science project. 2.3. how to use data 2.4. Howto choose an AI project-I 2.5. Howto choose an AI project-II 2.6. Working with an AI team. 2.7. How to process and visualize	i. Understand the organization's goal and challenges for AI projects. ii. Use libraries like Pandas for cleaning and processing data.

exploring and analyzing. **SO2.3**How to select an AI project for your company. S**O2.4**To process and visualize data. **SO2.5**Learn technical tools for AI and use of python in AI projects.		data. -I 2.8. How to process and visualize data-II 2.9. TechnicaltoolsforAIteams. -I 2.10. TechnicaltoolsforAIteams. -II 2.11. useofpython in AIrelated projects-I 2.12. useofpython in AIrelated projects-II	

SW-2 SuggestedSessionalWork(SW):

a. Assignments:

i. Explore a dataset of your choice. Clean the data, visualize key trends using graphs or charts, and perform basic statistical analysis.

ii. Create a guide or presentation on essential technical tools for AI teams.

b. **MiniProject:**

Develop a simple AI project using Python. This could be a basic machine learning model, a data analysis task, or a script to interact with an API

c. **OtherActivities(Specify):**

Form a hypothetical AI team and assign roles to each member. Develop a communication plan, set up collaborative tools, and outline a project management strategy for a given AI project.

2CS701.3 UnderstandhowtobuilddifferentAIprojects.

Approximate Hours

Item	AppX Hrs
Cl	10
LI	
SW	2
SL	1
Total	13

SessionOutcomes (SOs)	**LaboratoryInstruction (LI)**	**ClassroomInstruction (CI)**	**SelfLearning (SL)**

SO3.1A case study ofnew smart speaker with advanced AI capabilities **SO3.2**A case study of self-driving car to enhance safety. **SO3.3** Understanding example roles of an AI team. **SO3.4**AI pitfall to avoid project failure. **SO3.5**Survey of major AI application area.		**Unit-3** :**Building AI in your company.** 3.13 3.14 e goal is to case study a device that not only plays music but also understands and responds to user commands, acting as a virtual assistant. 3.15 3.16 e goal is to case study a device that not only plays music but also understands and responds to user commands, acting as a virtual assistant…continued 3.17 3.18 case study of a self-driving car to enhance safety and provide an autonomous driving experience. 3.19 3.20 case study of a self-driving car to enhance safety and provide an autonomous driving experience continued… 3.21 3.22 aluate the role of AI project team members.-I 3.23 3.24 aluate the role of AI project team members-II 3.25 3.26 derstanding AI pitfalls to avoid project failure.-I 3.27 nderstanding AI pitfalls to avoid project failure-II 3.28 nderstanding the use of AI in major application areas.-I 3.10.Understanding the use of AI in	T T A A E E U	i. Clearly outline the goals of the smart speaker, including the desired AI features. ii. Explore the motivation behind creating smart speakers.

		major application areas.-II	

SW-3 SuggestedSessionalWork(SW):

c. **Assignments:**
i. Introduce the specific smart speaker or brand you will focus on for the case study.
ii. Research and identify at least five common pitfalls associated with AI development and deployment.

d. **MiniProject:**
Explore the machine learning and AI models used in the development of smart speakers.

OtherActivities(Specify):
Speculate on potential future developments in smart speaker technology.

2CS701.4 Evaluate the impact of AI on society.

Approximate Hours

Item	AppX Hrs
Cl	14
LI	0
SW	2
SL	1
Total	17

SessionOutcomes (SOs)	LaboratoryInstruction (LI)	ClassroomInstruction (CI)	SelfLearning (SL)
SO4.1 To understand realistic view of AI. **SO4.2** Understanding the discrimination/Bi		**Unit-4 :AIandSociety** 4.1. Assessment of AI's current capabilities, 4.2. limitations and 4.3. challenges.	i. Find out areas where AI struggles, such as common-sense reasoning, ethical considerations, and the need for

as in AI **SO4.3**Understanding adversarial attacks on AI. **SO4.4**Understand adverse uses of AI. **SO4.5**Impact of AI on employment.		4.4. Define the concepts of discrimination and bias in the context of AI. 4.5. Define adversarial attacks and 4.6. their significance in the context of AI with example. 4.7. Explore the ethical implications of using AI for malicious purposes. 4.8. Explore how AI can benefit developing economies, such as improving healthcare, optimizing agriculture, and enhancing education. 4.9. Explore how AI can benefit developing economies, such as improving healthcare, optimizing agriculture, and enhancing education…continued… 4.10. Examine the impact of AI on different sectors of employment.-I 4.11. Examine the impact of AI on different sectors of employment -II 4.12. Discuss instances where AI may lead	massive amounts of data. ii. Explore how bias can emerge in AI systems

		to job displacement and 4.13. Scenarios where it contributes to job creation. 4.14. Explore how the job market may require new skill sets due to AI integration.	

SW-4 SuggestedSessionalWork(SW):

b. Assignments:

i. Highlight AI applications that have made positive impacts, such as healthcare diagnostics, language translation and automation.
ii. Explore how the job market may require new skill sets due to AI integration.

e. **MiniProject:**

Create a report to discuss potential policy interventions to manage the impact on employment, such as retraining programs and social safety nets.

f. OtherActivities(Specify):

Power Point Presentation on adverse uses of AI.

2CS701.5 ApplyAItechniquesto anyapplication domain.

Approximate Hours

Item	AppX Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

SessionOutcomes (SOs)	**LaboratoryInstruction (LI)**	**ClassroomInstruction (CI)**	**SelfLearning (SL)**
SO5.1 Explore AI case studies related to a specific domain.	**LI.5.1**Implementself-drivingvehiclealgorithm. **LI 5.2** Use techniques like one-hot encoding, scaling, and dimensionality reduction. **LI 5.3** Train a neural network using a deep learning library like TensorFlow or PyTorch.	**Unit 5: AI case studies related to a specific domain.** **5.1** Case study of medical Imaging using AI. **5.2** Case study of Retina scan using AI. **5.3** Case study of Mining surveying using AI. **5.4** Case study of AI in Share Market. **5.5** Case study of Google weather forecasting using AI. **5.6**Case study of smart watch using AI. **5.7** Case study of Tesla self driving cars using AI. **5.8** Case study of AI in vaccination development. **5.9** Case study of " HANOOMAN" BharatGPT. **5.10** Case study of AI in Airforce. **5.11** Case study of AI in Defence. **5.12**. Case study of AI in chadrayaan 3.	1.Try to study some major AI application domains like : Healthcare, finance, retail, Education, manufacturing, autonomous vehicles, Entertainment, agriculture, cybersecurity etc.

SW-5 SuggestedSessionalWork(SW):

b. Assignments:

i. Find out uses AI to make trading decisions based on market trends and historical data.

ii**.** Adapts educational content to individual student needs.

c. **MiniProject:**

Implementself-drivingvehiclealgorithm.

d. OtherActivities(Specify):

Demonstrate the versatility of AI in addressing complex challenges and optimizing processes across various industries.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
OE004.1 UnderstandthebasicconceptsofAIandmachine learning.	12	2	1	15
OE004.2 Understandtheworkingofself-drivingsystems.	12	2	1	15
OE004.3 UnderstandhowtobuilddifferentAIprojects.	10	2	1	13
OE004.4 Evaluate the impact of AI on society.	14	2	1	17
OE004.5 Apply AI techniques to any application domain.	12	2	1	15
Total Hours	60	10	5	75

Suggestion for End Semester Assessment

SuggestedSpecificationTable(ForESA)

CO	UnitTitles	MarksDistribution			Total Marks
		R	U	A	
CO-1	UnderstandthebasicconceptsofAIandmachine learning.	03	01	01	05
CO-2	Understandtheworkingofself-drivingsystems.	02	06	02	10
CO-3	UnderstandhowtobuilddifferentAIprojects.	03	07	05	15
CO-4	Evaluate the impact of AI on society.	02	08	05	15
CO-5	ApplyAItechniquesto anyapplication domain.	03	02	-	05
Total		13	24	13	50

Legend: R:Remember, U:Understand, A:Apply

TheendofsemesterassessmentforAI for everyonewillbeheld with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wiseteachers for above tasks. Teachers can also design different tasks as per requirement, for endsemesterassessment.

SuggestedInstructional/ImplementationStrategies:

1. ImprovedLecture
2. Tutorial
3. CaseMethod
4. GroupDiscussion
5. RolePlay
6. Case study on AI domain
7. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
8. Brainstorming

SuggestedLearningResources:

(a) **Books**:

S. No.	Title	Author	Publisher	Edition&Year
1	ArtificialIntelligence:AModernApproach	StuartRussell	PrenticeHall	2010
2	Artificial Intelligence:TheBasics	KevinWarwick	Routledge2011	1999

3	ArtificialIntelligenceforHumans	JeffHeaton	CreateSpaceIndependentPublishing	2015
4	https://www.coursera.org/learn/ai-for-everyone#syllabus			
5	https://www.edx.org/course/artificial-intelligence-for-everyone			

AKS University
Faculty of Basic Science
Curriculum of B. Sc. (Honours / By Research) Program
(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Program: B.Sc IT
Course Code : 2CS701
Course Title: AI for Everyone

CourseOutcomes	ProgramOutcomes												ProgramSpecificOutcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct studies of difficult problems	Utilization of modern tools	Engineers and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-longlearning				
CO 1: Understandthebasicconceptsof AI andmachine learning.	1	1	2	2	3	2	3	2	3	1	3	2	2	3	3	1
CO 2 Understand the working of self-driving systems	1	1	2	2	1	2	3	2	1	1	3	2	2	2	1	1
CO 3: Understand how to build different AI projects	2	2	1	1	1	2	2	2	1	2	1	2	1	1	3	2
CO 4: Evaluate the impact of AI on society.	3	2	2	1	3	2	3	2	2	1	2	3	2	3	3	2
CO5:UsApply AI techniques to any application domain.	-	-	-	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map

POs&PSOsNo.	COsNo.&Titles	SOsNo.	LaboratoryInstruc (LI)
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	CO 1: UnderstandthebasicconceptsofAIandmachine learning	SO1.1 SO1.2 SO1.3 SO1.4	LI1.1 LI1.2 LI1.3

		SO1.5	
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	CO 2 Understandtheworkingofself-drivingsystems	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	LI2.1 LI2.2 LI2.3
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	CO 3: UnderstandhowtobuilddifferentAIprojects	SO3.1SO3.2 SO3.3 SO3.4 SO3.5	LI3.1 LI3.2 LI3.3
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	CO 4: Evaluate the impact of AI on society.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	LI4.1 LI4.2 LI4.3
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	CO 5 ApplyAItechniquesto anyapplication domain.	SO5.1	LI5.1 LI5.2 LI5.3

Curriculum Development Team

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Course Code: 2RM702

Course Title : Research Methodology and IPR

Pre-requisite: Student should have basic knowledge of research and Statistics.

Rationale: This course will help them to select an appropriate research design. With the help of this course, students will be able to take up and implement a research project/ study. The course will also enable them to collect the data, edit it properly and analyze it accordingly.

Course Outcomes:

2RM702.1: Understand research problem formulation.
2RM702.2: Analyze research related information and Follow research ethics

2RM702.3: Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
2RM702.4: Understanding that when IPR would take such important place in growth of Individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering In particular.
2RM702.5:IPR protection incentivizes inventors to invest in R&D, leading to new and improved products, economic growth, and social benefits.

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL	
Program Core (PCC)	**2RM702**	Research Methodology and IPR	4	0	2	1	6	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performance laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	**(ESA)**	(PRA + ESA)

PCC	2RM702	Research Methodology and IPR	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1: Understand research problem formulation.

Approximate Hours

Item	Appx Hrs
Cl	11
LI	0
SW	2
SL	1
Total	14

Session Outcomes(SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)

SO1.1 Define a research problem **SO1.2** Explain Characteristics of a good research problem **SO1.3** Explain Scope and objectives of research problem **SO1.4** Discuss data collection **SO1.5** Explain analysis, interpretation .	.	**Unit-1Introduction to Research** 1.1 Meaning of research problem, 1.2 Sources of research problem 1.3 Criteria Characteristics of a good researchproblem, 1.4 Errors in selecting a research problem 1.5 Scope of research problem. 1.6 objectives of research problem. 1.7 Approaches of investigation of solutions for research problem 1.8 data collection, 1.9 data analysis, 1.10 data interpretation, 1.11 Necessary instrumentations-1	3. Write a Process of research problem identification

SW-1 Suggested Sessional Work (SW):

a. Assignments:
   (i) Discuss aboutErrors in selecting a research problem

b. Presentation

c. Pictorial representation of different components of computer

CO2: Analyze research related information and Follow research ethics

Approximate Hours

Item	Appx Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 To Understand Effective literature studies. SO2.2 To learn different approaches. SO2.3 Explain Plagiarism. SO2.4 Explain research ethics.	.	**Unit-2 : Literature Review** 2.1 Literature review 2.2 How to write literature reviews 2.3 Effective literature studies 2.4 Approaches to literature studies 2.5 Analysis 2.6 References and bibliography 2.7 APA/MLA and other reference styles 2.8 Plagiarism, 2.9 **Types of plagiarism** 2.10 **Plagiarism tools** 2.11 Research ethics-1 2.12 Research ethics-2	1.Write a Review

SW-2 Suggested Seasonal Work (SW):

a. Assignments:
   (i) Write the different approaches of analysis?

b. **Presentation**

c. **Pictorial representation of different components of research design?**

CO3: Understand that today'sworldis controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity

Approximate Hours

Item	Appx Hrs
Cl	11
LI	0
SW	2
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO3. 1 To understand Effective technical writing, SO3.2 know the Format of research proposal SO3.3 Develop a Research Proposal SO3.4 know about presentation of research proposal SO3.5 To understand the assessment of research proposal.		**Unit-3:Research Proposal** 3.1 **Research Proposal** 3.2 **types** 3.3 Effective technical writing-1 3.4 Effective technical writing-2 3.5 How to write report, 3.6 How to write report, research Paper. 3.7 Developing a Research Proposal, 3.8 Format of research proposal 3.9 Write a research proposal 3.10 presentation 3.11assessment by a review committee	**i. Design a research proposal**

SW-2 Suggested Seasonal Work (SW):

a. Assignments:
   (i) Explain writing a project proposal?
b. Presentation
c. Pictorial representation of different components of computer

CO4: Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

Approximate Hours

Item	Appx Hrs
Cl	13
LI	0
SW	2
SL	1
Total	16

Session Out comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 To Understand Nature of Intellectual Property **SO4.2** To understand Patents, Designs, Trade and Copyright **SO4.3** Explain the process of patenting **SO4.4** Tounderstand the development of technological research **SO4.5** To Understand Procedure for grants of patents, Patenting under PCT.	.	**Unit-4 : Intellectual Property** 4.1 Nature of Intellectual Property. 4.2 Patents, 4.3 Designs, 4.4 Trade and 4.5 Copyright 4.6 Process of Patenting and 4.7 Development technological research 4.8 innovation, 4.9 patenting, 4.10 development. 4.11 International cooperation on Intellectual Property 4.12 Procedure for grants of patents, 4.13 Patenting under PC	i. Prepare a intellectual property proposal ii. Draw a classification diagram of RAID

SW-4 Suggested Seasonal Work (SW):

a. Assignments:
b. (i) Write the process of patent design
c. **Presentation**
d. **Pictorial representation of different steps of patent design.**

CO5:IPR protection incentivizes inventors to invest in R&D, leading to new and improved products, economic growth, and social benefits.

Approximate Hours

Item	Appx Hrs
Cl	13
LI	0
SW	2
SL	1
Total	16

Session Outcomes(SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1 ExplainPatent Rights **SO5.2** Discuss Licensing and transfer of technology **SO5.3**Discuss aboutPatent informationand databases **SO5.4** Understand Geographical Indications **SO5.5**Explain new developments in IPR		**Unit5: IPR protection and Developments in IPR** 5.1 Patent Rights-1 5.2 Patent Rights-2 5.3 Scope of Patent Rights 5.4 Licensing and transfer of technology-1 5.5 information and databases-1 5.6 Geographical Indication 5.7 Administration of Patent System. 5.8 New developments in IPR; 5.9 IPR of Biological Systems, 5.10 IPR of Computer Software etc. 5.11 Traditional knowledge 5.12 Case Studies, 5.13 IPR and IITs	i. Learn about scope of patent rights ii. Learn about IPR

SW-5Suggested Seasonal Work(SW):

a. Assignments:
   (i) Explain in detail about geographical indications.

b. **Presentation:**

c. Other Activities (Specify):
   (i) Group discussion of important topics.

CO5: To better products, and in turn brings about, economic growth and social benefitsApproximate Hours

Item	AppXHrs
Cl	7
LI	0
SW	2
SL	2
Total	11

Session Outcomes (SOs)	**LaboratoryInstruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO6.1 Understand Administration of Patent System **SO6.2** Explain new developments in IPR **SO6.3**Discuss aboutIPR of Biological Systems, Computer Software etc. **SO6.4** Understand Traditional knowledge Case Studies, IPR and IITs.		**Unit6:New Developments in IPR** 6.1 Administration of Patent System. 6.2 New developments in IPR; 6.3 IPR of Biological Systems, Computer Software etc. 6.4 Traditional knowledge 6.5 Case Studies, IPR and IITs	iii. Learn about IPR

SW-5Suggested Seasonal Work(SW):

d. Assignments:
Write a case study on Patents.

e. **Presentation:**

f. Other Activities (Specify):Group discussion

BriefofHours suggested fortheCourseOutcome

CourseOutcomes	ClassLecture (Cl)	SessionalWork (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
CO1 Understand research problem formulation	11	2	1	14
CO2 Analyze research related information and Follow research ethics	11	2	1	14
CO3 Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.	12	2	1	15
CO4 Understanding that when IPR would take such important place in growth of Individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering In particular.	13	2	1	16
CO5IPR protection incentivizes inventors to invest in R&D, leading to new and improved products, economic growth, and social benefits.	13	2	1	16
Total Hours	60	10	6	76

Suggestion for End Semester Assessment

Suggested Specification Table (ForESA)

CO	Unit Titles	MarksDistribution			TotalMarks
		R	U	A	
CO-1	Unit-1	03	02	03	08
CO-2	Unit-2	03	01	05	09
CO-3	Unit-3	03	07	02	12

CO-4	Unit-4	03	05	05	13
CO-5	Unit-5	03	02	03	08
Total		15	17	18	50

Legend: R: Remember, U: Understand, A:Apply

TheendofsemesterassessmentforResearch Methodology & IPRwillbeheld with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wiseteachers for above tasks. Teachers can also design different tasks as per requirement, for endsemesterassessment.

SuggestedInstructional/ImplementationStrategies:

1. ImprovedLecture
2. Tutorial
3. CaseMethod
4. GroupDiscussion
5. RolePlay
6. Data center
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Face book, Twitter,WhatsApp,Mobile,Onlinesources)
9. Brainstorming

SuggestedLearningResources:

A. Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Research Methodology	C R Kothari ,Gaurav Garg	New Age International	2023
2	Research Methodology: Concepts And Cases	Deepak Chawla (Author), Neena Sondhi (Author)	Vikas Publishing House	May 2016

B. Alternative NPTEL/SWAYAM/MOOC Course (if any): NA

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AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

COs,POs and PSOs Mapping

Course Title: B.Sc. IT

Course Code: 2RM702

Course Title:Research Methodology and IPR

CourseOutcomes	ProgramOutcomes												ProgramSpecificOutcome			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct studies of difficult problems	Utilization of modern tools	Engineers and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-longlearning				
2RM702.1 At the end of this chapter the student will Understand research problem formulation.	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1
2RM702.2 At the end of this chapter the student will Analyze research related information and Follow research ethics	1	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1
2RM702.3 At the end of this chapter the student will Understand that today's world	3	2	2	2	3	2	3	2	2	1	2	3	3	3	3	2
2RM702.4 At the end of this chapter the student will know about Intellectual Property Right	-	-	-	1	1	3	3	3	1	1	2	2	3	3	1	3

2RM702.5 at the end of this chapter the student will Understand that IPR protection	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map

POs&PSOsNo.	COsNo.&Titles	SOsNo.	LaboratoryInstruction (LI)	Classroom Instruction(CI)	Self-Learning(SL)
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	**CO1** At the end of this chapter the student will Understand research problem formulation.	SO1.1 SO1.2 SO1.3 SO1.4		Unit-1 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11	Asmentioned above
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	**CO2** At the end of this chapter the student will Analyze research related information and Follow research ethics	SO2.1 SO2.2 SO2.3 SO2.4		Unit-2 2.1, 2.2, 2.3, 2.4, 2.5,2.6,2.7,2.8,2.9,2.10,2.11	
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	**CO3** At the end of this chapter the student will Understand that today's world	SO3.1 SO3.2 SO3.3 SO3.4		Unit-3 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11,3.12	
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	**CO4** At the end of this chapter the student will know about Intellectual Property Right	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12,4.13	
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	**CO5** at the end of this chapter the student will Understand that IPR protection	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit-5 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11,5.12,5.13	

Curriculum Development Team

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Course Code: 1MS701

Course Title: Jacobi Polynomial and H-Function

Pre-requisite: Higher knowledge of mathematics.

Rationale: Theaimofthecourseistointroducetothefieldofmathematicswithemphasisonitsusetosolverealworldproblemsforwhichsolutionsaredifficulttoexpressusingthe different methods. Itexplorestheessentialtheorybehindmethodsfordevelopingsystemsthatdemonstrateintelligentbehaviorincludingdealingwithuncertainty,learningfromexperienceandfollowingproblem-solving strategies founding nature.

Course Outcomes:

CO-1MS701.1: Understanding of special functions and their importance in various mathematical and physical applications.

CO-1MS701.2: Using Jacobi polynomials as a basis and apply them to various mathematical and physical problems.

CO-1MS701.3: Understand the concept of applied in manipulating and solving problems involving the H-function.

CO-1MS701.4: Understand the concept of integral transforms, specifically the H-transform, and its use in solving integral equations.

CO-1MS701.5: Understanding of fractional calculus and its importance in modelling complex systems with fractional derivatives and integrals.

AKS University
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Curriculum of B. Sc. (Honours / By Research) Program
(Revised as on 01 August 2023)

SchemeofStudies:

Board ofStudy	CourseCode	CourseTitle	Scheme ofstudies(Hours/Week) CI	LI	SW	SL	Total Study Hours(CI+LI+SW+SL)	Total Credits(C)
ProgramCore	1MS701	Jacobi Polynomial and H-Function	6	0	1	1	6	6

Legend:
CI: ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)andothers),
LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworkshop,fieldorotherlocationsusingdifferentinstructionalstrategies)
SW: SessionalWork(includesassignment,seminar,miniprojectetc.),
SL: SelfLearning,
C: Credits.

Note:
SW&SLhastobeplannedandperformedunderthecontinuousguidanceandfeedback ofteacherto ensure outcome ofLearning.

SchemeofAssessment:

Theory

Board of Study	Course	CourseTitle	SchemeofAssessment(Marks) Progressive Assessment (PRA) Class/HomeAssignment5 number 3 markseach	Class Test2(2bestout of3)10 markseach(CT)	Seminarone	Class Activityonone (CAT)	ClassAttendance (AT)	TotalMarks (CA+CT+SA+CAT+AT)	EndSemester Assessment (ESA)	TotalMarks (PRA+ESA)
P	1M	Jacobi Polynomial	1	20	5	5	5	50	5	100

CC	S701		5						0	

Course-CurriculumDetailing:

This course syllabus illustrates the expected learning achievements, both at the course and sessionlevels, which students are anticipated to accomplish through various modes of instruction includingClassroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self-Learning (SL). Asthecourseprogresses,studentsshouldshowcasetheirmasteryofSessionOutcomes (SOs),culminatingintheoverallachievementof CourseOutcomes (COs) uponthecourse's conclusion.

CO-1MS701.1:Understanding of special functions and their importance in various mathematical and physical applications.

ApproximateHours

Item	AppXHrs
Cl	12
LI	0
SW	2
SL	1
Total	15

SessionOutcomes (SOs)	**LaboratoryInstruction (LI)**	**ClassroomInstruction (CI)**	**Self-Learning (SL)**
SO1.1 Understand the concept of Jacobi polynomial **SO1.2**Understand the concept of special function	.	**Unit-1.0** Jacobi polynomial 1.55 Introduction 1.56 Recurrence relation 1.57 Examples of recurrence relation 1.58 Rodrigue’s formula 1.59 Examples of Rodrigues formula 1.60 Generating functions 1.61 Examples of	4. Writes special functions and their importance

		generating function 1.62 Orthogonal properties 1.63 Expansions of polynomials. 1.64 Uses of recurrence relation. 1.65 Uses of properties 1.66 Solve polynomials	

SW-1SuggestedSessionalWork(SW):

Assignments:

i. Numerical based on Jacobi polynomial.
ii. Numerical based on recurrence relation
iii. Solve related example generating function

CO-1MS701.2:Using Jacobi polynomials as a basis and apply them to various mathematical and physical problems.

ApproximateHours

Item	AppXHrs
Cl	12
LI	0
SW	2
SL	1
Total	15

SessionOut comes (SOs)	**LaboratoryInstru ction (LI)**	**ClassroomInstru ction (CI)**	**Self-Lear ning (SL)**

SO2.1 Understand the concept variable **SO2.2**Understand the concept of Differentiation	.	**Unit-2.0 H** Functionon one variable 2.1. Definition and notation. 2.2. Related examples 2.3. Differentiation formulas 2.4. Related examples 2.5. Partial derivatives 2.6. Examples of partial derivatives 2.7. Parameters 2.8. Parameter related examples 2.9. Expansion formula 2.10. Solve partial differential 2.11. Uses of parameters 2.12. Solve expansion formula	1. Writes examples of one variable 2. Solve Partial derivativeswith examples.

SW-1SuggestedSessionalWork(SW):

Assignments:

iv. Numerical based differentiationFunction.
v. Numerical based on partial derivatives.
vi. Examples of expansion formula.

CO-1MS701.3:Understand the concept of applied in manipulating and solving problems involving the H-function.

ApproximateHours

Item	AppXHrs
Cl	12
LI	0
SW	2
SL	1
Total	15

SessionOutcomes (SOs)	**LaboratoryInstruction (LI)**	**ClassroomInstruction (CI)**	**Self-Learning (SL)**
SO3.1 Understand the concept of partial two variables **SO3.2**Usesof properties and functions	.	**Unit-3.0** The H Functions of two variables 3.1. Definition and notation. 3.2. Related examples 3.3. Examples of two variables, 3.4. elementary properties 3.5. Related examples of elementary properties 3.6. Uses of elementary properties 3.7. Special cases 3.8. Examples of special cases 3.9. Uses of special cases 3.10. Definitions 3.11. Elementary examples 3.12. Two variables examples	1. Writes examples of two variables 2. Writes examples of special cases.

SW-1SuggestedSessionalWork(SW):

Assignments:

vii. Numerical based on two variables.
viii. Numerical based on elementary properties
ix. Writes related examples special cases.

CO-1MS701.4:Understand the concept of integral transforms, specifically the H-transform, and its use in solving integral equations.

ApproximateHours

Item	AppXHrs
Cl	12
LI	0
SW	2
SL	1
Total	15

SessionOutcomes (SOs)	**LaboratoryInstruction (LI)**	**ClassroomInstruction (CI)**	**Self-Learning (SL)**
SO4.1 Understand the concept of H-Functions **SO4.2**Application of H-Functions **SO4.3** How to learn one and two variable on H-Functions	.	**Unit-4.0** Finite Summation formulas 4.1. H- Functions of two variables 4.2. Examples of H- function 4.3. Derivatives 4.4. Related examples of derivatives 4.5. Examples of H- Functions of two variables 4.6. Contiguous relations 4.7. Example of contiguous relation 4.8. Total Count of recurrences. 4.9. Example of Total Count of recurrences. 4.10. Basic H function 4.11. Derivation examples 4.12. Examples of H functions	1. H-Functions of two variables

SW-1SuggestedSessionalWork(SW):

Assignments:

i. Questions based on H- Functions.
ii. Questions based on Count of recurrences.
iii. Questions based on one and two variables.

CO-1MS701.5: Understanding of fractional calculus and its importance in modeling complex systems with fractional derivatives and integrals.

ApproximateHours

Item	AppXHrs
Cl	12
LI	00
SW	02
SL	01
Total	15

SessionOutcomes (SOs)	**LaboratoryInstruction (LI)**	**ClassroomInstruction (CI)**	**Self-Learning (SL)**
SO5.1 Understand the concept of finite and infinite series **SO5.2**uses some method to solve the examples.	.	**Unit-5.0** Method and schemes 5.1. Writes different methods 5.2. sum of finite series. 5.3. sum of infinite series. 5.4. Examples of finite series 5.5. Uses of finite and infinite series 5.6. Example of infinite series 5.7. Double summation formulas 5.8. Uses of summation formula 5.9. Example of double summation formula 5.10. Uses of finite series 5.11. Uses of infinite series 5.12. Uses of Double summation	1. Method for obtaining sum of finite or infinite series.

SW-1SuggestedSessionalWork(SW):

Assignments:

iDifferent types of methods

ii.Writes Examples of finite and infinite series.

Brief of Hours suggested for the Course Outcome:

CourseOutcomes	**ClassLecture (Cl)**	**SessionalWork (SW)**	**Self-Learning (Sl)**	**Total hour(Cl+SW+Sl)**
CO-1MS701.1:Understanding of special functions and their importance in various mathematical and physical applications.	12	02	01	15
CO-1MS701.2:Using Jacobi polynomials as a basis and apply them to various mathematical and physical problems	12	02	01	15
CO-1MS701.3:Understand the concept of applied in manipulating and solving problems involving the H-function.	12	02	01	15
CO-1MS701.4:Understand the concept of integral transforms, specifically the H-transform, and its use in solving integral equations.	12	02	01	15

CO-1MS701.5 :Understanding of fractional calculus and its importance in modeling complex systems with fractional derivatives and integrals.	12	02	01	15
TotalHours	60	10	5	75

SuggestionforEndSemesterAssessment

SuggestedSpecificationTable(ForESA)

CO	**UnitTitles**	**MarksDistribution**			**TotalMarks**
		R	**U**	**A**	
CO -1	Jacobi polynomial	03	02	03	08
CO -2	The H Functions of one variables	03	01	05	09
CO -3	The H Functions of two variables	03	07	02	12
CO -4	Finite Summation formulas	03	05	05	13
CO -5	Method and schemes	03	02	03	08
Total		15	17	18	50

Legend: R:Remember, U:Understand, A:Apply

Note.DetailedAssessmentrubricneedtobepreparedbythecoursewiseteachersforabovetasksTeacherscanalsodesigndifferenttasksasperrequirement,forendsemesterassessment.

SuggestedInstructional/ImplementationStrategies:

10. ImprovedLecture
11. Tutorial
12. CaseMethod
13. GroupDiscussion
14. RolePlay
15. Visittocementplant
16. Demonstration
17. ICTBasedTeachingLearning(VideoDemonstrat

ion/TutorialsCBT,Blog,Facebook, Twitter,WhatsApp,Mobile,Onlinesources)

18. Brainstorming
19. SuggestedLearningResources:

C. Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Special Functions	Rainville. E.D.	The Macmillan Co. New. York.	1971
2	The H- Functions of One and Two Variables with applications.	Shrivastava. H.M., Gupta K.C. and Goyal. S.P.	South Asian Publication New Delhi	-
3	The H-Function: Theory and Applications	A.M. Mathai and R.K. Saxena.	-	-
4	Special functions and Their Applications.	Lebdev. N.N.	Prentice Hall. Englewood Hall phase new Jersy USA	1965

CO, PO and PSO Mapping

CourseTitle: B.Sc. Mathematics
Course Code: -CO-1MS701
Course Title: Jacobi polynomial and H- Function

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO 1	PO 2	PO3	PO4	PO5	PO 6	PO7	PO 8	PO 9	PO10	PO1 1	PO12	PSO 1	PSO 2	PSO 3	PSO4
	Engineering knowledge	Problem Analysis	Design/development of solutions	Conduct studies of difficult problems	Utilization of modern tools	Engineers and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply knowledge	Ability to understand of problems	Ability to understand & technology	Ability to use research and innovation
CO1	3	2	2	2	2	1	1	1	1	1	1	3	2	2	3	3
CO2	2	3	3	2	2	2	1	1	1	1	1	3	2	3	2	3
CO3	3	2	3	3	2	2	1	1	1	1	1	3	2	2	2	3

CO4	3	3	3	2	2	2	1	1	1	1	1	3	2	2	3	2
CO5	3	2	3	2	2	2	1	1	1	1	1	3	2	2	3	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs&PSOsNo.	CosNo.&Titles	SOsNo.	LaboratoryInstruction(LI)	Classroom Instruction(CI)	SelfLearning(SL)
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	**CO1:Understanding of special functions and their importance in various mathematical and physical applications.**	SO1.1 SO1.2		Unit-1.0 Jacobi polynomial 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11,1.12	
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO2:Using Jacobi polynomials as a basis and apply them to various mathematical and physical problems	SO2.1 SO2.2		Unit-2 The H Functions of one variables 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9,2.10,2.1	

				1,2.12	
PO: 1,2,3,4,5,6 ,7,8,9,10,1 1,12 PSO: 1,2,3,4	**CO3: Understand the concept of applied in manipulating and solving problems involving the H-function.**	SO3.1SO3.2 SO3.3		Unit-3 :The H Functions of two variables 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.1 1,3.12	
PO: 1,2,3,4,5,6 ,7,8,9,10,1 1,12 PSO: 1,2,3,4	**CO4:Understand the concept of integral transforms, specifically the H-transform, and its use in solving integral equations.**	SO4.1 SO4.2 SO4.3		Unit-4: Finite Summation formulas 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10, 4.11,4.12	

PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO5:Understanding of fractional calculus and its importance in modeling complex systems with fractional derivatives and integrals.	SO5.1 SO5.2		Unit5:Method and schemes5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11,5.12	

Curriculum Development Team

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Course Code:	2MS702
Course Title :	Real Analysis
Pre- requisite:	Students should have basic knowledge of and deep understanding of the theory of the functions of real variables. and Riemann-StieltjesIntegral
Rationale:	The program aims to develop advanced problem-solving and analytical skills and prepares students for careers in academia, research, industry, or other sectors that require advanced mathematical expertise.

CO1-2MS702.1 Understand the importance of properties of Riemann-Stieltjes integrals

CO2-2MS702.2 Determine the Rearrangements of terms of a series

CO3-2MS702.3 Demonstrate an understanding of the theory of sequence and Students will be able to describe all elements in Uniform Convergence of Sequence

CO4-2MS702.4 Define and recognize the series and Students will compute the expression of Linear transformations.

CO5-2MS702.5 Students will create the concept of a Differential forms,Stoke'stheoremto sequences, and series,

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Program Core (PCC)	2MS702	Real Analysis	4	0	1	1	6	4

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional

strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA+ ESA)
			Class/Home	Class	Seminar	Class	Class	Total		

			Assignment 5 number 3 marks each (CA)	Test 2 (2 best out of 3) 10 marks each (CT)	one (SA)	Activity any one (CAT)	Attendance (AT)	Marks (CA+CT+SA +CAT+ AT)		
PCC	2MS702	Real Analysis	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1-2MS702.1 Understand the importance of Understand the concept of Riemann-Stieltjes Integral

Approximate Hours

Item	AppXHrs
Cl	14
LI	0
SW	1
SL	1
Total	16

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO1.1 Understand the concept of Riemann-Stieltjes Integra l**SO1.2** Understand the Properties of the Riemann Stieltjes Integral **SO1.3** Understand The fundamental theorem **SO1.4** Understand the Rectifiable Curves **SO1.5** Understand the Mean value theorem		**Unit-1.0** **1.1** Introduction of Riemann-Stieltjes Integral, **1.2** Some theorems on Riemann-Stieltjes Integral, **1.3** Riemann-StieltjesIntegral,as limit of sum **1.4** Some classes of Riemann-Stieltjesfunction. **1.5** Properties of the Riemann-Stieltjes Integral, **1.6** Integration **1.7** differentiation, **1.8** The fundamental theorem of calculus **1.9** Tutorial 1 **1.10** Mean value theorem **1.11** Integration of vector valued function **1.12** Rectifiable Curves-Introduction **1.13** Rectifiable Curves-theorems	**SL.1** Theorems on Riemann Stieltjes Integrals

		1.14 Tutorial 2	

SW-1 Suggested Sessional Work (SW):

a. Assignments:
i. State and prove fundamental theorem of calculus
ii. State and prove Mean Value theorem
iii. Properties of R S Integral.
iv. Theorems on Rectifiable Curve
b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO2-2MS702.2 determine Rearrangements of terms of a series

Approximate Hours

Item	AppXHrs
Cl	5
LI	0
SW	1
SL	1
Total	7

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning
SO2.1A Relation between the Riemann		**Unit2.0**	**(SL.1)** Some examples on Riemann's

Integral and RS Integral, SO2.2Rearrangements of terms of a series, SO2.3Riemann's		2.1A Relation between the Riemann Integral and Riemann stieltjes Integral, 2.2 Tutorial 1 2.3 Rearrangements of terms of a series 2.4 Tutorial 2 2.5 Riemann's theorem	

SW-2 Suggested Sessional Work (SW):
a. Assignments:
i. The sum of an absolute convergent series does not alter with any rearrangements of terms.
ii. State and prove Riemanns theorems
iii. some theorems on Riemanns

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO3-2MS702.3 Students will be able to describe all elements in Uniform Convergence of Sequence

Approximate Hours

Item	AppXHrs
Cl	15
LI	0
SW	1

SL	1
Total	17

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**

SO3.1 Understand the Cauchy criterion for uniform convergence SO3.2 Understand the Power series, SO3.3 Understand the Radius of Convergence SO3.4Understand the Radius of Convergence		**Unit-** **3.0** 3.1 Sequence and Series of function, 3.2 Point wise convergence in a metric space 3.3Pointwise and uniform convergence of sequence. 3.4 Cauchy criterion for uniform convergence, 3.5Test for uniform convergence 3.6 Weierstrass M-Test, 3.7 Abel's test 3.8 Direchlets test 3.9 Uniform convergence and continuity, 3.10Weierstrass'sapproximation theorem, 3.11Power series, 3.12Uniqueness for power series, 3.13Radius of Convergence of power series, 3.14Abel's theorem, 3.15Tauber's theorem.	**SL.1**Algebra of Power Series

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. state and prove Tauber's theorem.

ii. State and prove Weierstrass's approximation theorem
iii. State and prove Cauchy 's general principle.

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO4-2MS702.4 Students will compute the expression of Linear transformations

Approximate Hours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO4.1 Understand the linear transformations SO4.2 Understand the Taylor's theorem SO4.3 Understand the Inverse function theorem		**Unit-4.0** 4.1 Linear transformation, 4.2 Derivatives in an open subset of R^n, 4.3Chain rule of Differentiation, 4.4Interchange of order of Differentiation, 4.4 Derivatives of	**SL.1** Properties of Linear transformation

		higher order, 4.5 Taylor's theorem, 4.6 Inverse function theorem, 4.7The Implicit function theorem 4.8 Derivatives of higher order 4.9 interchange of order of differentiation 4.10 Tutorial 1 4.11 Repeated partial derivatives 4.12 Tutorial 2	

SW-4 Suggested Sessional Work (SW):
a. Assignments:
i. Taylor's theorem
ii. Inverse function theorem
iii. The Implicit function theorem

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO5-2MS702.5
Students will create the concept of a Differential forms,Stoke's theorem.

Approximate Hours

Item	AppXHrs

Cl	14
LI	0
SW	1
SL	1
Total	16

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO5.1 Understand the concept of Jacobian **SO5.2** Understand the Properties of the Extremum problem **SO5.3** Understand The Differentiation of Integrals **SO5.4** Understand The Stoke's theorem		**Unit-5.0** 5.1Jacobian 5.2 Jacobian of Functions of functions 5.3 Jacobian of implicit functions, 5.4 Extremum problem with constraints, 5.5Lagrange's multiplier method, 5.6 Differentiation of Integrals 5.7Differential forms- Introduction 5.8 Elementary Properties 5.9 Basic K- forms 5.10 Product of basic K form 5.11 Tutorial 5.12Stoke's theorem- statement 5.13Stoke's theorem- Proof	**SL.1** Examples Lagrange's multiplier method.

		5.14 Tutorial 2	

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
CO1-2MS702.1 Understand the importance of Riemann-Stieltjes Integral .	14	1	1	16
CO1-2MS702.2 Determine the Rearrangements of terms of a series	5	1	1	7
CO1-2MS702.3 Students will be able to describe all elements in Uniform Convergence of Sequence	15	1	1	17
CO1-2MS702.4 Students will compute the expression of Linear transformations.	12	1	1	14
CO1-2MS702.5 Students will create the concept of a Differential forms,Stoke’s theorem	14	1	1	16

Total Hours	60	5	5	70

Suggest for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**					**Total Marks**
		R	**U**	**A**			
CO-1	Understand the importance of Riemann-Stieltjes Integral .	03	01	01			05
CO-2	Determine the Rearrangements of terms of a series	02	06	02			10
CO-3	Students will be able to describe all elements inUniform Convergence of Sequence .	03	07	05			15
CO-4	Students will compute the expression of Linear transformations.	-	10	05			15
CO-5	Students will create the concept of a Differential forms,Stoke's theorem	03	02		-		05
Total		11	26		13		50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies

1. Improved Lecture
2. Tutorial
3. Presentation
4. Group Discussion
5. Online sources
6 .Seminar
7. Workshop

Suggested Learning Resources:

a) Books :

S.No.	Title	Author	Publisher	Edition & Year
1	Real Analysis-I	Dr.H.K.Pathak	Shree Sahitya Siksha Prakashan, Meerut.	2018
2	Real Analysis	S. C. Malik	Willey Eastern Ltd.,ew Delhi, 1985.	
3	Real Analysis,.	N. L. Carothers,	Cambridge University Press, UK, 2000	
4	Elementary Analysis:	Kenneth A. Ross	The theory of Calculus, Springer, New York, 2004.	
5	Principles of Mathematical Analysis	Walter Rudin	3 rd Edition, McGraw – Hill International Book Company, Singapore, 1982	

Cos,POs and PSOs Mapping

Course Title: B.Sc(VII) (Mathematics)
Course Code :2MS702
Course Title: Real Analysis

Course Outcome	PO1	PO2	PO3	PO 4	PO5	PO 6	PO7	PO8	PO9	PO1 0	PO 11	PO1 2	PSO 1	PS O 2	PSO 3	PS O 4
	Advanced Mathematical Knowledge	Problem-solving Skills	Research Abilities	Quantitative Analysis	Teaching and Academia	Theoretical Understanding	Communication Skills	Operations Research	Application in Industry	Engineering and Technology	Government and Public Sector	Consulting	Understand the mathematical concepts and applications in the field of algebra	Handle the advanced techniques	Develop necessary skills and expertise in the field of research	Creates Mathematical Models
CO1-2MS702.1 Understand the importance of Understand	2	3	1	2	1	2	2	2	1	1	1	1	2	1	1	

the concept of Riemann-Stieltjes Integral .																
CO2-2MS702.2 Determine the Rearrangements of terms of a series	1	3	2	1	1	1	1	1	1	1	1	1	1	1	1	
CO3-2MS702.3 Students will be able to describe all elements in Uniform Convergence of Sequence .	2	3	1	1	1	1	3	2	2	1	2	2	1	2	1	
CO4-2MS702.4 Students will	2	3	1	2	3	2	1	1	1	1	1	2	2	1	1	

compute the expression of Linear transformations.																
CO5-2MS702.5 Students will create the concept of a Differential forms, Stoke's theorem	1	2	3	2	2	2	2	2	1	1	1	1	1	1	1	

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO1-2MS702.1** Understand the importance of properties of Riemann-Stieltjes integrals	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 Riemann-Stieltjes Integral 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9.1.10,1.11,1.12, 1.13,1.14	SL1.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO2-2MS702.2** Rearrangements of terms of a series	SO2.1 SO2.2 SO2.3		Unit-2 Rearrangements of term of series 2.1, 2.2, 2.3, 2.4,2.5	SL2.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO3-2MS702.3** Students will be able to describe all elements in Uniform Convergence of Sequence	SO3.1 SO3.2 SO3.3 SO3.4		Unit-3 Uniform Convergence of Sequence 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8,3.9,3.10,3.11,3.12,3.13,2.14,3.15	SL3.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO4-2MS702.4** Students will compute the expression of Linear transformations	SO4.1 SO4.2 SO4.3		Unit-4 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7,4.8,4.9,4.10,4.11,4.12	SL4.1
PO 1,2,3,4,5,6	**CO5-2MS702.5** Students will	SO5.1		Unit-5	SL5.1

7,8,9,10,11,12 PSO 1,2, 3, 4	create the concept of a Differential forms, Stoke's theorem	SO5.2 SO5.3 SO5.4		5.1, 5.2, 5.3, 5.4, 5.5, 5.6,5.7,5.8,8.9,5.10,5.11, 5.12,5.13,5.14	

Curriculum Development Team

1. Dr.Sudha Agrawal, HOD, Department of Mathematics.
2. Dr.Ekta Shrivastava , Assistant Professor, Department of Mathematics.
3. Mr.Neelkanth Napit, Assistant Professor, Department of Mathematics.
4. Mrs.Vandana Soni, Assistant Professor, Department of Mathematics.
5. Mr.Radhakrishna Shukla, Assistant Professor, Department of Mathematics.
6. Mr.Ghanhyam sen, Assistant Professor, Department of Mathematics.
7. Ms. Pushpa Kushwaha, Assistant Professor, Department of Mathematics.
8. Ms. Arpana Tripathi, Assistant Professor, Department of Mathematics.

Course Name: Research Methodology
Course Code: 2MH702

Pre-requisite: Students must have fundamental knowledge of precision and accuracy, types of error, data collections, mean, median and mod etc to understand the concept of research program and its methodology.

Rationale: The rationale for choosing a specific research methodology is crucial as it provides a solid foundation for the entire research process. The choice of methodology should align with the research objectives and questions, guiding the researcher in collecting, analyzing, and interpreting data.

Course Outcomes:
After the completion of this course, the learner will able to

2MH702.1: Discuss the purpose of research, research process and research design by acquiring the knowledge of types and method of research.

2MH702.2: Conceptualize and design research projects, including selecting appropriate data collection methods and planning for subsequent analysis.

2MH702.3: Explain the processing and analysis of data with the skills and knowledge necessary to manage and analyze data effectively.

2MH702.4:Understand a foundational understanding of the ethical considerations, philosophical principles, and standards of scientific conduct that are crucial in various fields of study.

2MH702.5: Explain of the ethical considerations and standards related to publishing academic and research work.

UNIT-I (2MH702.1): Introduction & Research design

Nature and objectives of research, Methods of Research: historical, descriptive and experimental. Types of Research, Research process, research approaches, criteria for good research meaning of research design .

UNIT II (2MH702.2): Data Collection & Analysis

Types of data, methods and techniques of data collection, Hypothesis Testing, primary and secondary data, meta analysis, historical methods, content analysis, devices used in data collection.

UNIT III (2MH702.3): Processing and analysis of data

Measures of central Tendency. Measures of dispersion. Measures of variation. Measures of central tendency vs. measures of dispersion. Normal distribution. Measures of skewness and Interpretation. Correlation and regression: types & application. Chi-square test its purpose and use.

UNIT IV (2MH702.4): Philosophy, Ethics & Scientific conduct

Introduction to philosophy: definition, nature and scope, concept, branches, Ethics: definition, moral philosophy, nature of moral judgements and reactions, Ethics with respect to science and research Intellectual honesty and research integrity, *UNIT V (2MH702.5): Publication Ethics*

Publication ethics: definition, introduction and importance , Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest Pblication misconduct: definition, concept, problems that lead to unethical behavior and vice versa.

Reference Book
Research in Education, 10th Edition, Best &
KahnResearch Methodology C.R.KOTHAR
Methodology of Educational Research, Lokesh

KoulSUGGESTED WEB SOURCES

- https://nptel.ac.in/course.html
- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5
- https://swayam.gov.in/explorer?category=Chemistry

Mode OF Transaction:Lecture,demonstration,E-tutoring,discussion,assignments,quizzes, case study, power point; LMS/ICT Tools**:** Digital Classrooms, DLMS, ZOOM, G-Suite,MSPower-Point, Online Resources.

Mappingof COandPO for 76CH-

2MH702 Scheme of Studies:

Board ofStudy	**CourseCode**	**CourseTitle**	**Scheme ofstudies (Hours/Week)**					**Total Credits(C)**
			Cl	**LI**	**SW**	**SL**	**Total Study Hours(CI+LI+SW+SL)**	
ProgramCore(PCC)	2MS702	Research Methodology & Research Ethics	4	0	1	1	4	4

Legend : CI: ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)andothers),

LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworksh op,fieldorotherlocationsusingdifferentinstructionalstrategies)
SW: SessionalWork(includesassignment,seminar,miniprojectetc.),
SL: SelfLearnin g,**C:** Credits.

Note:

SW&SLhastobeplannedandperformedunderthecontinuousguidanceandfeedbac kofteacherto ensure outcome ofLearning.

SchemeofAssessment: Theory

Board ofStudy	Course Code	Course Title	**SchemeofAssessment(Marks)**						
			ProgressiveAssessment(RA)					**EndSemester Assessment (ESA)**	**Total Marks (PRA + ESA)**
			Class/HomeAssignment5number 3 markseach (CA)	Class Test2 (2bestoutof3) 10 markseach(CT)	Seminarone + Class activity	ClassAttendance (AT)	Total Marks (CA+CT +SA +AT)		
PCC	2CH702	Research Methodology & Research Ethics	15	20	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

UNIT-I (2MH702.1): Introduction & Research design

Nature and objectives of research, Methods of Research: historical, descriptive and experimental. Types of Research, Research process, research approaches, criteria for good research meaning of research design.

Activity	**AppX Hrs**
Cl	09
LI	0
SW	1
SL	1
Total	11

Session Outcomes (SOs)	**LI**	**CI**	**SL**
After the completion of topics students will be able to SO1.1 understand the nature and objectives of research SO1.2 describe the methods of research like historical, descriptive and experimental SO1.3 explain the criteria for good research like meaning of research design		**UNIT-I (76CH401.1): Introduction & Researchdesign** Introduction to nature and objectives of research Methods of Research: historical, descriptive and experimental. Types of Research Research process Research approaches Criteria for good research meaning of research design.	• Error types of error

SW-1 Suggested Sessional Work(SW):

Assignments: Precision and accuracy

Mini Project:

Other Activities (Specify):

UNIT II (2MH702.2): Data Collection & Analysis

Types of data, methods and techniques of data collection, Hypothesis Testing, primary and secondary data, meta analysis, historical methods, content analysis, devices used in data collection.

Activity	**AppX Hrs**
Cl	09
LI	0
SW	1
SL	1
Total	11

Session Outcomes(SOs)	Laboratory Instruction(LI)	Class room Instruction(CI)	Self Learning (SL)
After the completion of topics students will be able to **SO2.1** understand the types of data, methods and techniques of data collection **SO2.2** Explain primary and secondary data **SO2.3 Explain** devices used in data collection		**UNIT II** (76CH-401.**2): Data Collection & Analysis** Types of data, methods and techniques of datacollection Hypothesis Testing, 2.15Primary and secondary data2.16Deta analysis 2.17Historical methods T1. Content analysis, devices used in data collection.	• Sampling ofmaterials

SW-2 Suggested Sessional Work (SW):

Assignments: Mean, median and mod

Mini Project:

Other Activities (Specify):

UNIT III (2MH702.3): Processing and analysis of data

Measures of variation. Measures of central tendency vs. measures of dispersion. Normal distribution. Measures of skewers and Interpretation. Correlation and regression: types & application. Chi-square test its purpose and use.

Activity	AppX Hrs
Cl	09
LI	0
SW	1
SL	1
Total	08

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction(CI)**	**Self Learning (SL)**
After the completion of topics students will be able to **SO3.1** understand the measures of central tendency vs. measures of dispersion **SO3.2** understand measures of skewers and Interpretation **SO3.3** explain correlation and regression: types & application		**UNIT III** (76CH-401.**3**): **Processing andanalysis of data** Measures of central Tendency Measures of dispersion Measures of variation Normal distribution Measures of skewers and Interpretation Correlation and regression: types & application	• Chi-square test, its purpose and use.

SW-3 Suggested Sessional Work (SW):
Assignments: Chi-square test its purpose and use
Mini Project:
Other Activities (Specify):
UNIT IV (**2MH702.4): Philosophy, Ethics & Scientific conduct**
Introduction to philosophy: definition, nature and scope, concept, branches, Ethics: definition, moral philosophy, nature of moral judgments and reactions, Ethics with respect to science and research Intellectual honesty and research integrity,

Activity	**AppX Hrs**
Cl	09
LI	0
SW	1
SL	1
Total	11

Session Outcomes(SOs)	**Laboratory Instruction(LI)**	**Class room Instruction(CI)**	**Self Learning (SL)**
After the completion of topics students will be able to **SO4.1 understand** the term philosophy **SO4.2 explain the term e**thics with respect to science andresearch **SO4.3 explain i**ntellectual honesty and research integrity		UNIT IV (76CH-401**.4): Philosophy, Ethics & Scientific conduct** Introduction to philosophy Introduction to ethics: definition, moral philosophy Nature of moral judgments and reactions Ethics with respect to science andresearch Intellectual honestyT1 Research integrity	• Ethics with respect to science

SW-4 Suggested Sessional Work (SW)
Assignment: Nature of moral judgments and reactions
Mini Project:
Other Activities (Specify):

UNIT V (**2MH702.5): Publication Ethics**
Publication ethics: definition, introduction and importance , Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa.

Activity	**AppX Hrs**
Cl	09
LI	0
SW	1
SL	1
Total	11

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction(CI)**	**Self Learning (SL)**
After the completion of topics students will be able to **SO5.**1 understand publication ethics **SO5.2** explains best practices and standards setting initiatives **SO5.3 Explain the c**onflicts of interestand publication misconduct	.	UNIT V (76CH-401.5): Publication Ethics Publication ethics: definition, introduction and importance Best practices / standards setting initiatives and guidelines COPE WAME Conflicts of interest Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa.	• Best practices

SW-5 Suggested Sessional Work (SW):
Assignments: Standards setting initiatives and guidelines: COPE, WAME, etc
Mini Project:
Other Activities (Specify):

Brief of Hours suggested for the Course Outcome

Course Outcomes	**Class Lecture(Cl)**	**Sessional Work (SW)**	**Self Learning (Sl)**	**Total hour(Cl+SW+Sl)**
2MH702.1: Discuss the purpose of research, research process and research design by acquiring the knowledge of types and method of research	12	02	01	15
2MH702.2: conceptualize and design research projects, including selecting appropriate data collection methods and planning for subsequent analysis.	12	02	01	15
2MH702.3: explain the processing and analysis of data with the skills and knowledge necessary to manage and analyze data effectively.	12	02	01	15

2MH702.4:understand a foundational understanding of the ethical considerations, philosophical principles, and standards of scientific conduct that are crucial in various fields of study.	12	02	01	15
2MH702.5: Explain of the ethical considerations and standards related to publishing academic and research work.	12	02	01	15
Total Hours	60	10	05	75

Suggestion for End Semester Assessment

SuggestedSpecificationTable(ForESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	76CH401.1: Discuss the purpose of research, research process and research design by acquiring the knowledge of types and method of research	03	01	01	05
CO-2	76CH-401.2: Conceptualize and design research projects, including selecting appropriate data collection methods and planning for subsequent analysis.	02	06	02	10
CO-3	76CH-401.3: Explain the processing and analysisof data with the skills and knowledge necessary to manage and analyze data effectively.	03	07	05	15
CO-4	76CH-401.4:Understand a foundational understanding of the ethical considerations, philosophical principles, and standards of scientific conduct that are crucial in various fields of study.	-	10	05	15
CO-5	76CH-401.5: Explain of the ethical considerationsand standards related to publishing academic and research work.	03	02	-	05
Total		11	26	13	50

Legend: R:Remember, U:Understand, A:Apply

The written examination of 50 marks will be held at the end of semester for Inorganic Chemistry

Note.Detailed Assessment need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement ,for end semester assessment.

SuggestedInstructional/ImplementationStrategies:

46. Improved Lecture
47. Tutorial
48. Case Method
49. Group Discussion
50. Role Play
51. Visitto NCL, CSIR laboratories
52. Demonstration
53. ICT Based Teaching Learning (VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Wh a tsapp ,Mobile,Onlinesources)
54. Brainstorming

Suggested Learning Resources:

(k) Books:

S. No.	Title	Author	Publisher	Edition& Year
1	Research Methodology	C.R. Kothari	New Age International Publisher	2^{nd} Revision edition
2	Handbook ofResearch Methodology	Dr. Shanti Bhushan Mishra and Dr. Shashi Alok	Educreation Publishing	2^{nd} edition

SuggestedWebSources:

35. https://celqusb.files.wordpress.com/2017/12/inorganic-chemistry-g-l-miessler-2014.pdf
36. https://www.slideshare.net/MANISHSAHU106/inert-and-labile-complexes
37. https://swayam.gov.in/explorer?category=Chemistry

ModeofDelivery:Lecture,demonstration,E-tutoring,discussion,assignments,quizzes, case study, power point;

LMS/ICT Tools: Digital Classrooms, DLMS, ZOOM, G-Suite,MSPower-Point, Online Resources.

Title:Research Methodology & Research Ethics **Course Code : 2MH702**

	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
Course Outcomes	**Knowledge**	**Research Aptitude**	**Communication**	**Problem Solving**	**Individual and Team Work**	Investigation of Problems	**Modern Tool usage**	**Science and Society**	**Life-Long Learning**	**Ethics**	**Project Management**	**Environment and sustainability**	**The detailed functional knowledge of theoretical concepts and experimental aspects of chemistry**	**To integrate the gained knowledge with various contemporary and evolving areas in chemical sciences like analytical, synthetic, pharmaceutical etc.**	**understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomenon-based problems in chemical sciences.**	**Provide opportunities to excel in academics, research or Industry by research based innovative knowledge for sustainable development in chemical science**
2MH702.1: Discuss the purpose of research, research process and research design by acquiring the knowledge of	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**

types and method of research																
2MH702.2: conceptualize and design research projects, including selecting appropriate data collection methods and planning for subsequent analysis.	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
2MH702.3: explain the processing and analysis of data with the skills and knowledge necessary to manage and analyze data effectively.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
2MH702.4:understand a foundational understanding of the ethical considerations, philosophical principles, and standards of scientific conduct that are crucial in various fields of study.	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**

2MH702.5: Explain of the ethical considerations and standards related to publishing academic and research work.	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: 1–Low, 2–Medium, 3–High

Course Curriculum Map:

POs &PSOsNo.	**Cos No. & Titles**	**SOs No.**	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**2MH702**.1: Discuss the purpose of research, research process and research design by acquiring the knowledge of types and method of research	SO1.1 SO 1.2SO 1.3 SO1.4 SO1.5		UNIT-I (2MH702.1): Introduction & Research design 1.1,1.2,1.3,1.4,1.5,1.6,1.7	• Error types of error
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**2MH702**.2: conceptualize and design research projects, including selecting appropriate data collection methods and planning for subsequent analysis.	SO2.1 SO 2.2SO 2.3 SO2.4 SO2.5		UNIT II (2MH702.2): Data Collection & Analysis 2.1,2.2,2.3,2.4,2.5,2.6, 2.7, 2.8,2.9	• Sampling of materials
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**2MH702**.3: explain the processing and analysis of data with the skills and knowledge necessary to manage and analyze data effectively.	SO3.1SO3.2 SO3.3 SO3.4		UNIT III (2MH702.3): Processing and analysis of data 3.1, 3.2,3.3,3.4,3.5,3.6,3.	• Chi-square test, its purpose and use.

		SO3.5		7	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**2MH702**.4:understand philosophical principles, and standards of scientific conduct that are crucial in various fields of study.	SO4.1 SO 4.2SO 4.3 SO4.4 SO4.5		UNIT IV (2MH702.4): Philosophy, Ethics & Scientific conduct 4.1, 4.2,4.3,4.4,4.5,4.6,4.7	• Ethics with respect to science
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**2MH702**.5: Explain of the ethical considerations and standards related to publishing academic and research work.	SO5.1 SO 5.2SO 5.3 SO5.4 SO5.5		UNIT V : (2MH702. 5): Publication Ethics 5.1,5.2,5. 3,5.4,5.5, 5.6,5.7	• Best practices

Curriculum Development Team

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8. Ms. Arpana Tripathi, Assistant Professor, Department of Mathematics.

CourseCode:	**1PH701**
CourseTitle:	**Electronic Devices**
Pre-requisite:	Understanding fundamental concepts in physics like electricity, magnetism, voltage, current, resistance, and power is crucial. This knowledge forms the foundation of electronics.
Rationale:	The students studying Physics should possess foundational understanding about electronic devices lies in their ability to manipulate and control the flow of electrons to perform specific functions. Electronic devices are designed to process, store, transmit, or display information, and they have become an integral part of modern technology. Here are some key rationales behind electronic devices.

CourseOutcomes

1PH701.1: Understand the characteristics, properties, and functions of common electronic components such as resistors, capacitors, inductors, diodes, transistors, and integrated circuits.

1PH701.2: Gain knowledge about semiconductor materials, their properties, and the operation of semiconductor devices such as diodes and transistors. Understand their applications in rectification, amplification, and switching

1PH701.3: Learn about different types of amplifiers and their characteristics. Understand the operation and applications of operational amplifiers (op-amps) in various electronic circuits.

1PH701.4: Explore the world of integrated circuits, including their types, fabrication methods, and applications. Understand the functionality and operation of common ICs, such as operational amplifiers, timers, voltage regulators, and digital logic ICs.

1PH701.5: Dive deeper into the applications of operational amplifiers (op-amps). Explore op-amp circuits such as active filters, oscillators, comparators, voltage regulators, and instrumentation amplifiers. Understand the design principles and analysis techniques for these circuits**.**

SchemeofStudies:

Boardof Study	Course Code	CourseTitle	Schemeofstudies(Hours/Week)					TotalCredits (C)
			CI	LI	SW	SL	TotalStudyHours (CI+LI+SW+SL)	
Program Core (PCC)	1PH701	Electronic Devices	4	4	1	1	10	6

Legend: **CI:**ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)andothers),
LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworkshop, field or other locations using different instructional strategies)
SW: SessionalWork(includesassignment,seminar,miniprojectetc.),
SL: SelfLearning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacher to ensure outcome of Learning.

SchemeofAssessment:

Theory

Board ofStudy	CouseCode	CourseTitle	SchemeofAssessment(Marks)							
			ProgressiveAssessment(PRA)						EndSemesterAssessment (ESA)	Total Marks (PRA+ ESA)
			Class/HomeAssignment5number 3marks each (CA)	ClassTest2 (2bestoutof3) 10marks each (CT)	Seminarone (SA)	Class Activityanyone (CAT)	ClassAttendance (AT)	TotalMarks (CA+CT+SA+CAT+AT)		
PCC	**1PH701**	Electronic Devices	15	20	5	5	5	50	50	100

Course-CurriculumDetailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PH701.1: Knowledge of Electronic Components: Understand the characteristics, properties, and functions of common electronic components such as resistors, capacitors, inductors, diodes, transistors, and integrated circuits

ApproximateHours	
Item	AppXHrs
Cl	16
LI	12
SW	2
SL	3
Total	33

SessionOutcomes (SOs)	**Lab Instructions (LI)**	**ClassroomInstruction (CI)**	**Self-Learning (SL)**
SO1.1 Understanding the principles of radiative and non-radiative transitions in thin film materials. **SO1.2** Exploring the factors affecting the efficiency of radiative transitions, such as material properties and defect states. **SO1.3** Analyzing the responsivity, quantum efficiency, and noise characteristics of photodetectors. **SO1.4** Understanding the principles and operation of solar cells. **SO1.5** Analyzing the open circuit voltage, short circuit current, and fill factor of solar cells. **SO1.6.** Understanding the high-frequency limits of LED operation. **SO1.7.** Exploring the operation and characteristics of LEDs, including efficiency, color emission, and temperature dependence. **SO1.8.** Understanding the conditions required for population inversion and lasing in diode lasers. .	**1.1** To Study Characteristics curve of P-N Junction Diode and Zener Diode. **1.2** To study characteristics of PNP and NPN transistor s with CB mode	**Unit 1: Diodes** **1.1.** Radiative and non-radiative transitions in thin films **1.2.** Introduction to diode photodetectors **1.3.** Principles of diode photodetection **1.4.** Characteristics and performance parameters of diode photodetectors **1.5.** Introduction to solar cells **1.6.** Open circuit voltage and short circuit current in solar cells **1.7.** Fill factor and its significance in solar cell performance **1.8.** Analysis of solar cell characteristics and efficiency **1.9.** Introduction to light-emitting diodes (LEDs) **1.10.** High-frequency limit of LEDs and considerations for high-speed operation **1.11.** Effect of surface recombination and indirect recombination current in LEDs **1.12.** LED operation principles and applications **1.13.** Introduction to diode lasers **1.14.** Conditions for population inversion in diode lasers **1.15.** Inactive region and its significance in diode lasers **1.16.** Optical gain and threshold	**i.** Photodete-ctors **ii.** Open circuit voltage **iii.** population inversion

		current for lasing in diode lasers	

SW-1SuggestedSessionalWork(SW):

a. Assignments:

i. To Study bipolar junction transistors (BJT) and their construction, working and its Applications.

ii. LED operation principles and applications

b. OtherActivities(Specify): Seminar and group discussion related to subject

PH701.2:Understanding of Semiconductor Devices: Gain knowledge about semiconductor materials, their properties, and the operation of semiconductor devices such as diodes and transistors. Understand their applications in rectification, amplification, and switching

ApproximateHours	
Item	AppXHrs
Cl	12
LI	12
SW	2
SL	2
Total	28

SessionOutcomes (SOs)	Lab Instructions (LI)	ClassroomInstruction (CI)	Self Learning (SL)

SO2.1. Understanding the construction and structure of JFET. **SO2.2.**Exploring the high-frequency limitations of JFET. **SO2.3.** Understanding the construction and structure of BJT (both NPN and PNP). **SO2.4.** Analyzing the working principle of BJT and its modes of operation (active, cutoff, and saturation). **SO2.5**.Exploring the high-frequency limitations of BJT. **SO2.6**..Understanding the construction and structure of MOSFET (both N-channel and P-channel). **SO2.7**.Understanding the construction and structure of MESFET. **SO2.8**.Exploring the I-V characteristics of MESFET and its high-frequency limitations.	**2.1** To study characteristics of tunnel diode 2.2 To study characteristics curve of FET	**Unit 2: Transistors** **2.1.** Introduction to junction field-effect transistors (JFET) and their construction **2.2.** Working principles of JFETs and analysis of their I-V characteristics **2.3.** High-frequency limits of JFETs and considerations for high-frequency applications **2.4.** Introduction to bipolar junction transistors (BJT) and their construction **2.5.** Working principles of BJTs and analysis of their I-V characteristics **2.6.** High-frequency limits of BJTs and considerations for high-frequency applications **2.7.** Introduction to metal-oxide-semiconductor **2.8.** field-effect transistors (FET) **2.9.** MESFET **2.10.** Construction and working principles of MOSFETs and MESFETs **2.11.** Derivation of equations for I-V characteristics under different conditions **2.12.** High-frequency limits of MOSFETs and MESFETs	**i.** Transistor **ii.** Frequency **iii.** Semicondu-ctor

SW-2 SuggestedSessionalWork(SW):

a. Assignments:

i. Construction and working principles of MOSFETs and MESFETs

ii. Working principles of BJTs and analysis of their I-V characteristics

b. OtherActivities(Specify):**Seminar and group discussion related to subject**

PH701.3:Amplifiers and Operational Amplifiers: Learn about different types of amplifiers and their characteristics. Understand the operation and applications of operational amplifiers (op-amps) in various electronic circuits.

ApproximateHours	
Item	AppXHrs
Cl	10
LI	12

SW	2
SL	3
Total	27

SessionOutcomes (SOs)	**Lab Instructions (LI)**	**ClassroomInstruction (CI)**	**Self-Learning (SL)**
SO3.1 Understanding the characteristics and operating principles of different logic families used in digital circuits. **SO3.2**Analyzing parameters such as power consumption, speed, noise immunity, voltage levels, and fan-out of logic families. **SO3.3**Comparing and evaluating the advantages and disadvantages of different logic families. **SO3.4**Analyzing the circuit configurations, voltage levels, and performance characteristics of saturated logic families. **SO3.5**Understanding non-saturated bipolar logic families such as TTC (Transistor-Transistor Logic) and ECL (Emitter-Coupled Logic). **SO3.6**Analyzing the circuit configurations, voltage levels, speed, and power consumption of non-saturated bipolar logic families. **SO3.7**Understanding unipolar logic families, which are based on a single type of charge carrier (either electrons or holes). **SO3.8**Understanding the classification of digital integrated circuits based on their complexity and functionality.	**3.1** To Study characteristics curve of UJT 3.2 To study characteristics curve of MOSFET	**Unit 3: Digital Integrated Circuits** **1.1.** Characteristics of logic families: RTL, DCTL, **1.2.** DTL, **1.3.** TTL, **1.4.** IIL, **1.5.** HTL **1.6.** Overview of non-saturated bipolar logic families: TTC, ECL **1.7.** Unipolar logic families: MOS and CMOS **1.8.** Introduction to digital integrated circuits: SSI, **1.9.** MSI, LSI, **1.10.** VLSI circuits	**i.** Logic gates **ii.**Noise **iii.**Digital Circuit

SW-3SuggestedSessionalWork(SW):

a. *Assignments:*
   i. Unipolar logic families: MOS and CMOS
   ii. VLSI circuits
b. *OtherActivities(Specify):**Seminar and group discussion related to subject***

PH701.4:Integrated Circuits (ICs): Explore the world of integrated circuits, including their types, fabrication methods, and applications. Understand the functionality and operation of common ICs, such as operational amplifiers, timers, voltage regulators, and digital logic ICs.

ApproximateHours	
Item	AppXHrs
Cl	10
LI	12
SW	2
SL	3
Total	27

SessionOutcomes(SOs)	**Lab Instructions (LI)**	**ClassroomInstruction (CI)**	**Self-Learning (SL)**
SO4.1 Understanding the principles of a differential amplifier and its applications.. **SO4.2** Analyzing the common-mode rejection ratio (CMRR) and differential gain of a differential amplifier. **SO4.3** Understanding the basics of operational amplifiers, their internal circuitry, and the golden rules of op-amp analysis. **SO4.4**Exploring the real-world limitations of op-amps, including finite gain, input bias currents, and input offset voltage. **SO4.**5. Understanding the key parameters of operational amplifiers, such as gain bandwidth product (GBW), slew rate, input and output voltage ranges, and noise characteristics. **SO4.**6.Understanding the inverting and non-inverting configurations of op-amps.	**4.1** Characteristics and application of silicon controller rectifier 4.2 Response curve for CE mode amplifier with feedback and without feedback circuits	**Unit-4:**Operational Amplifiers **4.1.** Introduction to differential amplifiers **4.2.** operational amplifiers (OP-AMP) **4.3.** Parameters and specifications of OP-AMPs **4.4.** Inverting modes of OP-AMP operation **4.5.** non-inverting modes of OP-AMP operation **4.6.** Applications of OP-AMPs: adder, subtractor, **4.7.** inverter, differentiator, **4.8.** integrator, **4.9.** function generator **4.10.** Active filters and their implementation using OP-AMPs.	**i.** Amplifiers **ii.** Inverting modes **iii.** Active filters.

SO4.7.Exploring the applications and advantages of inverting and non-inverting amplifiers. **SO4.**8.Exploring the use of op-amps as adders, subtractors, inverters, differentiators, integrators, and function generators.			

SW-4SuggestedSessionalWork(SW):

a) *Assignments:*

(i) ***Inverting modes of OP-AMP operation***

(ii) ***Active filters and their implementation using OP-AMPs.***

c. *OtherActivities(Specify):* ***Seminar and group discussion related to subject***

PH701.5: Operational Amplifier Applications: Dive deeper into the applications of operational amplifiers (op-amps). Explore op-amp circuits such as active filters, oscillators, comparators, voltage regulators, and instrumentation amplifiers. Understand the design principles and analysis techniques for these circuits**.**

Approximated Hours	
Item	AppXHrs
Cl	12
LI	12
SW	2
SL	3
Total	29

SessionOutcomes (SOs)	**Lab Instructions (LI)**	**ClassroomInstruction (CI)**	**Self-Learning (SL)**

SO5.1 Comprehending the principles, structures, and operation of static random access memory (SRAM) and dynamic random access memory (DRAM). **SO5.2** Differentiating between CMOS and NMOS technologies and their applications in memory devices. **SO5.3** Understanding the basics of magnetic, optical, and ferroelectric memories and their uses in data storage. **SO5.4** Understanding the principles and operation of charge-coupled devices (CCD) and their applications in imaging and signal processing. **SO5.5.** Analyzing the working principles of CCDs as image sensors and their advantages in capturing high-quality images. **SO5.6** Understanding the principles of electro-optic, magneto-optic, and acousto-optic effects. **SO5.7.** Exploring examples of active devices in integrated optics based on these effects, such as modulators, switches, and detectors.	**5.1** Verification of truth table for basic logic electronic gates i.e.AND gate, OR gate and NOT gate by using basic passive electronic components **5.2** Use Operational amplifier (OP Amplifier) as a) Inverting and b) Non-inverting amplifier.	**Unit 5: Memory Devices and Other Electronic Devices** **5.1.** Static and dynamic random-access memories (SRAM and DRAM) **5.2.** CMOS and NMOS technologies in memory devices **5.3.** Introduction to non-volatile memories: magnetic, optical, and ferroelectric memories **5.4.** Charge-coupled devices (CCD) and their applications **5.5.** Introduction to electro-optic, magneto-optic, and acousto-optic effects **5.6.** Active devices in integrated optics based on these effects **5.7.** Liquid crystal display (LCD) devices and their operation **5.8.** Piezoelectric effect and materials exhibiting this property **5.9.** Piezoelectric filters, resonators, **5.10.** High-frequency piezoelectric devices **5.11.** Capacitors, electrets, **5.12.** piezoelectric electromechanical transducer devices	**i.** Memories **ii.** Active device **iii.** Piezoelectric materials

SW-5SuggestedSessionalWork(SW):

a. Assignments:

a. Study of non-volatile memories: magnetic, optical, and ferroelectric memories.
b. Study of piezoelectric electromechanical transducer devices.

*b. OtherActivities(Specify):**Seminar and group discussion related to subject***

BriefofHourssuggestedfortheCourseOutcome

CourseOutcomes	Class Lecture (Cl)	Lab Instructions (LI)	Sessional Work (SW)	Self Learning (Sl)	Totalhour (Cl+SW+Sl)

PH701.1: Knowledge of Electronic Components: Understand the characteristics, properties, and functions of common electronic components such as resistors, capacitors, inductors, diodes, transistors, and integrated circuits.	16	12	2	3	33
PH701.2: Understanding of Semiconductor Devices: Gain knowledge about semiconductor materials, their properties, and the operation of semiconductor devices such as diodes and transistors. Understand their applications in rectification, amplification, and switching	12	12	2	3	29
PH701.3: Amplifiers and Operational Amplifiers: Learn about different types of amplifiers and their characteristics. Understand the operation and applications of operational amplifiers (op-amps) in various electronic circuits.	10	12	2	3	27
PH701.4: Integrated Circuits (ICs): Explore the world of integrated circuits, including their types, fabrication methods, and applications. Understand the functionality and operation of common ICs, such as operational amplifiers, timers, voltage regulators, and digital logic ICs.	10	12	2	3	27
PH701.5: Operational Amplifier Applications: Dive deeper into the applications of operational amplifiers (op-amps). Explore op-amp circuits such as active filters.	12	12	2	3	29
TotalHours	**60**	**60**	**10**	**15**	**145**

SuggestionforEndSemesterAssessment

SuggestedSpecificationTable (ForESA)

CO	UnitTitles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Diodes	03	01	01	05
CO-2	Transistors	02	06	02	10
CO-3	Digital Integrated Circuits	03	07	05	15
CO-4	Operational Amplifiers	-	10	05	15
CO-5	Memory Devices and Other Electronic Devices	03	02	-	05
Total		11	26	13	50

Legend: R:Remember, U:Understand, A:Apply

TheendofsemesterassessmentforIntroductiontoPortlandcementwillbeheldwithwritten examination of 50 marks

Note.DetailedAssessmentrubricneedtobepreparedbythecoursewiseteachersforabovetasks.
Teacherscanalsodesigndifferenttasksasperrequirement,forendsemesterassessment.

SuggestedInstructional/ImplementationStrategies:

1. ImprovedLecture
2. Tutorial
3. CaseMethod
4. GroupDiscussion
5. RolePlay
6. Visittocementplant
7. Demonstration
8. ICT Based Teaching Learning (VideoDemonstration/Tutorials CBT, Blog,Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

SuggestedLearningResources:

(a)Books:

S. No.	Title	Author	Publisher	Edition& Year
1	Semi-Conductor Devices – Physics and Technology :	SM Sze	Wiley,	1985
2	Instrumentation and Experimental Design in Physics and Engineering :	M. Sayer and A. Mansingh	Prentice Hall India Learning Private Limited	(1 January 1999)
3	Optical Electronics :	AjoyGhatak and K. Thygarajan	Cambridge Univ. Press.).	
4	Introduction to Semiconductor devices	M.S. Tyagi	(John Wiley and Sons)	

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AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Cos,POsandPSOsMapping

CourseTitle:Electronic Devices

Course Code: 1PH701

CourseOutcomes	**ProgramOutcomes**												**ProgramSpecificOutcome**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
	Engineering knowledge	Problemanalysis	Design/developmentof solutions	Conductinvestigationsofcomplexproblems	Modern tool usage	Theengineerandsociety	Environmentandsustainability:	Ethics	Individualandteamwork	Communication:	Projectmanagementandfinance:	Life-long learning	Identify,formulate,and solve Physicsproblems.	Designandconductexperiments, aswellastoanalyseandinterpretdata.	Apply knowledge of Physics in a different stream of science and to communicate effectively.	Ability to use the techniques, skills, and modern physical tools in real world application.	Engage in life-long learning and will have re

																	cognition.
1PH701.1: Knowledge of Electronic Components: Understand the characteristics, properties, and functions of common electronic components such as resistors, capacitors, inductors, diodes, transistors, and integrated circuits.	**1**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**2**	**1**
1PH701.2: Understanding of Semiconductor Devices: Gain knowledge about semiconductor materials, their properties, and the operation of semiconductor devices such as diodes and transistors. Understand their applications in rectification, amplification, and switching	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**3**	**1**
1PH701.3: Amplifiers and Operational Amplifiers: Learn about different types of amplifiers and their characteristics. Understand the operation and applications of operational	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**	**2**

amplifiers (op-amps) in various electronic circuits.																	
1PH701.4: Integrated Circuits (ICs): Explore the world of integrated circuits, including their types, fabrication methods, and applications. Understand the functionality and operation of common ICs, such as operational amplifiers, timers, voltage regulators, and digital logic ICs.	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**	**2**
1PH7015: Operational Amplifier Applications: Dive deeper into the applications of operational amplifiers (op-amps). Explore op-amp circuits such as active filters.	**-**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**	**3**

Legend:1–Low,2–Medium,3– High

AKS University
Faculty of Basic Science
Curriculum of B. Sc. (Honours / By Research) Program
(Revised as on 01 August 2023)

CourseCurriculumMap:

POs&PSOs No.	COsNo.&Titles	SOsNo.	Lab Instructions (LI)	ClassroomInstruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	**1PH701.1: Knowledge of Electronic Components: Understand the characteristics, properties, and functions of common electronic components such as resistors, capacitors, inductors, diodes, transistors, and integrated circuits.**	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5 SO1.6 SO1.7 SO1.8	1.1,1.2	Unit-1.Diodes 1.1,1.2,1.3,1.4,1.5,1.6,1.7, 1.8, 1.9,1.10,1.11, 1.12,1.13,1.14,1.15,1.16	i, ii,iii
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	**1PH701.2: Understanding of Semiconductor Devices: Gain knowledge about semiconductor materials, their properties, and the operation of semiconductor devices such as diodes and transistors. Understand their applications in rectification, amplification, and switching**	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5 SO2.6 SO2.7 SO2.8	2.1,2.2	Unit-2Transistors 2.1,2.2,2.3,2.4,2.5,2.6,2.7, 2.8,2.9,2.10,2.11,2.12	i, ii,iii
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	**1PH701.3: Amplifiers and Operational Amplifiers: Learn about different types of amplifiers and their characteristics. Understand the operation and applications of operational amplifiers (op-amps) in various electronic circuits.**	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5 SO3.6 SO3.7 SO3.8	3.1,3.2	Unit-3:Digital Integrated Circuits 3.1, 3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10	i, ii,iii
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	**1PH701.4: Integrated Circuits (ICs): Explore the world of integrated circuits, including their types, fabrication methods, and applications. Understand the functionality and operation of common**	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1,4.2	Unit-4 : Operational Am	i, ii,iii

	ICs, such as operational amplifiers, timers, voltage regulators, and digital logic ICs.			pl ifi er s 4.1, 4.2,4.3,4.4,4.5 ,4.6,4.7,4.8,4. 9,4.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	**1PH701.5: Operational Amplifier Applications: Dive deeper into the applications of operational amplifiers (op-amps). Explore op-amp circuits such as active filters.**	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1,5.2	Unit5:Memory Devices. 5.1,5.2,5.3,5.4,5.5,4.6,4.7, 4.8,4.9,4.10, 4.11,4.12	i, ii,iii

Curriculum Development Team

1. Dr. O .P. Tripathi, Head of the Department, of Physics, AKS University
2. Dr. C. P. Singh, Assistant Professor, Dept. of Physics
3. Dr. Lovely Singh, Assistant Professor, Dept. of Physics
4. Dr. Saket Kumar, Assistant Professor, Dept. of Physics
5. Mr. Manish Agrawal, Assistant Professor, Dept of Physics
6. Ms. Swati Kushwaha, Lab Assistant Dept. of Physics

CourseCode: **2PH701**

CourseTitle: **Atomic, Molecular and Laser Physics**

Pre-requisite: It's important to note that specific course prerequisites may vary based on the institution and the level of the course. Students are advised to check the course catalog or consult with the instructor for the most accurate information regarding prerequisites for a particular Atomic, Molecular, and Laser Physics course.

Rationale: The study of Atomic, Molecular, and Laser Physics is essential for understanding the fundamental nature of matter and has wide-ranging applications in technology, medicine, chemistry, physics, and various interdisciplinary fields. The knowledge gained in this field continues to drive innovations and discoveries with profound implications for diverse scientific and technological endeavors.

CourseOutcomes:

2PH701.1: Atomic Spectra: To provide students with a comprehensive understanding of atomic spectra and quantum mechanics, preparing them for advanced studies and applications in the field. Students should be able to apply theoretical concepts to interpret experimental data.

2PH701.2: Molecular Spectra: To equip students with a strong foundation in molecular spectroscopy, enabling them to understand and analyze rotational spectra for different types of molecules. Students are expected to develop critical thinking, problem-solving skills.

2PH701.3:Oscillator:Students have a comprehensive understanding of the theoretical principles, mathematical models, and practical applications of molecular vibrations and spectroscopy in diatomic molecules.

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2PH701.4. Spectroscopy: To provide students with a comprehensive understanding of various spectroscopic techniques and experimental methods, preparing them for applications in research, industry, and analytical chemistry.

2PH701.5. Laser: Course aims to provide students with a comprehensive understanding of laser physics and its applications, preparing them for advanced studies in optics, photonics, and laser technology.

AKS University
Faculty of Basic Science
Curriculum of B. Sc. (Honours / By Research) Program
(Revised as on 01 August 2023)

SchemeofStudies:

Boardof Study	Course Code	CourseTitle	Schemeofstudies(Hours/Week)					TotalCredits (C)
			Cl	LI	SW	SL	TotalStudyHours (CI+LI+SW+SL)	
Program Core (PCC)	**2PH701**	Atomic, Molecular and Laser Physics	4	0	1	1	6	4

Legend: **CI:**ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)andothers),
LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworkshop, field or other locations using different instructional strategies)
SW: SessionalWork(includesassignment,seminar,miniprojectetc.),
SL: SelfLearning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacher to ensure outcome of Learning.

SchemeofAssessment:

Theory

Board ofStudy	CouseCode	CourseTitle	**SchemeofAssessment(Marks)**							
			ProgressiveAssessment(PRA)						**EndSemesterAssessment (ESA)**	**Total Marks** (PRA+ESA)
			Class/HomeAssignment5 number 3marks each (CA)	ClassTest2 (2bestoutof3) 10marks each (CT)	Seminarone (SA)	Class Activityanyone (CAT)	ClassAttendance (AT)	TotalMarks (CA+CT+SA+CAT+AT)		
PCC	**2PH701**	Atomic, Molecular and Laser Physics	15	20	5	5	5	50	50	100

Course-CurriculumDetailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

2PH701.1: Atomic Spectra: To provide students with a comprehensive understanding of atomic spectra and quantum mechanics, preparing them for advanced studies and applications in the field. Students should be able to apply theoretical concepts to interpret experimental data.

ApproximateHours	
Item	AppXHrs
Cl	14
LI	0
SW	2
SL	3
Total	19

SessionOutcomes (SOs)	**ClassroomInstruction (CI)**	**Self-Learning (SL)**
SO1.1.: Understand the fundamental principles of quantum mechanics and their applications in atomic and molecular physics. **SO1.2.:**Analyze and interpret atomic and molecular spectra. **SO1.3.:**Understand the methods and models used in molecular quantum mechanics. **SO1.4.:**Explain the principles behind statistical models such as the Thomas-Fermi model. **SO1.5.:**Analyze the behavior of electrons in complex systems, including the two-electron system. **SO1.6.:**Understand the mechanisms behind hyperfine structure and line broadening in atomic and molecular spectra	**Unit 1: Atomic Spectra** **1.1.** Introduction to Quantum Mechanics **1.2.** Schrodinger Equation **1.3.** Atomic Orbitals **1.4.** Hydrogen Spectrum **1.5.** Pauli's Principle **1.6.** Overview of Alkali Elements **1.7.** Spin-Orbit Interaction **1.8.** Line Structure of Alkali Spectra **1.9.** Molecular Quantum Mechanics **1.10.** Hartree and Hartree-Fock Methods **1.11.** Two-Electron System **1.12.** Interaction Energy in LS and JJ Coupling **1.13.** Hyperfine Structure **1.14.** Line Broadening Mechanisms	**iv.** Quantum Mechanics **v.** Alkali Spectra **vi.** Orbitals

SW-1SuggestedSessionalWork(SW):

c. *Assignments:*

i. Pauli's Principle

ii. Line Broadening Mechanisms

d. OtherActivities(Specify):

Seminar and group discussion related to subject

2PH701.2: Molecular Spectra: To equip students with a strong foundation in molecular spectroscopy, enabling them to understand and analyze rotational spectra for different types of molecules. Students are expected to develop critical thinking, problem-solving skills

ApproximateHours	
Item	AppXHrs
Cl	09
LI	0
SW	2
SL	3
Total	13

SessionOutcomes (SOs)	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO2.1.: Classify molecules based on their structural and symmetry characteristics. **SO2.2.:**Understand the principles of rotational spectroscopy for diatomic molecules. **SO2.3.:**Analyze the rotational spectra of diatomic molecules using the rigid rotor model. **SO2.4.:**Extend the understanding to non-rigid rotators and analyze deviations from the rigid rotor model. **SO2.5.:**Understand the factors influencing the intensity of rotational spectral lines. **SO2.6.:**Describe the rotational motion and spectral features of symmetric top, asymmetric top, and spherical top molecules. **SO2.7.:**Analyze real-world applications of rotational spectroscopy.	**Unit2: Molecular Spectra** **2.1.** Overview of Molecular Types **2.2.** Diatomic Linear Molecules **2.3.** Symmetric Top Molecules **2.4.** Rotational Spectra of Diatomic Molecules (Rigid Rotor Model) **2.5.** Asymmetric Top Molecules **2.6.** Energy Levels and Spectra of Non-Rigid Rotator **2.7.** Spherical Top Molecules **2.8.** Intensity of Rotational Lines **2.9.** Applications of Rotational Spectroscopy	**iv.** Energy Levels **v.**Spectra **vi.** Molecules

SW-2SuggestedSessionalWork(SW):

d. Assignments:

i. Rotational Spectra of Diatomic Molecules (Rigid Rotor Model)
ii. Spherical Top Molecules

e. OtherActivities(Specify):

Seminar and group discussion related to subject

2PH701.3:Oscillator: Students have a comprehensive understanding of the theoretical principles, mathematical models, and practical applications of molecular vibrations and spectroscopy in diatomic molecules.

ApproximateHours	
Item	AppXHrs
Cl	09
LI	0
SW	2
SL	3
Total	12

SessionOutcomes (SOs)	ClassroomInstruction (CI)	Self -Learning (SL)
SO3.1.: Understand the principles of molecular vibrations and their significance. **SO3.2.:**Analyze the diatomic molecule as a simple harmonic oscillator and extend it to vibrational energy levels. **SO3.3.:**Describe the characteristics of vibrational spectra in diatomic molecules, considering both simple harmonic oscillators and Morse potential models. **SO3.4.:**Understand the combined vibrational and rotational motion in molecules. **SO3.5.:**Explain the PQR branches in the infrared spectrum and understand qualitative aspects of IR spectrometry.	**Unit3: Oscillator** **1.11.**Overview of Molecular Vibrations **1.12.**Diatomic Molecule as a Simple Harmonic Oscillator **1.13.**Energy Levels of Vibrating Diatomic Molecules **1.14.**Vibrational Spectrum of Diatomic Molecules **1.15.**Morse Potential Energy Curve **1.16.**Vibrational Energy Levels and Spectrum with Morse Potential **1.17.**Molecules as Vibrating Rotators **1.18.**PQR Branches in the Infrared Spectrum **1.19.**Qualitative Aspects of IR Spectrometry	**i.** Vibrations **ii.** Spectrum **iii.** Potentia

SW-3SuggestedSessionalWork(SW):

c. *Assignments:*
   iii. IR Spectrometry
   iv. Molecules as Vibrating Rotators
d. *OtherActivities(Specify):*
   Seminar and group discussion related to subject

2PH701.4. Spectroscopy: To provide students with a comprehensive understanding of various spectroscopic techniques and experimental methods, preparing them for applications in research, industry, and analytical chemistry.

ApproximateHours	
Item	AppXHrs
Cl	13
LI	0
SW	2
SL	3
Total	18

SessionOutcomes (SOs)	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO4.1: Understand the principles and applications of various spectroscopic techniques. **SO4.2:** Analyze electronic, vibrational, and rotational transitions in UV-Vis, IR, and Raman spectra. **SO4.3:** Describe the techniques and instrumentation used in UV-Vis, IR, and Raman spectroscopy. **SO4.4:** Understand advanced Raman techniques, including stimulated Raman spectroscopy. **SO4.5:** Explain the principles and applications of experimental techniques such as photoelectron spectroscopy, photoacoustic spectroscopy, Mossbauer spectroscopy, and NMR spectroscopy. **SO4.6:** Analyze real-world applications of various spectroscopic techniques.	**UNIT.4: Spectroscopy** **4.1.** Overview of Spectroscopy **4.2.** UV-Visible Spectroscopy **4.3.** Infrared (IR) Spectroscopy **4.4.** Introduction to Raman Spectroscopy **4.5.** Pure Rotational and Vibrational Spectra in Raman **4.6.** Techniques and Instrumentation in UV-Vis and IR Spectroscopy **4.7.** Raman Spectroscopy Techniques **4.8.** Stimulated Raman Spectroscopy **4.9.** Experimental Techniques: Photoelectron Spectroscopy **4.10.** Introduction to Photoacoustic Spectroscopy **4.11.** Introduction to Mossbauer Spectroscopy **4.12.** Introduction to NMR Spectroscopy **4.13.** Applications of Various Spectroscopic Techniques.	**iv.** Raman Effect **v.** Rotational Spectra **vi.** Photoelectron

SW-

SuggestedSessionalWork(SW):

b) *Assignments:*
i. To Study of NMR Spectroscopy
ii. To Study Mossbauer Spectroscopy

f. OtherActivities(Specify):

Seminar and group discussion related to subject

2PH701.5. Laser: Course aims to provide students with a comprehensive understanding of laser physics and its applications, preparing them for advanced studies in optics, photonics, and laser technology.

Approximated Hours	
Item	AppXHrs
Cl	15
LI	0
SW	2
SL	3
Total	20

SessionOutcomes (SOs)	**ClassroomInstruction (CI)**	**Self-Learning (SL)**

SO5.1: Understand the fundamental principles of laser physics, including stimulated emission and population inversion. **SO5.2:** Describe the characteristics of laser light and the conditions for laser amplification. **SO5.3:** Analyze line broadening mechanisms, spectral narrowing, and gain clamping in lasers. **SO5.4:** Understand spatial and spectral hole burning and their consequences. **SO5.5:** Describe the principles and applications of various types of lasers, including gas lasers, solid-state lasers, and dye lasers. **SO5.6:** Analyze real-world applications of laser technology in different scientific and industrial domains.	**UNIT.5: Laser** **5.1.** Introduction to Stimulated Emission **5.2.** Population Inversion **5.3.** Laser Amplification **5.4.** Oscillation Condition for Lasers **5.5.** Characteristics of Laser Light **5.6.** Line Broadening Mechanism **5.7.** Spectral Narrowing in a Laser **5.8.** Gain Clamping **5.9.** Spatial and Spectral Hole Burning **5.10.** Power in Laser Oscillator **5.11.** Optimum Coupling **5.12.** Atomic and Molecular Gas Lasers **5.13.** Solid State Lasers **5.14.** Dye Lasers **5.15.** Applications of Lasers	**iv.** Absorption **v.** Emission **vi.** Coupling

SW-5SuggestedSessionalWork(SW):

c. *Assignments:*
   i. Dye Lasers
   ii. Applications of Lasers

d. *OtherActivities(Specify):*
   Seminar and group discussion related to subject

BriefofHourssuggestedfortheCourseOutcome

CourseOutcomes	**Class Lecture (Cl)**	**Sessional Work (SW)**	**Self Learning (Sl)**	**Totalhour (Cl+SW+Sl)**
2PH701.1: Atomic Spectra: To provide students with a comprehensive understanding of atomic spectra and quantum mechanics, preparing them for advanced studies and applications in the field. Students should be able to apply theoretical concepts to interpret experimental data.	14	2	3	19
2PH701.2: Molecular Spectra: To equip students with a strong foundation in molecular spectroscopy, enabling them to understand and analyze rotational spectra for different types of molecules. Students are expected to develop critical thinking, problem-solving skills.	09	2	3	14

2PH701.3:Oscillator: Students have a comprehensive understanding of the theoretical principles, mathematical models, and practical applications of molecular vibrations and spectroscopy in diatomic molecules.	09	2	3	14
2PH701.4. Spectroscopy: To provide students with a comprehensive understanding of various spectroscopic techniques and experimental methods, preparing them for applications in research, industry, and analytical chemistry.	13	2	3	18
2PH701.5. Laser: Course aims to provide students with a comprehensive understanding of laser physics and its applications, preparing them for advanced studies in optics, photonics, and laser technology.	15	2	3	20
TotalHours	**60**	**10**	**15**	**85**

SuggestionforEndSemesterAssessment

SuggestedSpecificationTable (ForESA)

CO	**UnitTitles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Atomic Spectra	03	01	01	05
CO-2	Molecular Spectra	02	06	02	10
CO-3	Oscillator	03	07	05	15
CO-4	Spectroscopy	2	10	05	17
CO-5	Laser	03	02	3	08
Total		11	26	13	50

Legend: R:Remember, U:Understand, A:Apply

TheendofsemesterassessmentforIntroductiontoPortlandcementwillbeheldwithwritten examination of 50 marks

Note.DetailedAssessmentrubricneedtobepreparedbythecoursewiseteachersforabovetasks. Teacherscanalsodesigndifferenttasksasperrequirement,forendsemesterassessment.

SuggestedInstructional/ImplementationStrategies:

1. ImprovedLecture
2. Tutorial
3. CaseMethod
4. GroupDiscussion
5. RolePlay
6. Demonstration
7. ICT Based Teaching Learning (VideoDemonstration/Tutorials CBT, Blog,Facebook,Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

SuggestedLearningResources:

(a)Books:

S. No.	Title	Author	Publisher	Edition&Year
1	Introduction to Atomic Spectra	H.E. White	MCGRAWHILL EXCLUSIVE (CBS)	(1 January 2019)
2	Fundamentals of molecular spectroscopy	C.B. Banwell	VISIONIAS	(1 January 2022)
3	Spectroscopy vol.I, II & III	Walker and Stanghen	Cambridge Univ. Press.)	1967
4	Introduction to molecular spectroscopy	G.M. Barrow	(John Wiley and Sons)	1962
4	Spectra of diatomic molecules	Herzberg.	Krieger Publishing Company;	2ndedition(1 December 1950)
5	Molecular spectroscopy	Jeanne L. Mc Hale	CRC Press;	2nd edition (16 May 2017)
6	Molecular spectroscopy	J.M.Brown	Oxford University Press	1998
7	Spectra of atoms and molecules	P.F.Bemath.	OUP USA;	4th edition (29 June 2020)
8	Modern spectroscopy	J.M. Halian	Wiley–Blackwell;	3rd edition (14 June 1996)
9	Lasers and Non-Linear Optics	B.B. Laud.	(Wiley Eastern Ltd.)	1991
10	Lasers principles and Applications (Lied) –	Wilson & Hawkes	Prentice Hall	1987
11	Laser Fundamentals	William T. Silfvast	Cambridge Univ. Press.	2004

Cos,POsandPSOsMapping

CourseTitle:B.Sc.

Course Code: 2PH701
CourseTitle:Atomic, Molecular and Laser Physics

CourseOutcomes	**ProgramOutcomes**												**ProgramSpecificOutcome**				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
	Engineeringknowledge	**Problemanalysis**	**Design/developmentofsolutions**	**Conductinvestigationsofcomplexproblems**	**Moderntoolusage**	**Theengineerandsociety**	**Environment and sustainability:**	**Ethics**	**Individualandteamwork:**	**Communication:**	**Projectmanagement and finance:**	**Life-longlearning**	Identify,formulate,andsolvePhysicsproblems.	Designandconductexperiments,aswellastoanalyseandinterpretdata.	Apply knowledge of Physics in a different stream of science and to communicate effectively.	Ability to use the techniques, skills, and modern physical tools in real world application.	Engage in life-long learning and will have recognition.

2PH701.1: Atomic Spectra: To provide students with a comprehensive understanding of atomic spectra and quantum mechanics, preparing them for advanced studies and applications in the field. Students should be able to apply theoretical concepts to interpret experimental data**.**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**2**	**3**	**3**	**2**	**1**
2PH701.2: Molecular Spectra: To equip students with a strong foundation in molecular spectroscopy, enabling them to understand and analyze rotational spectra for different types of molecules. Students are expected to develop critical thinking, problem-solving skills.	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**
2PH701.3: Oscillator: Students have a comprehensive understanding of the theoretical principles, mathematical models, and practical applications of molecular vibrations and spectroscopy in diatomic molecules.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**	**2**

2PH701.4. Spectroscopy: To provide students with a comprehensive understanding of various spectroscopic techniques and experimental methods, preparing them for applications in research, industry, and analytical chemistry.	**2**	**1**	**2**	**2**	**2**	**1**	**2**	**2**	**3**	**2**	**1**	**2**	**3**	**2**	**2**	**2**	**2**
2PH701.5. Laser: Course aims to provide students with a comprehensive understanding of laser physics and its applications, preparing them for advanced studies in optics, photonics, and laser technology.	**2**	**2**	**2**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**	**3**

Legend:1–Low,2–Medium,3– High

CourseCurriculumMap:

POs&PSOs No.	COsNo.&Titles	SOsNo.	ClassroomInstruction(CI)	Self-Learning(SL)
PO: 1,2,3,4,5,6 7,8,9,10,11,12 PSO:1,2,3,4,5	**2PH701.1:** Atomic Spectra: To provide students with a comprehensive understanding of atomic spectra and quantum mechanics, preparing them for advanced studies and applications in the field. Students should be able to apply theoretical concepts to interpret experimental data.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5 SO1.6	Unit-1. Atomic Spectra 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8.1.9,1.10,1.11,1.12, 1.13,1.14	i,ii,iii
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	**2PH701.2:** Molecular Spectra: To equip students with a strong foundation in molecular spectroscopy, enabling them to understand and analyze rotational spectra for different types of molecules. Students are expected to develop critical thinking, problem-solving skills.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5 SO2.6 SO2.7	Unit-2Molecular Spectra: 2.1,2.2,2.3,2.4,2.5,2.6,2.7, 2.8,2.9	i,ii,iii
PO:1,2,3,4,5,67,8, 9,10,11,12 PSO:1,2,3,4,5	**2PH701.3:** Oscillator: Students have a comprehensive understanding of the theoretical principles, mathematical models, and practical applications of molecular vibrations and spectroscopy in diatomic molecules.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	Unit-3:Oscillator: 3.1, 3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,	i,ii,iii
PO: 1,2,3,4,5,67,8,9 ,10,11,12 PSO1,2,3,4,5	**2PH701.4.** Spectroscopy: To provide students with a comprehensive understanding of various spectroscopic techniques and experimental methods, preparing them for applications in research, industry, and analytical chemistry.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5 SO4.6	Unit-4 : Spectroscopy: 4.1, 4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12,4.13	i,ii,iii

PO: 1,2,3,4,5,6 7,8,9,10,11,12 PSO:1,2,3,4,5	**2PH701.5.** Laser: Course aims to provide students with a comprehensive understanding of laser physics and its applications, preparing them for advanced studies in optics, photonics, and laser technology.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5 SO5.5	Unit5:Laser: 5.1,5.2,5.3,5.4,5.5,5.6, 5.7,5.8,5.9,5.10,5.11,5.12,5.13,5.14,5.15	i,ii,iii

Curriculum Development Team

1. Dr. O .P. Tripathi, Head of the Department, of Physics, AKS University
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3. Dr. Lovely Singh, Assistant Professor, Dept. of Physics
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6. Ms. Swati Kushwaha, Lab Assistant Dept. of Physics

Course Name: Research Methodology
Course Code: 2PH702

Pre-requisite: Students must have fundamental knowledge of precision and accuracy, types of error, datacollections, mean, median and mod etc to understand the concept of research program and its methodology.

Rationale: The rationale for choosing a specific research methodology is crucial as it provides a solid foundation forthe entire research process. The choice of methodology should align with the research objectives and questions, guiding the researcher in collecting, analyzing, and interpreting data.

Course Outcomes:
After the completion of this course, the learner will able to
2PH702.1: Discuss the purpose of research, research process and research design by acquiring the knowledge oftypes and method of research.

2PH702.2: Conceptualize and design research projects, including selecting appropriate data collection methodsand planning for subsequent analysis.

2PH702.3: Explain the processing and analysis of data with the skills and knowledge necessary to manage and analyze data effectively.

2PH702.4:Understand a foundational understanding of the ethical considerations, philosophical principles, and standards of scientific conduct that are crucial in various fields of study.
2PH702.5: Explain of the ethical considerations and standards related to publishing academic and research work.

*UNIT-I (**2PH702**.1): Introduction & Research design*

Nature and objectives of research, Methods of Research: historical, descriptive and experimental. Types of Research, Research process, research approaches, criteria for good research meaning of research design .

*UNIT II (**2PH702**.2): Data Collection & Analysis*

Types of data, methods and techniques of data collection, Hypothesis Testing, primary and secondary data, meta analysis, historical methods, content analysis, devices used in data collection.

*UNIT III (**2PH702**.3): Processing and analysis of data*

Measures of central Tendency. Measures of dispersion. Measures of variation. Measures of central tendency vs. measures of dispersion. Normal distribution. Measures of skewness and Interpretation. Correlation and regression: types & application. Chi-square test its purpose and use.

*UNIT IV (**2PH702**.4): Philosophy, Ethics & Scientific conduct*

Introduction to philosophy: definition, nature and scope, concept, branches, Ethics: definition, moral philosophy, nature of moral judgements and reactions, Ethics with respect to science and research Intellectual honesty and research integrity,

*UNIT V (**2PH702**.5): Publication Ethics*

Publication ethics: definition, introduction and importance , Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest Pblication misconduct: definition, concept, problems that lead to unethical behavior and vice versa.

Reference Book
Research in Education, 10th Edition, Best &
KahnResearch Methodology C.R.KOTHAR
Methodology of Educational Research, Lokesh

KoulSUGGESTED WEB SOURCES

- https://nptel.ac.in/course.html
- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5
- https://swayam.gov.in/explorer?category=Chemistry

Mode OF Transaction:Lecture,demonstration,E-tutoring,discussion,assignments,quizzes, case study, powerpoint; LMS/ICT Tools**:** Digital Classrooms, DLMS, ZOOM, G-Suite,MSPower-Point, Online Resources.

Mappingof COandPO for

2PH702Scheme of Studies:

Board ofStudy	**CourseCode**	**CourseTitle**	**Scheme ofstudies (Hours/Week)**					**Total Credits(C)**
			Cl	**LI**	**SW**	**SL**	**Total Study Hours(CI+LI+SW+SL)**	
ProgramCore(PCC)	**2PH702**	Research Methodology & Research Ethics	2	0	1	1	4	4

Legend : CI: ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)andothers),
LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworkshop,fieldorotherlocationsusingdifferentinstructionalstrategies)
SW: SessionalWork(includesassignment,seminar,miniprojectetc.),
SL: SelfLearning,**C:** Credits.

Note:

SW&SLhastobeplannedandperformedunderthecontinuousguidanceandfeedbackofteacherto ensure outcome ofLearning.

SchemeofAssessment: Theory

Board ofStudy	Course Code	Course Title	**SchemeofAssessment(Marks)**						
			ProgressiveAssessment(RA)					**EndSemester Assessment (ESA)**	**Total Marks (PRA + ESA)**
			Class/HomeAssignment5number 3 markseach (CA)	Class Test2 (2bestoutof3) 10 markseach(CT)	Seminarone + Class activity	ClassAttendance (AT)	Total Marks (CA+CT +SA +AT)		
PCC	**2PH702**	Research Methodology & Research Ethics	15	20	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs)upon the course's conclusion.

*UNIT-I (**2PH702**.1): Introduction & Research design*

Nature and objectives of research, Methods of Research: historical, descriptive and experimental. Types of Research, Research process, research approaches, criteria for good research meaning of research design.

Activity	AppX Hrs
Cl	06
LI	0
SW	1
SL	1
Total	08

Session Outcomes (SOs)	LI	CI	SL
After the completion of topics students will be able to SO1.1 understand the nature and objectives of research SO1.2 describe the methods of research like historical, descriptive and experimental SO1.3 explain the criteria for good research like meaning of research design		**UNIT-I (76CH401.1): Introduction & Researchdesign** Introduction to nature and objectives of research Methods of Research: historical, descriptive and experimental. Types of Research Research process Research approaches Criteria for good research meaning of research design.	• Error types of error

SW-1 Suggested Sessional Work(SW):

Assignments: Precision and accuracy

Mini Project:

Other Activities (Specify):

*UNIT II (**2PH702**.2): Data Collection & Analysis*

Types of data, methods and techniques of data collection, Hypothesis Testing, primary and secondary data, metaanalysis, historical methods, content analysis, devices used in data collection.

Activity	AppX Hrs
Cl	06
LI	0
SW	1
SL	1
Total	08

Session Outcomes(SOs)	Laboratory Instruction(LI)	Class room Instruction(CI)	Self Learning (SL)
After the completion of topics students will be able to **SO2.1** understand the types of data, methods and techniques of data collection **SO2.2** Explain primary and secondary data **SO2.3 Explain** devices used in data collection		**UNIT II** (76CH-401.**2): Data Collection & Analysis** Types of data, methods and techniques of datacollection Hypothesis Testing, 2.15Primary and secondary data2.16Deta analysis 2.17Historical methods T1. Content analysis, devices used in data collection.	• Sampling ofmaterials

SW-2 Suggested Sessional Work (SW):

Assignments: Mean, median and mod

Mini Project:

Other Activities (Specify):

*UNIT III (**2PH702**.3): Processing and analysis of data*

Measures of variation. Measures of central tendency vs. measures of dispersion. Normal distribution. Measures ofskewers and Interpretation. Correlation and regression: types & application. Chi-square test its purpose and use.

Activity	**AppX Hrs**
Cl	06
LI	0
SW	1
SL	1
Total	08

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction(CI)**	**Self Learning (SL)**
After the completion of topics students will be able to **SO3.1** understand the measures of central tendency vs. measures of dispersion **SO3.2** understand measures of skewers and Interpretation **SO3.3** explain correlation and regression: types & application		**UNIT III** (76CH-401**.3**): **Processing andanalysis of data** Measures of central Tendency Measures of dispersion Measures of variation Normal distribution Measures of skewers and Interpretation Correlation and regression: types & application	• Chi-square test, its purpose and use.

SW-3 Suggested Sessional Work (SW):
Assignments: Chi-square test its purpose and use
Mini Project:
Other Activities (Specify):

UNIT IV (**2PH702.4): Philosophy, Ethics & Scientific conduct**

Introduction to philosophy: definition, nature and scope, concept, branches, Ethics: definition, moral philosophy, nature of moral judgments and reactions, Ethics with respect to science and research Intellectual honesty and research integrity,

Activity	**AppX Hrs**
Cl	06
LI	0
SW	1
SL	1
Total	08

Session Outcomes(SOs)	**Laboratory Instruction(LI)**	**Class room Instruction(CI)**	**Self Learning (SL)**
After the completion of topics students will be able to **SO4.1 understand** the term philosophy **SO4.2 explain the term e**thics with respect to science andresearch **SO4.3 explain i**ntellectual honesty and research integrity		UNIT IV (76CH-401**.4): Philosophy, Ethics & Scientific conduct** Introduction to philosophy Introduction to ethics: definition, moral philosophy Nature of moral judgments and reactions Ethics with respect to science andresearch Intellectual honestyT1 Research integrity	• Ethics with respect to science

SW-4 Suggested Sessional Work (SW)

Assignment: Nature of moral judgments and reactions

Mini Project:

Other Activities (Specify):

UNIT V (**2PH702.5): Publication Ethics**

Publication ethics: definition, introduction and importance , Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa.

Activity	**AppX Hrs**
Cl	06
LI	0
SW	1
SL	1

Total	08

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction(CI)**	**Self Learning (SL)**
After the completion of topics students will be able to **SO5.**1 understand publication ethics **SO5.2** explains best practices and standards setting initiatives **SO5.3 Explain the c**onflicts of interestand publication misconduct	.	UNIT V (76CH-401.5): Publication Ethics Publication ethics: definition, introduction and importance Best practices / standards setting initiatives and guidelines COPE WAME Conflicts of interest Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa.	• Best practices

SW-5 Suggested Sessional Work (SW):
Assignments: Standards setting initiatives and guidelines: COPE, WAME, etc
Mini Project:
Other Activities (Specify):

Brief of Hours suggested for the Course Outcome

Course Outcomes	**Class Lecture(Cl)**	**Sessional Work (SW)**	**Self Learning (Sl)**	**Total hour(Cl+SW+Sl)**
2PH702.1: Discuss the purpose of research, research process and research design by acquiring the knowledge of types and method of research	12	02	01	15
2PH702.2: conceptualize and design research projects, including selecting appropriate data collection methods and planning for subsequent analysis.	12	02	01	15
2PH702.3: explain the processing and analysis of data with the skills and knowledge necessary to manage and analyze data effectively.	12	02	01	15

2PH702.4:understand a foundational understanding of the ethical considerations, philosophical principles, and standards of scientific conduct that are crucial in various fields of study.	12	02	01	15
2PH702.5: Explain of the ethical considerations and standards related to publishing academic and research work.	12	02	01	15
Total Hours	60	10	05	75

Suggestion for End Semester Assessment

SuggestedSpecificationTable(ForESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	76CH401.1: Discuss the purpose of research, research process and research design by acquiring the knowledge of types and method of research	03	01	01	05
CO-2	76CH-401.2: Conceptualize and design research projects, including selecting appropriate data collection methods and planning for subsequent analysis.	02	06	02	10
CO-3	76CH-401.3: Explain the processing and analysisof data with the skills and knowledge necessary to manage and analyze data effectively.	03	07	05	15
CO-4	76CH-401.4:Understand a foundational understanding of the ethical considerations, philosophical principles, and standards of scientific conduct that are crucial in various fields of study.	-	10	05	15
CO-5	76CH-401.5: Explain of the ethical considerationsand standards related to publishing academic and research work.	03	02	-	05
Total		11	26	13	50

Legend: R:Remember, U:Understand, A:Apply

The written examination of 50 marks will be held at the end of semester for Inorganic Chemistry

Note.Detailed Assessment need to be prepared by the course wise teachers for above tasks. Teachers can also designdifferent tasks as per requirement ,for end semester assessment.

SuggestedInstructional/ImplementationStrategies:

46. Improved Lecture
47. Tutorial
48. Case Method
49. Group Discussion
50. Role Play
51. Visitto NCL, CSIR laboratories
52. Demonstration
53. ICT Based Teaching Learning (VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Wh a tsapp ,Mobile,Onlinesources)
54. Brainstorming

Suggested Learning Resources:

(I) Books:

S. No.	Title	Author	Publisher	Edition& Year
1	Research Methodology	C.R. Kothari	New Age International Publisher	2^{nd} Revision edition
2	Handbook ofResearch Methodology	Dr. Shanti Bhushan Mishra and Dr. Shashi Alok	Educreation Publishing	2^{nd} edition

SuggestedWebSources:

38. https://celqusb.files.wordpress.com/2017/12/inorganic-chemistry-g-l-miessler-2014.pdf
39. https://www.slideshare.net/MANISHSAHU106/inert-and-labile-complexes
40. https://swayam.gov.in/explorer?category=Chemistry

ModeofDelivery:Lecture,demonstration,E-tutoring,discussion,assignments,quizzes, case study, power point;

LMS/ICT Tools: Digital Classrooms, DLMS, ZOOM, G-Suite,MSPower-Point, Online Resources.

Title:Research Methodology & Research Ethics **Course Code : 2PH702**

	Program Outcomes												Program Specific Outcome			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
Course Outcomes	**Knowledge**	**Research Aptitude**	**Communication**	**Problem Solving**	**Individual and Team Work**	Investigation of Problems	**Modern Tool usage**	**Science and Society**	**Life - Long Learning**	**Ethics**	**Project Management**	**Environment and sustainability**	**The detailed functional knowledge of theoretical concepts and experimental aspects of chemistry**	**To integrate the gained knowledge with various contemporary and evolving areas in chemical sciences like analytical, synthetic, pharmaceutical etc.**	**understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomenon-based problems in chemical sciences.**	**Provide opportunities to excel in academics, research or Industry by research based innovative knowledge for sustainable development in chemical science**
2PH702.1: Discuss the purpose of research, research process and research design by acquiring the knowledge of	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**

types and method of research																
2PH702.2: conceptualize and design research projects, including selecting appropriate data collection methods and planning for subsequent analysis.	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
2PH702.3: explain the processing and analysis of data with the skills and knowledge necessary to manage and analyze data effectively.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
2PH702.4:understand a foundational understanding of the ethical considerations, philosophical principles, and standards of scientific conduct that are crucial in various fields of study.	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**

2PH702.5: Explain of the ethical considerations and standards related to publishing academic and research work.	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: **1–Low,** **2–Medium,** **3–High**

Course Curriculum Map:

POs &PSOsNo.	Cos No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**2PH702**.1: Discuss the purpose of research, research process and research design by acquiring the knowledge of types and method of research	SO1.1 SO 1.2SO 1.3 SO1.4 SO1.5		UNIT-I (76CH401.1): Introduction & Research design 1.1,1.2,1.3,1.4,1.5,1.6,1.7	• Error types of error
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**2PH702**.2: conceptualize and design research projects, including selecting appropriate data collection methods and planning for subsequent analysis.	SO2.1 SO 2.2SO 2.3 SO2.4 SO2.5		UNIT II (76CH-401.2): Data Collection & Analysis 2.1,2.2,2.3,2.4,2.5,2.6, 2.7, 2.8,2.9	• Sampling of materials
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**2PH702**.3: explain the processing and analysis of data with the skills and knowledge necessary to manage and analyze data effectively.	SO3.1SO3 .2 SO3.3 SO3.4 SO3.5		UNIT III (76CH-401.3): Processing and analysis of data 3.1, 3.2,3.3,3.4,3.5,3.6,3.7	• Chi-square test, its purpose and use.
PO1,2,3,4,5,6 7,8,9,10,11,12	**2PH702**.4:understand a foundational	SO4.1 SO		UNIT IV (76CH-401.4): Philosophy, Ethics	• Ethics with respect to science

PSO 1,2, 3, 4	understanding of the ethical considerations, philosophical principles, and standards of scientific conduct that are crucial in various fields of study.	4.2SO 4.3 SO4.4 SO4.5		& Scientific conduct 4.1, 4.2,4.3,4.4,4.5,4.6,4.7	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**2PH702**.5: Explain of the ethical considerations and standards related to publishing academic and research work.	SO5.1 SO 5.2SO 5.3 SO5.4 SO5.5		UNIT V (76CH-401.5): Publication Ethics 5.1,5.2,5.3,5.4,5.5,5.6,5.7	• Best practices

Curriculum Development Team

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3. Dr. Lovely Singh, Assistant Professor, Dept. of Physics
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CODE: 1CH701

COURSE NAME: Group theory and Spectroscopy I

Pre-requisite: Students should have basic knowledge of symmetry and group theory, electromagnetic radiation, interaction of electromagnetic radiation with matter and spectroscopy.

Rationale: The students studying group theory and spectroscopy should possess foundational understanding about, symmetry, EMR, NMR,PES.

Course Outcomes:

After the completion of this course, the learner will

1CH701.1: Explain and apply the basic concept symmetry and group theory.

1CH701.2: Describe fundamental aspects of spectroscopy and apply the knowledge these aspects on solving problem related to these.

1CH701.3: Apply the basic concept of microwave and its principle

1CH701.4:Explain and apply the principle of atomic spectroscopy and photo electron spectroscopy**.**

1CH701.5: Apply the knowledge of NMR principle, instrumentation and applications. And apply the knowledge to solve issues related to NMR spectroscopy

Unit-I: Symmetry and Group Theory

Symmetry elements and Symmetry operations, definitions of group, subgroups, relationship between orders of a finite group and its subgroup. Conjugacy relation and classes.

Unit-II: Unifying Principles

Electromagnetic radiation, interaction of electromagnetic radiation with matter –Absorption, emission, transmission, reflection, refraction, dispersion, polarization and scattering. Uncertainty relation and natural line width and natural line broadening, transition probability, results of time dependent perturbation theory, transition moment, selection rules, Intensity of spectral lines, Born Oppenheimer approximation, rotational, Vibrational and electronic levels.

Unit-III: Microwave Spectroscopy

Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non rigid rotors . Stark effect, nuclear and electron spin interaction and effect of external field.

Unit-IV: Electronic Spectroscopy

A-Atomic Spectroscopy: Energies of atomic orbitals, vector representation of momenta and vector coupling, spectra of hydrogen atoms and alkali metal atoms.

Photo electron spectroscopy: Basic principles, photo-electric effect, ionization process, Koopman's theorem, photo electron spectra of simple molecules.

Unit-V: Nuclear Magnetic Resonance Spectroscopy

Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift, deshielding, spin-spin interactions, factor influencing coupling constant"J". Classification (ABX,AMX,ABC,A2B2,etc.), spin decoupling, basic ideas about instrument.

Scheme of Studies:

Board Of Study	**Course Code**	**Course Title**	**Scheme ofstudies(Hours/Week)**					**Total Credits(C)**
			Cl	**LI**	**SW**	**SL**	**Total Study Hours(CI+LI+SW+ SL)**	
Program Core (PCC)	1CH701	Group theory and spectroscopy	4	0	1	1	6	4

Legend: **CI:** Class room Instruction (Includes different instructional strategies i.e .Lecture (L) and Tutorial (T) And others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locates using different instructional strategies) **SW:** Seasonal Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning,

C: Credits.

Note: SW& SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment: Theory

Board of Study	Couse Code	Course Title	**Scheme of Assessment (Marks)**						
			Progressive Assessment (PRA)					**End Semester Assessment (ESA)**	**Total Marks (PRA+ ESA)**
			Class/Home Assignment 5 number 3marks each (CA)	Class Test 2 (2best out of3) 10 marks each(CT)	Seminar one (SA)	Class Attendance (AT)	Total Marks (CA+CT+SA +AT)		
PCC	1CH701	Group theory and spectroscopy	15	20	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1CH701.1: Explain and apply the basics concept symmetry and group theory.

Approximate Hours

Activity	Apex Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction(CI)**	**Self Learning (SL)**
SO1.1Restate the concept of symmetry and symmetry elements. SO1.2 Apply concept of symmetry operation on compounds SO1.3 Describe different types of symmetry elements. SO1.4 Discuss about plane ofsymmetry and its types. SO1.5 Explain and apply the group ,sub group and classes of symmetry elements of a molecule.		**Unit-1 symmetry and grouptheory** Introduction of symmetry symmetry elements identity proper axis of symmetry improper axis of symmetry plane of symmetry in version centre symmetry operation group and sub group T1 Order of group T2 class of group T3 prediction of symmetry elements of molecules	Prediction of symmetry elements in benzene, PtCI4.

SW-1Suggested Sessional Work(SW):

a. Assignments:

Discuss the Symmetry elements and Symmetry operations of various types of molecules.

***b.** Mini Project:*

group, subgroups, order of group of symmetry elements.

c.** Other Activities (Specify)**):

Note on relationship between orders of a finite group and its subgroup

1CH701.2: Describe fundamental aspects of spectroscopy and apply the knowledge these aspects on solving problem related to these.

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Activity	AppX Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning(SL)
SO2.1 Restate the term electromagnetic radiation. **SO2.2** Describe the interaction of electromagnetic radiationwith matter with different phenomenon. **SO2.3** Discuss transmission,reflection, refraction		**Unit-2.0 Unifying Principles** Introduction of EMR discovery, properties of EMR. Types of electromagnetic radiation. Born Oppenheimer approximation. Interaction of electromagneticradiation with matter 2.6absorption and emission	interaction of electromagnetic radiation with matter

SO2.4 Explain and apply thephenomenon of scattering and polarization of light, its types and uses. **SO2.5** Explain elementary idea Uncertainty relation andnatural line width and natural line broadening, transition probability.		2.7Phenomenon's of transmission, reflection and refraction of light 2.8The phenomenon of scattering and polarization of light, its types and uses. 2.9 Uncertainty relation and naturalline width T1-Natural line broadening, transitionprobability. T2-Selection rule T3- factors affecting band width broadening.	

SW-2 Suggested Sessional Work (SW):

A .Assignments:

Discussion of different phenomenon's of electromagnetic radiation interaction with matter.

b. Mini Project:

Natural line width and natural line broadeningand factors affecting band width broadening.

c. Other Activities (Specify):

Write an essay on electromagnetic radiation, interaction of electromagnetic radiation with matter

1CH701.3: Describe details ofclassification of molecules, classical model of rigid rotator and analyses effect of isotopic substitution on the transition frequencies, intensities and stark effect.

Activity	**AppX Hrs**
Cl	15
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learnin g(SL)**
SO3.1 Restate classification of molecules, homo and hetroatomic microwave activity. **SO3.2** Explain, moment of inertia,kinetic energy and rotational energyof rigid rotator by classical model. **SO3.3** Explain selection rule and spectral intensities of rigid rotator. **SO3.4** Describe the effectof isotopic substitution on the transition frequencies. **SO3.5** Explain and apply stark effect, nuclear and electron spin interaction and effect of external field.		**Unit-3.0** **Microwav eSpectroscopy** Classification of molecules homo and hetroatomic molecules microwave activity microwave activity. 3.4Moment of inertia of rigid rotator. 3.5kinetic energy of rigid rotator. 3.6rotational energyof rigid rotator by classical model Mathematical derivation of rigid rotator by classical model selection rule and spectral intensities of rigid rotator. effect of isotopic substitution on the transition frequencies. T1 stark effect T2 Types of stark effect, T3nuclear and electron spin	Microwave activity of different molecules.

		interaction and effect of external field.	

SW-3 Suggested Sessional Work (SW):

a. Assignments:

Isotopic substitution on the transition frequencies.

b. *Mini Project:*

Stark effect, nuclear and electron spin interaction and effect of external field.

c. *Other Activities (Specify):*

Explanatory note on importance of Microwave Spectroscopy

1CH701.4: Explain energies of atomic orbital's, vector representation of momenta and vector coupling, spectra of hydrogen atoms and Photo electron spectroscopy

Activity	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO4.1 Explain and apply about Atomic Spectroscopy, Energies of atomic orbital's**,** vibronic transition. **SO4.2** Restate vector coupling of electron of atom andvector representation of momenta **SO4.3** Describe the spectra of hydrogen atoms with spectral lines and importance.		**Unit-4.0 Atomic Spectroscopy** 4.1 Energies of atomic orbital's 4.2 electronic transition, 4.3 frank Condon principle. 4.4 vector representation of momenta 4.5 vector coupling of electron of atom. 4.6The spectra of hydrogen atoms with spectral lines and importance. 4.7 Photo electron spectroscopy**-** 4.8 Types of PES, Basic	Types of electronic transition and vibronic transition.

SO4.4 Discuss Photo electron spectroscopy**-** Basic principles, mechanism of photoelectric effect. **SO4.5** Explain and apply instrumentation of photo electron spectrometer and its application		principles, 4.9 mechanism of photoelectric effect, ionization process. T1 Instrumentation of photo electron spectrometer T2 its application. T3 PES Spectra of molecules	

*Suggested Sessional Work (SW)**:***

a. Assignments:

Spectra of hydrogen atom and spectral line with importance.

***b.** Mini Project:*

Vector representation of momenta and vector coupling of electron of atom.

b. Other Activities (Specify):

Importance and applications of photo electron spectroscopy.

1CH701.5: Apply the knowledge of the Nuclear Magnetic Resonance Spectroscopy, NMR activity,chemical shift and its measurements, factors influencing chemical shift, spin-spin interactions, basic ideas about instrument.

Activy	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning(SL)**
SO5.1 Explain and apply the introduction of NMR ,Nuclearspin, nuclear resonance **SO5.2** Describe shielding and deshielding of magnetic nuclei. **SO5.3** Restatechemical shift , delta value and its measurements and factors influencing chemical shift, **SO5.4** Discuss spin-spin interactions, factor influencing coupling constant. **SO5.5** Restate spins decoupling and basic ideas about instrumentation of NMR spectrophotometer.	.	**Unit-5.0 Nuclear MagneticResonance Spectroscopy.** 5.1 introduction of NMR. 5.2Nuclear spin quantum number NMR activity, nuclear resonance Shielding and deshielding of magnetic nuclei. chemical shift, delta value and TMS scale. delta value and its measurements 5.7factors influencing chemical shift. 5.8 spin-spin interactions, 5.9Factor influencing coupling constant “J” T1-Classification (ABX, AMX, ABC,A2B2 etc.) T2 Spin decoupling and basic ideasabout it. T3-Instrumentation of NMR spectrophotometer.	Chemical shift and its measurements of different organic compound.

SW-5 Suggested Sessional Work (SW):

a. **Assignments:**

Chemical shift and its measurements of different organic compound.

c. *Mini Project:*

Spin-spin interactions and coupling constant "J" for (ABX,AMX,ABC,A2B2,etc.),

d. *Other Activities (Specify):*

Basic ideas about instrumentation of NMR spectrophotometer.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning(Sl)	Total hour (Cl+SW+Sl)
1CH701.1: Explain and apply the basic concept symmetry and group theory.	12	02	01	15
1CH701.2: Describe fundamental aspects of spectroscopy and apply the knowledge these aspects on solving problem related to these	12	02	01	15
1CH701.3: Apply the basic concept of microwave and its principle.	12	02	01	15
1CH701.4 Explain and apply the principle of atomic spectroscopy and photo electron spectroscopy .	12	02	01	15
1CH701.5: Explain of NMR principle, instrumentation and applications. And apply the knowledge to solve issues related to NMR spectroscopy.	12	10	05	15
Total Hours	60	10	05	75

Suggestion for End Semester Assessment

Suggested Specification Table(For ESA)

CO	UnitTitles	MarksDistribution			Total Marks
		R	U	A	
CO-1	Symmetry and Group Theory	03	01	01	05
CO-2	Unifying Principles	02	06	02	10
CO-3	Microwave Spectroscopy	03	07	05	15
CO-4	Electronic Spectroscopy	-	10	05	15
CO-5	Nuclear Magnetic Resonance Spectroscopy	03	02	-	05
Total		11	26	13	50

Legend: R:Remember, U:Understand, A:Apply

The end of semester assessment for Organic Chemistry I will be held withwritten examination of 50 marks

Note.Detailed Assessmentrubric need to be prepared by the course wise teachers for above tasks.Teachers can also design different tasks as per requirement,for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to NCL, CSIR laboratories
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration /Tutorials CBT,Blog,Facebook,Twitter,Whatsapp,Mobile,Online sources)
9. Brain storming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition& Year
1	Modern Spectroscopy	J. M. Hoilas	John Wiley.	Revised editionedition2 020
2	Applied Electron Spectroscopy for Chemical Analysis	Ed. H. Windawiand F. L. HO	Wiley Interscience.	New edition, 2021
3	NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry	R. V. Parish	Ellis Harwood.	New edition, 2021
4	Physical Mehtods in Chemistry	R. S. Drago	Saunders	Revised edition
5	Chemical Applicationsof Group Theory	F. A. Cotton.	--	Revised edition
6	Introduction to Molacular Spectroscopy	G. M. Barrow	McGRraw Hill.	2020Revised edition

SuggestedWebSources:

6. https://nptel.ac.in/course.html
7. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5
8. https://swayam.gov.in/explorer?category=Chemistry

ModeofDelivery:Lecture,demonstration,E-tutoring,discussion,assignments,quizzes, case study, power point;

Title: Group Theory and Spectroscopy I **Course Code : 1CH701**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
	Knowledge	**Research Aptitude**	**Communication**	**Problem Solving**	**Individual and Team Work**	Investigation of Problems	**Modern Tool usage**	**Science and Society**	**Life-Long Learning**	**Ethics**	**Project Management**	**Environment and sustainability**	**The detailed functional knowledge of theoretical concepts and experimental aspects**	**To integrate the gained knowledge with various contemporary and evolving areas in chemical sciences like analytical,**	**understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic**	**Provide opportunities to excel in academics, research or Industry by research based innovative**

													of chemistry	**synthetic, pharmaceutical etc.**	**and phenome non-based problems in chemical sciences.**	**knowledge for sustainable development in chemical science**
CO1: Explain and apply the basic concept symmetry and group theory.	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**
CO 2 Describe fundamental aspects of spectroscopy and apply the knowledge these aspects on solving problem related to these	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
CO3 Apply the basic concept of microwave and	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**

its principle																
CO 4: Explain and apply the principle of atomic spectroscopy and photo electron spectroscopy	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO 5 Explain of NMR principle, instrumentation and applications. And apply the knowledge to solve issues related to NMR spectroscopy	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend:1–Low,2–Medium, 3–High

Course Curriculum Map:

POs & PSOsNo.	**COsNo.&Titles**	**SOsNo.**	**Laboratory Instuction (LI)**	**Classroom Instruction(CI)**	**Self Learning(SL)**
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO-1: : Explain and apply the basic concept symmetry and group theory.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 group theory and spectroscopy 1.1,1.2,1.3,1.4,1.5,1.6,1.7	Prediction of symmetry elements in benzene, PtCI4.
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO 2 : Describe fundamental aspects of spectroscopy and apply the knowledge these aspects on solving problem related to these	SO2.1 SO2.2 SO2.3 SO2.4 SO2		Unit-2 Uni	interaction of electromagnetic radiation with matter

		.5		fying Principles 2.1, 2.2, 2.3, 2.4,	

				2.5,2.6,2.7,2.8,2.9	
PO1,2,3,4,5,6 7,8,9,10,11,12	CO3 : Apply the basic concept of microwave and its principle	SO3.1 SO3.2 SO3.3		Unit-3 : Micr	Microwave activity of different molecules.

				owave Spectroscopy 3.1, 3.2, 3.3,	

PSO 1,2, 3, 4		SO3.4 SO3.5		3.4, 3.5, 3.6, 3.7	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO 4: Explain and apply the principle of atomic spectroscopy and photo electron spectroscopy	SO4.1 SO 4.2 SO4.3 SO4.4 SO4.5		Unit-4 : Electronic Spectroscopy 4.1, 4.2,4.3,4.4,4.5,4.6, 4.7	Types of electronic transition and vibronic transition
PO1,2,3,4,5,6 7,8,9,10,11,12	CO 5: Explain of NMR principle, instrumentation and applications. And apply the knowledge to	SO5.1 SO 5.2		Unit	Chemical shift and its measurements of different organic

PSO 1,2, 3, 4	solve issues related to NMR spectroscopy	SO5 .3 SO5 .4 SO5 .5		5 : N u c l e a r M a g n e t i c R e s o n a n c e S p e c	compound

				t r o s c o p y 5.1,5.2,5.3,5.4,5.5, 5.6,5.7		

Curriculum Development Team:

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3) Dr. Samit Kumar,Asso. Prof. , Department of Chemistry, AKS University, Satna (M.P.).
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5) Dr. Manoj Kumar Sharma, Asst. Prof. Department of Chemistry, AKS University, Satna (M.P.).
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Code: 2CH701
Course Name: Industrial Chemistry

Pre-requisite: Students should have basic knowledge of chemical industry, theoretical aspect of glass, ceramics, fertilizer and cement manufacturing soap, match,metal powders'.

Rationale: The students studying organic chemistry should possess foundational understanding about chemical bonding, structure, reactions and stereochemistry of organic compounds. This will provide applicalbe knoweledge about Nature of bonding in organic compounds, stereochemistry of organic compounds, reaction mechanisms, structure and reactivity, aliphatic and aromatic nucleophilic substitution

CourseOutcomes:

Afterthe completionofthiscourse, thelearner willbeableto:

2CH701.1: Apply quality of raw materials and energy for specific chemical industry

2CH701.2: Expert in theoretical aspect of glass, ceramics, fertilizer and cementmanufacturing.

2CH701.3: Explain preparation of materials in small scale industries like soap, match,metal powders etc

2CH701.4:Perform work according to need of sugar industry

2CH701.5: Capable to provide solution of environmental issues related tochemical industry

Unit I

Raw Materials and Energy for Chemical Industry: Raw materials – Characteristics of raw materials and their resources – methods of raw material concentrations – integral utilization of raw materials. Energy for chemical industry – Fuels – classification of fuels – coal – fuel gases and liquid fuels – petroleum – cracking – Octane number – cetane number – composition and uses of coal gas, water gas, producer gas,oil gas and gobar gas.

Unit II

Cement, Ceramics, Glass and Fertilizers Cement: Manufacture – Wet Process and Dry process. Types, Analysis of major constituents, setting of cement, reinforced concrete. Cement industries in India. Ceramics: Important clays and feldspar, glazing and verification.

Glass: Types, Composition, manufacture of Optical glass, colored glasses, lead glass and neutron absorbing glass. Fertilizers: Fertilizer industries in India, Manufacture of ammonia, ammonium salts, urea, superphosphate, triple superphosphate and nitrate salts.

Unit III

Small Scale Chemical Industries Electrothermal and electrochemical industries: electroplating surface coating industries – oils, fats and waxes – soaps and detergents – cosmetics. Match industries and fire works: manufacture of some industrially important chemicals like potassium chlorate, and red

phosphorus – metal powders.

Unit IV

Sugar and Agro Chemical Sugar: Cane sugar manufacture, recovery of sugar from molasses, sugar estimation, sugar industries in India. Agrochemical industries: Important categories of insecticides, fungicides, herbicides. Mode of action and synthesis of common pesticides like Gammexane, DDT, alathrin, Parathion, Malathion, Baygon, DDVP, Warfarin.

Unit V

Industrial Pollution & Chemical Toxicology Introduction – causes of industrial pollution – thermal power plants – nuclear power reactors– fertilizers andchemical industry – pulp and paper industries – agro based industries – cement industry. Toxic Chemicals in the environment – biochemical effects of arsenic, cadmium, lead, mercury and cyanide.

SchemeofStudies:

Board ofStudy	Course Code	CourseTitle	Scheme ofstudies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours(CI+LI+SW+SL)	
ProgramCore(PCC)	2CH701	INDUSTRIAL Chemistry	4	0	1	1	5	4

Legend: **CI:** Class room Instruction (Includes different in structional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop,field or other location susing different instructional strategies)
SW: Sessional Work (includes assignment,seminar, miniproject etc.),
SL: Self Learning,
C: Credits.

Note:

SW&SLhastobeplannedandperformedunderthecontinuousguidanceandfeedbackofteacherto ensure outcome ofLearning.

Scheme of Assessment:
Theory

Board ofStudy	Couse Code	CourseTitle	SchemeofAssessment(Marks)						
			ProgressiveAssessment(PRA)					EndSemesterAssessment	Total Marks
			Class/HomeAssignment5number 3 markseach (CA)	Class Test2 (2bestout of3) 10 marks each(CT)	Seminarone (SA)	ClassAttendance (AT)	TotalMarks (CA+CT+SA+AT)	(ESA)	(PRA+ESA)
PCC	2CH701	IndustralL **Chemistry**	15	20	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

2CH701.1: Apply quality of raw materials and energy for specific chemical industry

Activity	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction(LI)**	**Class room Instruction(CI)**	**Self Learning (SL)**
SO1.1 Expain Raw materials Characteristics of raw materials and their resources.		Unit-1. Raw Materials and Energy for Chemical Industry	Characteristics of raw
SO1.2 Apply methods of raw material concentrations ,integral utilization of raw materials SO1.3 Explain Fuels , classification of fuels coalfuel gases and liquid fuels SO1.4 Describe petroleum , cracking,Octane number , cetane number SO1.5 explain following topic-water gas, producer gas, oil gas and gobar gas.		methods of raw material concentrations integral utilization of raw materials Energy for chemical industry Fuels , classification of fuels coal solid fuel gases and liquid fuels petroleum – cracking Octane number – cetane number composition and uses of coal gas, water gas, producer gas, oil gas and gobar gas. T1- Fuels and characterization T2- raw material method T3 classification of coal analysis	materials and their resources composition and uses fuels

SW-1SuggestedSessionalWork(SW):

a.Assignments: discuss Raw materials – Characteristics of raw materials and their resources – methodsof raw material concentrations – integral utilization of raw materials
b.Mini Project: Fuels – classification of fuels
c.Other Activities (Specify):

- Note on applications of coal gas, water gas, producer gas, oil gas and gobar gas.

2CH701.2: Explain in theoretical aspect of glass, ceramics, fertilizer and cement manufacturing.

Activity	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning(SL)**

SO2.1 Describe & apply Cement: Manufacture – Wet Process andDry process **SO2.2** Explain Analysis of majorconstituents, setting of cement,reinforced concrete. Cement industries in India **SO2.3** Explain Glass: Types, Composition, manufacture of Optical glass, colored glasses, lead glass and neutron absorbing glass. **SO2.4** Understand and apply Glass: Types, Composition,		Unit-2 Cement, Ceramics, Glass and Fertilizers Cement: Manufacture Wet Process and Dry process. Types of cement . Analysis of major constituents, setting of cement, reinforced concrete. Cement industries in India. Ceramics Important clays and feldspar, glazing and verification. Glass Types, Composition, manufacture of Optical glass, colored glasses, lead glass and neutron absorbing glass. Fertilizers Fertilizer industries in India, Manufacture of ammonia, ammonium salts,	Types of cement . Glass: Types, Composition, manufacture of Optical glass, colored glasses, lead glass and neutron absorbing glass Fertilizers use
manufacture of Optical glass, colored glasses, lead glass and neutron absorbing glass. **SO2.5** Explain Fertilizers: Fertilizer industries in India, Manufacture of ammonia, ammonium salts, urea, superphosphate, triple superphosphate and nitrate salts.		urea, superphosphate, triple superphosphate and nitrate salts. T1- manufacture of Fertilizers T2- Manufacture of ammonia, ammonium salts, T3- setting and hardning of cement	

SW-2 Suggested Sessional Work (SW):

a.Assignments:
Apply Glass Types, Composition, manufacture of Optical glass, colored glasses, lead glassand neutron absorbing glass.
b.Mini Project: Fertilizers: Fertilizer industries in India,
c.Other Activities (Specify): Write uses of Fertilizers.

2CH701.3: Explain preparation of materials in small scale industrieslike soap, match,metal powders etc

Activity	AppX Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning(SL)
SO3.1 Understand and applySmallScale Chemical Industries **SO3.2** ExplainElectrothermal andelectrochemical industries **SO3.3** Explain electroplating – surface coating industries **SO3.4** Apply effect oils, fats andwaxes – soaps and detergents –cosmetics **SO3.5** Explain and apply Match industries and fire works: manufacture of some industrially important chemicals like potassium chlorate, and red phosphorus – metal powders.		**Unit-3.** Small Scale Chemical Industries Electrothermal and electrochemical industries electroplating surface coating industries oils, fats and waxes soaps and detergents cosmetics. Match industries and fire works manufacture of some industrially important chemicals potassium chlorate, and red phosphorus – metal powders. T1- manufacture of some industrially chemical T2- manufacture of soap and detergents. T3- important chemicals potassium chlorate, and red phosphorus – metal powders.	oils, fats and waxes chemicals lik epotassium chlorate, and red phosphorus – metal powders.

SW-3 Suggested Sessional Work (SW):

a.Assignments: soaps and detergents – cosmetics.
b.Mini Project: Match industries and fire works
c.Other Activities (Specify): manufacture of some industrially important chemicals potassium chlorate, and red phosphorus – metal powders.

2CH701.4: Explain Perform work according to need of sugar industry.

Activity	AppX Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction(LI)	Class room Instruction (CI)	Self Learning(SL)
SO4.1 Explain and apply Sugar and Agro Chemical Sugar: **SO4.2** ExplainCane sugar manufacture, recovery of sugar from molasses, **SO4.3** Explain Agrochemicalindustries **SO4.4**Explain and applyImportant categories of insecticides, fungicides, herbicides **SO4.5** Explain and apply synthesis of common pesticides like Gammexane, DDT, alathrin, Parathion, Malathion, Baygon, DDVP, Warfarin.		**Unit-4** Sugar and Agro Chemical Sugar Cane sugar manufacture, recovery of sugar from molasses, sugar estimation, sugar industries in India. Agrochemical industries Important categories of insecticides, fungicides, herbicides. Mode of action and synthesis of common pesticides Gammexane, DDT, alathrin, Parathion, Malathion, Baygon, DDVP,Warfarin. T1- manufacture of suger . T2- synthesis of common pesticides T3- synthesis of fungicides	sugar estimation, sugar industries in India. Agrochemical industries

SW-4 Suggested Sessional Work (SW):

a.Assignments: Cane sugar manufacture, recovery of sugar from molasses,
b.Mini Project: synthesis of common pesticides like Gammexane, DDT, alathrin, Parathion, Malathion,Baygon, DDVP, Warfarin.
c.Other Activities (Specify):
Impotance and applications of insecticides, fungicides, herbicides.

2CH701.5: Apply the knowledge of the Capable to provide solution of environmental issues related tochemical industry

Activity	AppX Hrs
Cl	07
LI	0
SW	2
SL	1
Total	15

Session Outcomes(SOs)	Laboratory Instruction(LI)	Class room Instruction (CI)	Self Learning(SL)
SO5.1 Explain and apply Industrial Pollution & Chemical Toxicology Introduction **SO5.2** Explain causes of industrial pollution thermal power plants power reactors– fertilizers andchemical industry **SO5.3** Explain and apply effect of pulp and paper industries – agro based industries – cement industry **SO5.4** Explain Toxic Chemicals in the environment – **SO5.5** Explain and apply biochemical effects of arsenic, cadmium, lead, mercury and cyanide.	.	**Unit-5-** 5.1 Industrial Pollution 5.2 Chemical Toxicology 5.3causes of industrial pollution thermal power plants power reactors– fertilizers andchemical industry pulp and paper industries agro based industries – cement industry. Toxic Chemicals in the environment biochemical effects of arsenic, cadmium, lead, mercury and cyanide. T1- Toxic Chemicals in the environment T2- biochemical effects of many chemicals. T3- causes of industrial pollution	Toxic Chemicals in theenvironment – biochemical effects of arsenic, cadmium, lead, mercury and cyanide.

SW-5 Suggested Sessional Work (SW):

a.Assignments: power reactors– fertilizers andchemical industry, causes of industrial pollution – thermal power plants

b.Mini Project: Toxic Chemicals in the environment
c.Other Activities (Specify): biochemical effects of arsenic, cadmium, lead, mercury and cyanide

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	SessionalWork (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
2CH702.1: Apply quality of raw materials and energy for specific chemical industry	12	02	01	15

2CH701.2: Expert in theoretical aspect ofglass, ceramics, fertilizer and cement manufacturing.	12	02	01	15
2CH701.3: Explain preparation of materials in small scale industries like soap, match, metal powders etc	12	02	01	15
2CH701.4:Perform work according to need of sugar industry	12	02	01	15
2CH701.5:. Capable to provide solution of environmental issues related to chemical industry	12	02	01	15
Total Hours	60	10	05	75

Suggestion for End Semester

Assessment

SuggestedSpecificationTable(ForESA)

CO	**UnitTitles**	**MarksDistribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Unit1	03	01	01	05
CO-2	Unit 2	02	06	02	10
CO-3	Unit 3	03	07	05	15
CO-4	Unit4	-	10	05	15
CO5	Unit 5	3	2	0	05
Total		11	26	13	50

Legend: **R:Remember, U:Understand,A:Apply**

The end of semester rassessment for industrial chemistry will be held with writtenexamination of 50 marks

Note.Detailed Assessment rubric need to be prepared by the cours ewiseteachersforabovetasks.Teacherscanalsodesigndifferenttasksasperrequirement,for endsemester assessment.

Suggested Instructional/Implementation Strategies:

37. ImprovedLecture
38. Tutorial
39. CaseMethod
40. GroupDiscussion
41. RolePlay
42. Visitto NCL, CSIR laboratories
43. Demonstration
44. ICTBasedTeachingLearning(VideoDemonstration/ T utorialsCBT,Blog,Facebook,Twitter,Whatsapp,Mo b ile,Onlinesources)
45. Brainstorming

Suggested Learning Resources:

(m) Books:

(n) (m)

S. No.	Title	Author	Publisher	Edition& Year
1	Chemical Technology,Vol. 1	I.Mukhlyonov(ed.), ,	Mir publication, Moscow	III edn., 1979
2	Environmental Chemistry,	A.K.De.,	Wiley Eastern Ltd.,11	edn., Meerut 1989.Chs 5-7
3	Industrial chemistry	B.K Sharma	Goel publishing house	
4	, Industrial Chemistry	B.N.Chakrabarty,	, Oxford&IBH Publishing Co.,New Delhi, 1981.	.,New Delhi, 1981.
5	Industrial Chemistry,	P.P.Singh, T.M.Joseph, R.G.Dhavale ,	, Himalaya Publishing House,Bombay,	, 4^{th} edn., 1983

6	, Environmental Pollution and Health Hazards – Causes and Control	A.K. Mukherjee,	Galgotia Press, NewDelhi 1986.	Press, New Delhi 1986.

Suggested Web Sources

1. https://nptel.ac.in/course.html
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5
3. https://swayam.gov.in/explorer?category=Chemistry

Mode Of Transaction:Lecture,demonstration,E-tutoring,discussion,assignments,quizzes, case study,power point;
LMS/ICT Tools: Digital Classrooms, DLMS, ZOOM, G-Suite,MSPower-Point, Online ResourcesDelhi 1986…….

Cours title ; Industrial Chemistry   Course code: 2CH701

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
	Knowledge	Research Aptitude	Communication	Problem Solving	Individual and Team Work	Investigation of Problems	Modern Tool usage	Science and Society	Life-Long Learning	Ethics	Project Management	Environment and sustainability	The detailed functional knowledge of theoretical concepts and experimental aspects of chemistry	To integrate the gained knowledge with various contemporary and evolving areas in chemical sciences like analytical, synthetic, pharmaceutical etc.	understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomenon-based problems in chemical sciences.	Provide opportunities to excel in academics, research or Industry by research based innovative knowledge for sustainable development in chemical science
CO1 : Apply quality of raw materials and energy for specific chemical industry	3	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1
CO 2 : : Expert in theoretica laspect of glass, ceramics, fertilizer and cement manufacturing	2	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1
CO3 : Explain preparation o fmaterials in small scale industries like soap, match,metal powders etc	2	2	1	1	1	2	2	2	1	2	1	2	1	1	2	2

CO 4: Perform work according to need ofsugar industry	2	2	2	2	3	2	3	2	2	1	2	3	3	3	3	2
CO 5:. Capable to provide solution of envirmental issues related to chemical industry	2	-	-	1	1	3	3	3	1	1	2	2	3	3	1	3

Course Curriculum Mapping

POs &PSOsNo.	COsNo.&Titles	SOsNo.	LaboratoryInstruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO-1:Apply quality of raw materials and energy for specific chemical industry	SO1.1SO1.2 SO1.3SO1.4 SO1.5		Unit-1.Raw Materials and Energy forChemical Industry 1.1,1.2,1.3,1.4,1.5,1.6,1.7	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO 2 : Expert in theoretical aspect of glass, ceramics, fertilizer and cement manufacturing.	SO2.1SO2.2 SO2.3 SO2.4 SO2.5		Unit-2. Cement, Ceramics, Glass andFertilizers Cement: Manufacture 2.1,2.2,2.3,2.4,2.5,2.6, 2.7, 2.8,2.9	.
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO3 : : Explain preparation of materials in small scale industries like soap, match, metal powders etc	SO3.1SO3. 2SO3.3 SO3.4 SO3.5		Unit-3 : Small Scale Chemical IndustriesElectrothermal and electrochemical industries 3.1, 3.2,3.3,3.4,3.5,3.6,3.7	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO 4: Perform work according toneed of sugar industry	SO4.1SO4.2 SO4.3SO4.4 SO4.5		Unit-4 : Sugar and Agro Chemical Sugar 4.1, 4.2,4.3,4.4,4.5,4.6,4.7	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO 5: :. Capable to provide solution of envirmental issues related to chemical industry	SO5.1SO5. 2SO5.3SO5 .4 SO5.5		Unit 5: Industrial Pollution &Chemical Toxicology 5.1,5.2,5.3,5.4,5.5,5.6,5.7	Toxic Chemicals in the environment .

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Course Name: Research Methodology & Research Ethics
Course Code: 2CH702

Pre-requisite: Students must have fundamental knowledge of precision and accuracy, types of error, datacollections, mean, median and mod etc to understand the concept of research program and its methodology.

Rationale: The rationale for choosing a specific research methodology is crucial as it provides a solid foundation forthe entire research process. The choice of methodology should align with the research objectives and questions, guiding the researcher in collecting, analyzing, and interpreting data.

Course Outcomes:
After the completion of this course, the learner will able to
2CH702.1: Discuss the purpose of research, research process and research design by acquiring the knowledge oftypes and method of research.

2CH702.2: Conceptualize and design research projects, including selecting appropriate data collection methodsand planning for subsequent analysis.

2CH702.3: Explain the processing and analysis of data with the skills and knowledge necessary to manage and analyze data effectively.

2CH702.4:Understand a foundational understanding of the ethical considerations, philosophical principles, and standards of scientific conduct that are crucial in various fields of study.
2CH702.5: Explain of the ethical considerations and standards related to publishing academic and research work.

UNIT-I (2CH702.1): Introduction & Research design

Nature and objectives of research, Methods of Research: historical, descriptive and experimental. Types of Research, Research process, research approaches, criteria for good research meaning of research design .

UNIT II (2CH702.2): Data Collection & Analysis

Types of data, methods and techniques of data collection, Hypothesis Testing, primary and secondary data, meta analysis, historical methods, content analysis, devices used in data collection.

UNIT III (2CH702.3): Processing and analysis of data

Measures of central Tendency. Measures of dispersion. Measures of variation. Measures of central tendency vs. measures of dispersion. Normal distribution. Measures of skewness and Interpretation. Correlation and regression: types & application. Chi-square test its purpose and use.

UNIT IV (2CH702.4): Philosophy, Ethics & Scientific conduct

Introduction to philosophy: definition, nature and scope, concept, branches, Ethics: definition, moral philosophy, nature of moral judgements and reactions, Ethics with respect to science and research Intellectual honesty and research integrity,

UNIT V (2CH702.5): Publication Ethics

Publication ethics: definition, introduction and importance , Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest Pblication misconduct: definition, concept, problems that lead to unethical behavior and vice versa.

Reference Book
Research in Education, 10th Edition, Best &
KahnResearch Methodology C.R.KOTHAR
Methodology of Educational Research, Lokesh

KoulSUGGESTED WEB SOURCES

- https://nptel.ac.in/course.html
- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5
- https://swayam.gov.in/explorer?category=Chemistry

Mode OF Transaction:Lecture,demonstration,E-tutoring,discussion,assignments,quizzes, case study, powerpoint; LMS/ICT Tools**:** Digital Classrooms, DLMS, ZOOM, G-Suite,MSPower-Point, Online Resources.

Mappingof COandPO for

76CH-401Scheme of Studies:

Board ofStudy	CourseCode	CourseTitle			Scheme ofstudies (Hours/Week)			Total Credits(C)
			Cl	LI	SW	SL	Total Study Hours(CI+LI+SW+SL)	

Legend : CI: ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)andothers),
LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworkshop,fieldorotherlocationsusingdifferentinstructionalstrategies)
SW: SessionalWork(includesassignment,seminar,miniprojectetc.),

SL: SelfLearnin
g,**C:** Credits.

Note:

SW&SL has to be planned and performed under the continuous guidance and feedbackk of teacher to ensure outcome of Learning.

SchemeofAssessment: Theory

Board ofStudy	Course Code	Course Title	**SchemeofAssessment(Marks)**						
			ProgressiveAssessment(RA)					**EndSemester Assessment (ESA)**	**Total Marks (PRA + ESA)**
			Class/HomeAssignment5number 3 markseach (CA)	Class Test2 (2bestoutof3) 10 markseach(CT)	Seminarone + Class activity	ClassAttendance (AT)	Total Marks (CA+CT +SA +AT)		
PCC	2CH702	Research Methodology & Research Ethics	15	20	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs)upon the course's conclusion.

UNIT-I (2CH702.1): Introduction & Research design

Nature and objectives of research, Methods of Research: historical, descriptive and experimental. Types of Research, Research process, research approaches, criteria for good research meaning of research design.

Activity	**AppX Hrs**
Cl	06
LI	0
SW	1
SL	1
Total	08

Session Outcomes (SOs)	LI	CI	SL
After the completion of topics students will be able to SO1.1 understand the nature and objectives of research SO1.2 describe the methods of research like historical, descriptive and experimental SO1.3 explain the criteria for good research like meaning of research design		**UNIT-I (76CH401.1): Introduction & Researchdesign** Introduction to nature and objectives of research Methods of Research: historical, descriptive and experimental. Types of Research Research process Research approaches Criteria for good research meaning of research design.	• Error types of error

SW-1 Suggested Sessional Work(SW):
Assignments: Precision and accuracy
Mini Project:
Other Activities (Specify):

UNIT II (2CH702.2): Data Collection & Analysis

Types of data, methods and techniques of data collection, Hypothesis Testing, primary and secondary data, metaanalysis, historical methods, content analysis, devices used in data collection.

Activity	AppX Hrs
Cl	06
LI	0
SW	1
SL	1
Total	08

Session Outcomes (SOs)	Laboratory Instruction(LI)	Class room Instruction(CI)	Self Learning (SL)
After the completion of topics students will be able to **SO2.1** understand the types of data, methods and techniques of data collection **SO2.2** Explain primary and secondary data **SO2.3 Explain** devices used in data collection		**UNIT II (**76CH-401**.2): Data Collection & Analysis** Types of data, methods and techniques of data collection Hypothesis Testing, 2.15Primary and secondary data 2.16Deta analysis 2.17Historical methods T1. Content analysis, devices used in data collection.	• Sampling of materials

SW-2 Suggested Sessional Work (SW):

Assignments: Mean, median and mod

Mini Project:

Other Activities (Specify):

UNIT III (2CH702.3): Processing and analysis of data

Measures of variation. Measures of central tendency vs. measures of dispersion. Normal distribution. Measures ofskewers and Interpretation. Correlation and regression: types & application. Chi-square test its purpose and use.

Activity	AppX Hrs
Cl	06
LI	0
SW	1
SL	1
Total	08

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction(CI)**	**Self Learning (SL)**
After the completion of topics students will be able to **SO3.1** understand the measures of central tendency vs. measures of dispersion **SO3.2** understand measures of skewers and Interpretation **SO3.3** explain correlation and regression: types & application		**UNIT III (**76CH-401**.3): Processing andanalysis of data** Measures of central Tendency Measures of dispersion Measures of variation Normal distribution Measures of skewers and Interpretation Correlation and regression: types & application	• Chi-square test, its purpose and use.

SW-3 Suggested Sessional Work (SW):
Assignments: Chi-square test its purpose and use
Mini Project:
Other Activities (Specify):
UNIT IV (**2CH702.4): Philosophy, Ethics & Scientific conduct**
Introduction to philosophy: definition, nature and scope, concept, branches, Ethics: definition, moral philosophy, nature of moral judgments and reactions, Ethics with respect to science and research Intellectual honesty and research integrity,

Activity	**AppX Hrs**
Cl	06
LI	0
SW	1
SL	1
Total	08

Session Outcomes (SOs)	**Laboratory Instruction(LI)**	**Class room Instruction(CI)**	**Self Learning (SL)**
After the completion of topics students will be able to **SO4.1 understand** the term philosophy **SO4.2 explain the term e**thics with respect to science and research **SO4.3 explain i**ntellectual honesty and research integrity		UNIT IV (76CH-401**.4): Philosophy, Ethics & Scientific conduct** Introduction to philosophy Introduction to ethics: definition, moral philosophy Nature of moral judgments and reactions Ethics with respect to science andresearch Intellectual honestyT1 Research integrity	• Ethics with respect to science

SW-4 Suggested Sessional Work (SW)
Assignment: Nature of moral judgments and reactions
Mini Project:
Other Activities (Specify):

UNIT V
(2CH702.5): Publication Ethics
Publication ethics: definition, introduction and importance , Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa.

Activity	**AppX Hrs**
Cl	06
LI	0
SW	1
SL	1
Total	08

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction(CI)**	**Self Learning (SL)**
After the completion of topics students will be able to	.	UNIT V (76CH-401**.**5): Publication Ethics	• Best practices

SO5.1 understand publication ethics **SO5.2** explains best practices and standards setting initiatives **SO5.3 Explain the c**onflicts of interestand publication misconduct		Publication ethics: definition, introduction and importance Best practices / standards setting initiatives and guidelines COPE WAME Conflicts of interest Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa.	

SW-5 Suggested Sessional Work (SW):
Assignments: Standards setting initiatives and guidelines: COPE, WAME, etc
Mini Project:
Other Activities (Specify):

Brief of Hours suggested for the Course Outcome

Course Outcomes	**Class Lecture(Cl)**	**Sessional Work (SW)**	**Self Learning (Sl)**	**Total hour(Cl+SW+Sl)**
2CH702.1: Discuss the purpose of research, research process and research design by acquiring the knowledge of types and method of research	12	02	01	15
2CH702.2: conceptualize and design research projects, including selecting appropriate data collection methods and planning for subsequent analysis.	12	02	01	15
2CH702.3: explain the processing and analysis of data with the skills and knowledge necessary to manage and analyze data effectively.	12	02	01	15
2CH702.4:understand a foundational understanding of the ethical considerations, philosophical principles, and standards of scientific conduct that are crucial in various fields of study.	12	02	01	15
2CH702.5: Explain of the ethical considerations and standards related to publishing academic and research work.	12	02	01	15
Total Hours	60	10	05	75

Suggestion for End Semester Assessment

SuggestedSpecificationTable(ForESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	76CH401.1: Discuss the purpose of research, research process and research design by acquiring the knowledge of types and method of research	03	01	01	05
CO-2	76CH-401.2: Conceptualize and design research projects, including selecting appropriate data collection methods and planning for subsequent analysis.	02	06	02	10
CO-3	76CH-401.3: Explain the processing and analysisof data with the skills and knowledge necessary to manage and analyze data effectively.	03	07	05	15
CO-4	76CH-401.4:Understand a foundational understanding of the ethical considerations, philosophical principles, and standards of scientific conduct that are crucial in various fields of study.	-	10	05	15
CO-5	76CH-401.5: Explain of the ethical considerationsand standards related to publishing academic and research work.	03	02	-	05
Total		11	26	13	50

Legend: R:Remember, U:Understand, A:Apply

The written examination of 50 marks will be held at the end of semester for Inorganic Chemistry

Note.Detailed Assessment need to be prepared by the course wise teachers for above tasks. Teachers can also designdifferent tasks as per requirement ,for end semester assessment.

SuggestedInstructional/ImplementationStrategies:

46. Improved Lecture
47. Tutorial
48. Case Method
49. Group Discussion
50. Role Play
51. Visitto NCL, CSIR laboratories
52. Demonstration
53. ICT Based Teaching Learning (VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Wh a tsapp ,Mobile,Onlinesources)
54. Brainstorming

Suggested Learning Resources:

(o) Books:

S. No.	Title	Author	Publisher	Edition& Year
1	Research Methodology	C.R. Kothari	New Age International Publisher	2nd Revision edition
2	Handbook ofResearch Methodology	Dr. Shanti Bhushan Mishra and Dr. ShashiAlok	Educreation Publishing	2nd edition

SuggestedWebSources:

41. https://celqusb.files.wordpress.com/2017/12/inorganic-chemistry-g-l-miessler-2014.pdf
42. https://www.slideshare.net/MANISHSAHU106/inert-and-labile-complexes
43. https://swayam.gov.in/explorer?category=Chemistry

ModeofDelivery:Lecture,demonstration,E-tutoring,discussion,assignments,quizzes, case study, power point;

LMS/ICT Tools: Digital Classrooms, DLMS, ZOOM, G-Suite,MSPower-Point, Online Resources

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Title:Research Methodology & Research Ethics **Course Code : 2CH702**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
	Knowledge	**Research Aptitude**	**Communication**	**Problem Solving**	**Individual and Team Work**	Investigation of Problems	**Modern Tool usage**	**Science and Society**	**Life-Long Learning**	**Ethics**	**Project Management**	**Environment and sustainability**	**The detailed functional knowledge of theoretical concepts and experimental aspects of chemistry**	**To integrate thegained knowledgewith various contemporary and evolving areas in chemical scienceslike analytical,synthetic, pharmaceutical etc.**	**understand, analyze,plan and implementqualitative as well asquantitative analyticalsyntheticand phenomenon-based problems in chemical sciences.**	**Provide opportunities to excel in academics, research or Industry by research based innovative knowledge for sustainable development in chemical science**
76CH401.1: Discuss the purpose of research, research process and research design by acquiring the knowledge of types and method of research	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**
76CH-401.**2**: conceptualize and design research projects, including selecting appropriate data collection methods and planning for subsequent analysis.	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
76CH-401.**3**: explain the processing and analysis of data with the skills and knowledge necessary to manage and analyze data effectively.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
76CH-401.**4**:understand a foundational understanding of the ethical considerations, philosophical principles, and standards of scientific conduct that are crucial in various fields of study.	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**

76CH-401**.5:** Explain of the ethical considerations and standards related to publishing academic and research work.	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: **1–Low,** **2–Medium,** **3–High**

Course Curriculum Map:

POs &PSOsNo.	Cos No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	76CH401.1: Discuss the purpose of research, research process and research design by acquiringthe knowledge of types and method of research	SO1.1SO 1.2SO1.3 SO1.4 SO1.5		UNIT-I (76CH401.1): Introduction & Research design 1.1,1.2,1.3, 1.4,1.5,1.6, 1.7	• Error types of error
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	76CH-401.2: conceptualize and design research projects, including selecting appropriate data collection methods and planning for subsequent analysis.	SO2.1SO 2.2SO2.3 SO2.4 SO2.5		UNIT II (76CH-401.2): Data Collection & Analysis 2.1,2.2,2.3,2.4,2.5,2.6, 2.7, 2.8,2.9	• Sampling of materials
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	76CH-401.3: explain the processing and analysis of data with the skills and knowledge necessary to manage and analyze data effectively.	SO3.1SO3.2 SO3.3 SO3.4 SO3.5		UNIT III (76CH-401.3): Processing and analysis of data3.1, 3.2,3.3,3.4,3.5,3.6,3.7	• Chi-square
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	76CH-401.4:understand a foundationalunderstanding of the ethical considerations, philosophical principles, and standards of scientific conduct that are crucial in various fields of study.	SO4.1SO 4.2SO4.3SO4.4 SO4.5		UNIT IV (76CH-401.4): Philosophy, Ethics & Scientific conduct4.1, 4.2,4.3,4.4,4.5,4.6,4.7	• Ethics with respect to science
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	76CH-401.5: Explain of the ethical considerations and standards related to publishing academic and research work.	SO5.1SO 5.2SO5.3 SO5.4 SO5.5		UNIT V (76CH-401.5): Publication Ethics 5.1,5.2,5.3,5.4,5.5,5.6,5.7	• Best practices

Curriculum Development Team:

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AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Course Code: **1CS801**

Course Title : Statistical Thinking for Data Science

Pre-requisite: Student should have basic knowledge of Statistics and database

Rationale: Statistical Thinking for Data Science boosts the discovery of new and unexpected insights From data.

Course Outcomes:

CO1: Understand the statistical foundation for data science

CO2: Apply statistical thinking in collecting, modeling and analyzing data
CO3: Apply statistical thinking in collecting, modeling and analyzing data

CO4: Ability to visualize all types of data
CO5: Understand how to use R for different types of data

SchemeofStudies:

Board of Study	**Course Code**	**Course Title**	**Scheme of studies(Hours/Week)**					**Total Credits (C)**
			Cl	**LI**	**SW**	**SL**	**Total StudyHours(CI+LI+SW+SL)**	
Program Core (DCC)		Statistical Thinking for Data Science	4	4	2	1	11	6

Legend:

CI: ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial(T)andothers),
LI: LaboratoryInstruction(IncludesPracticalperformancelaboratoryworkshop, field or other locations using different instructional strategies)
SW: Sessional Work(includesassignment, seminar, mini project etc.),
SL: SelfLearning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacherto ensureoutcomeofLearning.

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

SchemeofAssessment:
Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA + ESA)
			Assignment 5 number 3 marks	(2 best out of 3) 10 marks	Seminar one (SA)	Activity any one	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
DCC	OE CII - A	Statistical Thinking for Data Science	15	20	5	5	5	50	50	100

Course-CurriculumDetailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1CS801.1: Understand the statistical foundation for data science

Approximate Hours

Item	Appx.Hrs.
Cl	12
LI	12
SW	1
SL	1
Total	26

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Define Data acquisition **SO1.2** Explain cleaning and aggregation **SO1.3** Explain Exploratory data analysis **SO1.4** Discuss data Visualization **SO1.5** Model creation and validation .	LI1.1. Calculate the mean, median, and mode for a given dataset. LI1.2. Determine the standard deviation and variance of a set of data points. LI1.3. Create a histogram and interpret the distribution of a dataset.	**Unit 1: Introduction to Data Science: (9 lecture)** 1.1 Data acquisition-I 1.2 Data acquisition-II 1.3 Cleaning-I 1.4 Cleaning-II 1.5 Aggregation-I 1.6 Aggregation-II 1.7 Exploratory data analysis-I 1.8 Exploratory data analysis-II 1.9 Visualization 1.10 Feature engineering 1.11 Model creation and 1.12 validation	1. Learn Feature engineering

SW-1 Suggested Sessional Work(SW):

a. **Assignments:**
   (i) **Discuss about different techniques of data analysis**

b. **Presentation**

1CS801.2: Apply statistical thinking in collecting, modeling and analyzing data

Approximate Hours

Item	AppXHrs
Cl	12
LI	12
SW	1
SL	1
Total	26

SessionOutcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO2.1 To Understand Statistical Thinking, **SO2.2** To learn different approaches of data sampling **SO2.3**To Explain Probability **SO2.4** To Explain Statistical Inference	LI2.1. Apply the concept of conditional probability to a real-world scenario. LI2.2. Use the binomial distribution to model a probability scenario. LI2.3. Apply the normal distribution to solve a problem involving z-scores. .	**Unit-2: Statistical Thinking1(9 lectures)** 2.1 Examples of Statistical Thinking, 2.2 Numerical Data 2.3 Summary Statistics 2.4 From Population to Sampled Data 2.5 Different Types of Biases-I 2.6 Different Types of Biases 2.7 -II 2.8 Introduction to Probability 2.9 Concepts of Probability-I 2.10 Concepts of Probability-II 2.11 Introduction to Statistical Inference 2.12 Concepts of Statistical Inference	1. learn different types of Biases.

SW-2 Suggested Seasonal Work (SW):

a. **Assignments:**
   (i) **Write about numerical data?**

b. Presentation

1CS801.3: Apply statistical thinking in collecting, modeling and analyzing data

Approximate Hours

Item	AppXHrs
Cl	12
LI	12
SW	1
SL	1
Total	26

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3. 1 To understand Association and Dependence SO3.2 know the Conditional Probability and Bays Rule SO3.3 To understand the Linear Regression. SO3.4 develop a Special Regression Model	LI3.1. Compute probabilities for simple events and joint events. LI3.2. Calculate the margin of error and construct a confidence interval. LI3.3. Perform a hypothesis test and interpret the results.	**Unit3:Statistical Thinking 2 (9 lecture)** 3.1 Association and Dependence 3.2 Association and Causation 3.3 Conditional Probability-I 3.4 Conditional Probability-II 3.5 Bays Rule 3.6 Example of Bays Rule 3.7 Simpsons Paradox 3.8 Example 3.9 Confounding 3.10 Introduction to Linear Regression 3.11 Questions based on linear regression 3.12 Special Regression Model.	I. Learn aboutSimpsons Paradox

SW-2 Suggested Seasonal Work (SW):

a. **Assignments:**
   (i) Explain Association and Causation

b. **Presentation**

1CS801.4: Ability to visualize all types of data

Approximate Hours

Item	App X Hrs
Cl	12
LI	12
SW	1
SL	1
Total	26

Session Out comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 To Understand the Goals of statistical graphics and data visualization **SO4.2** Explain the Graphs of Data **SO4.3** implement Graphs of Fitted Models **SO4.4** To Understand the Principles of graphics	LI4.1. Use autocorrelation and partial autocorrelation functions in time series analysis. LI4.2. Apply ARIMA modeling to make predictions in a time series dataset. LI4.3. Evaluate the accuracy of time series forecasts using appropriate metrics.	**Unit-4 : Exploratory Data Analysis and Visualization (9 lectures)** 4.1. Goals of statistical graphics and 4.2. data visualization 4.3. Graphs of Data-I 4.4. Graphs of Data-II 4.5. Graphs of Fitted Models-I 4.6. Graphs of Fitted Models 4.7. -II 4.8. Graphs to Check Fitted Models-I 4.9. Graphs to Check Fitted Models-II 4.10. What makes a good graph? 4.11. Principles of graphics.-I 4.12. Principles of graphics.-II	i. Draw a different graphs to fitted models

SW-4 Suggested Seasonal Work (SW):

a. **Assignments:**
   (i) Write the Principles of graphics?
b. Presentation
c. Pictorial representation of different graphs for data visualization.

1CS801.5: Understand how to use R for different types of data

Approximate Hours

Item	AppXHrs
Cl	12
LI	12
SW	1
SL	1
Total	26

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1To Understand Bayesian inference **SO5.2** Discuss combining models and data in a forecasting problem **SO5.3** To ExplainBayesian hierarchical modeling for studying public opinion **SO5.4** To Understand Bayesian modeling for Big Data	LI5.1. Apply Bayes' Theorem to update probabilities based on new information. LI5.2. Identify trends and seasonality in a time series dataset. LI5.3. Develop a research question for a data science project.	**Unit5: Introduction to Bayesian Modeling (8 lectures)** 5.1 Bayesian inference-I 5.2 Bayesian inference-II 5.3 combining models and data 5.4 combining models and data 5.5 forecasting problem 5.6 forecasting problem 5.7 Bayesian hierarchical modeling 5.8 Bayesian hierarchical modeling 5.9 studying public opinion 5.10 studying public opinion 5.11 Bayesian modeling for Big Data 5.12 Bayesian modeling for Big Data	I. Learn forecasting problem

SW-5Suggested Seasonal Work (SW):

a. **Assignments:**
   (i) Explain in detail about Bayesian hierarchical modeling
b. Presentation:
c. **Other Activities (Specify): Group discussion of important topics.**

Brief of Hours suggested for the Course Outcome

CourseOutcomes	Class Lecture (Cl)	Laboratory Instruction(LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
CO1. Understand the statistical foundation for data science	12	12	1	1	**26**

CO2 Apply statistical thinking in collecting, modeling and analyzing data	12	12	1	1	**26**
CO3 Apply statistical thinking in collecting, modeling and analyzing data	12	12	1	1	**26**
CO4 Ability to visualize all types of data	12	12	1	1	**26**
CO5 Understand how to use R for different types of data	12	12	1	1	**26**
Total Hours	60	60	5	5	130

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	MarksDistribution			TotalMarks
		R	U	A	
CO-1	Unit 1: Introduction to Data Science	03	02	03	08
CO-2	Unit-2: Statistical Thinking 1	03	01	05	09
CO-3	Unit3:Statistical Thinking2	03	07	02	12
CO-4	Unit-4 : Exploratory Data Analysis and Visualization	03	05	05	13
CO-5	Unit5: Introduction to Bayesian Modeling	03	02	03	08
Total		15	17	18	50

Legend: R: Remember, U: Understand, A:Apply

TheendofsemesterassessmentforStatistical Thinking for Data Sciencewillbeheld with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wiseteachers for above tasks. Teachers can also design different tasks as per requirement, for endsemesterassessment.

SuggestedInstructional/ImplementationStrategies:

1. ImprovedLecture
2. Tutorial
3. CaseMethod
4. GroupDiscussion
5. RolePla
6. Demonstration

7. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Face book, Twitter,WhatsApp,Mobile,Onlinesources)
8. Brainstorming

SuggestedLearningResources:

A. Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Computational Thinking: A Primer For Programmers And Data Scientists	G Venkatesh	Notion Press	2022
2	Data Science A Beginner's Guide	C. Raju	Penguin Random House	2023

B. Alternative NPTEL/SWAYAM/MOOC Course (if any): NA

1. .

COs,POs and PSOs Mapping

Course Title: B. Sc. IT
Course Code: 1CS801
Course Title: Statistical Thinking for Data Science

CourseOutcomes	ProgramOutcomes												ProgramSpecificOutcome				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO 4	PS0 5

	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct studies of difficult problems	Utilization of modern tools	Engineers and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-longlearning	Use fundamental knowledge of math, science, and engineering to comprehend, evaluate, and create computer Programmes in the fields of algorithms, multimedia, big data analytics, machine learning, artificial intelligence, and networking for the effective design of computer-based	Utilize relevant methods and cutting-edge hardware and software engineering tools to develop and integrate computer systems and related technologies. This PSO2 also encourages lifelong learning for the advancement of technology and its use	Applying professional engineering solutions for societal improvement while taking into account the environmental context, being conscious of professional ethics, and being able to effectively communicate	Learn and use the most recent Artificial Intelligence and Data Science technologies in the fields of engineering and computer science	Recognize and examine issues in real life, then offer creative software solutions with the help of AI and Data Science Technologies.

CO1 Understand the statistical foundation for data science	**1**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**	**2**
CO2 Apply statistical thinking in collecting, modeling and analyzing data	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**3**
CO3 Apply statistical thinking in collecting, modeling and analyzing data	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**	**2**
CO4 Ability to visualize all types of data	**-**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**	**3**
CO5 Understand how to use R for different types of data	**2**	**3**	**1**	**1**	**2**	**3**	**-**	**-**	**2**	**-**	**2**	**2**	**3**	**2**	**2**	**3**	**2**

Legend: 1 – Low, 2 – Medium, 3 – High

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Course Curriculum Map

POs&PSOsNo.	COsNo.&Titles	SOsNo.	LaboratoryInstruction (LI)	Classroom Instruction(CI)	Self-Learning(SL)
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4	**CO1** Understand the statistical foundation for data science	SO1.1 SO1.2 SO1.3 SO1.4	LI1.1,LI1.2,LI1.3	**Unit 1: Introduction to Data Science: (9 lecture)** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9, 1.10,1.11,1.12	Asmentioned in pagenumber above
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4	**CO2** Apply statistical thinking in collecting, modeling and analyzing data	SO2.1 SO2.2 SO2.3 SO2.4	LI2.1,LI2.2,LI2.3	**Unit-2: Statistical Thinking 1** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7,2.8,2.9,2.10,2.11,2.12	
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4	**CO3** Apply statistical thinking in collecting, modeling and analyzing data	SO3.1 SO3.2 SO3.3 SO3.4	LI3.1,LI3.2,LI3.3	**Unit3:Statistical Thinking2**3.1,3.2,3.3,3.4,3.5,3.6, 3.7,3.8,3.9,3.10,3.11,3.12	
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4	**CO4** Ability to visualize all types of data	SO4.1 SO4.2 SO4.3 SO4.4	LI4.1,LI4.2,LI4.3	**Unit-4 : Exploratory Data Analysis and Visualization** 4.1,4.2,4.3,4.4, 4.5,4.6,4.7,4.8, 4.9,4.10,4.11,4.12	
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4	**CO5** Understand how to use R for different types of data	SO5.1 SO5.2 SO5.3 SO5.4	LI5.1,LI5.2,LI5.3	**Unit5: Introduction to Bayesian Modeling** 5.1,5.2,5.3,5.4, 5.5,5.6,5.7,5.8, 5.9,5.10,5.11,5.12	

Curriculum Development Team

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2. Dr. Pramod Singh, Associate Professor, Department of Computer Science and Engineering.

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Ms. Pushpa Kushwaha, Assistant Professor, Department of Computer Science and Engineering

Course Code: 2CS801

Course Title: English for Research Paper Writing

Pre- requisite: Students should have basic knowledge of presenting themselves, their thoughts and ideas

Rationale: Writing a research paper is the primary channel for passing on knowledge to the scientist working in the same field or related fields. It is important to know the skill of writing papers to demonstrate your ability to understand, relate to what has been learnt, as well as receive critical peer feedback.

2CS801.1: Student will learn how to improve their writing skills, and level of readability

2CS801.2: Students will understand the concept of plagiarism, and how to avoid ambiguity and vagueness

2CS801.3: Students will learn about what to write in each section of paper

2CS801.4: Students will understand significance of each section of paper, and learn how to write it at the same time.

2CS801.5: Ensure the good quality of paper at very first-time submission

Scheme of Studies:

Board of Study	Course Code	Course Title			Scheme of studies (Hours/Week)			Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
RC	OECIII - B	English for Research Paper Writing	4	0	2	1	7	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Scheme of Assessment:
Theory

Board of Study	Couse Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	**(ESA)**	(PRA+ ESA)
RC	2CS 801	English for Research Paper Writing	15	20	5	5	5	50	50	100

Course-Curriculum Detailing

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO 1: Student will learn how to improve their writing skills, and level of readability

Approximate Hours

Item	Appx Hrs.
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**(LI)**	**Class room Instruction (CI)**	**(SL)**
SO1.1 Students learn to design the research paper. SO1.2 Students learn to read the research paper in a systematic way. SO1.3Examine and identify the redundancy in a research paper SO1.4 Learn to summarise and be concise SO1.5 Understand the concept of ambiguity and vagueness		Unit 1: Preparationof Research Paper 1.1 Steps to introduce to the technique of reading research paper 1.2 Steps to introduce to the technique of reading research paper continued 1.3 Breaking up of sentences, 1.4 Breaking up of sentences continued 1.5 structuring paragraphs 1.6 structuring paragraphs continued 1.7 Making the paper concise 1.8 Making the paper concise continued 1.9 removing redundancy 1.10 removing redundancy Continued 1.11 Concept of Ambiguity and 1.12 Concept of Vagueness	Reading research papers on relevant topics

CO2: Students will understand the concept of plagiarism, and how to avoid ambiguity and vagueness

Approximate Hours

Item	Appx Hours
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**(LI)**	**Class room Instruction (CI)**	**Self - Learning (SL)**
SO2.1: Students learn to create a contrast between previous and present work. SO2.2: Learn paraphrasing tool SO2.3: Use of plagiarism check tool SO2.4: Students understand the concept of hedging and criticising	.	UNIT 2 – Paraphrasing and checking Plagiarism 2.1. Clarifying Who Did What, 2.2. Highlighting Your Findings, 2.3. Hedging and 2.4. Criticising, 2.5. Paraphrasing 2.6. Plagiarism 2.7. Clarification of previous work and their order 2.8. Highlighting your work 2.9. Paraphrasing and 2.10. its tools 2.11. Plagiarism Check Software 2.12. Use of Plagiarism Check Software	Learn different AI tools for Writing

CO3: Students will learn about what to write in each section of paper

Approximate Hours

Item	Appx Hours
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**(LI)**	**Class room Instruction (CI)**	**(SL)**
SO3.1**:** Students learn to write a research paper in proper format. SO3.2: Students are able to understand different sections of paper. SO3.3:Create an effective abstract and introduction. SO3.4**:**Describe Review of Literature. SO3.5: Learn to write Methodology of Research Paper.	.	Unit-3**:**Planning Sections of a Paper 3.1. Introduction to sections of a research paper. 3.2. Introduction to sections of a research paper continued 3.3. Key skills to write an Abstract and 3.4. Key skills to write an Introduction. 3.5. Skills to write Review of Literature. 3.6. Skills to write Review of Literature continued 3.7. Key skills to write Methodology. -I 3.8. Key skills to write Methodology. -II 3.9. Skills to draw diagrams 3.10. Skills to draw diagrams continued 3.11. Key skills to plot result graphs 3.12. Key skills to write future scope	Study key skills to write the abstract and Methodology

CO4: Students will understand significance of each section of paper, and learn how to write it at the same time.

Approximate Hours

Item	Appx Hours
Cl	9
LI	0
SW	0
SL	1
Total	10

Session Outcomes (SOs)	**(LI)**	**Class room Instruction (CI)**	**(SL)**
SO4.1: Students learn to state the result of their findings. SO4.2: Students learn to draw conclusions of their research SO4.3: Students are able to analyse and discuss their result of paper SO4.4: Students are able to evaluate their paper SO4.5: Students learn to assess their work through a final check.	.	Unit-4 :Finalising the Research Paper 4.1 Results of research findings-I 4.2Results of research findings-II 4.3Drawing conclusion of the research-I 4.4 Drawing conclusion of the research-II 4.5 Discussion on the result of paper-I 4.6 Discussion on the result of paper-II 4.7 Final check of the paper-I 4.8 Final check of the paper-II 4.9 Discussion of future scope	Study of to find research gaps

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CO5: Ensure the good quality of paper at very first-time submission

Item	Appx Hours
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**(LI)**	**Class room Instruction (CI)**	**(SL)**
SO5.1: Students are able to understand effective research paper writing skills		Unit 5- Research Paper Publication 5.1. Useful Phrases for effective research paper writing-I 5.2. Useful Phrases for effective research paper writing-II 5.3. Useful Phrases for effective research paper writing-III 5.4. Selection of appropriate journal 5.5. Selection of appropriate journal 5.6. Identify Predatory journal 5.7. Identify Predatory journal 5.8. Check submission format of research papers 5.9. Check submission format of research papers 5.10. Paper submission techniques-I 5.11. Paper submission techniques-II 5.12. Paper submission techniques-III	Study of different journals

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
CO1:Student will learn how to improve their writing skills, and level of readability	12	1	1	10
CO2: Students will understand the concept of plagiarism, and how to avoid ambiguityand vagueness	12		1	10
CO3: Students will learn about what to write in each section of paper	12		1	10
CO4: Students will understand significance of each section of paper, and learn how to write it at the same time.	12		1	9
CO5: Ensure the good quality of paper at very first-time submission.	12		1	10
Total Hours	60	1	04	49

Suggestion for End Semester Assessment 1

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
1	Unit 1: Preparation of Research Paper	2	5	3	10
2	Unit 2: Paraphrasing and checking Plagiarism	3	4	3	10
3	Unit 3:Planning Sections of a Paper	2	3	5	10
4	Unit 4: Finalising the Research Paper	2	2	6	10
5	Unit 5: Research Paper Publication	1	2	7	10
Total		10	16	24	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for English for Research Paper Writing swill be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Brainstorming

SuggestedStudies:

1. GoldbortR(2006)WritingforScience,YaleUniversityPress(availableonGoogleBooks)
2. DayR (2006)How toWriteandPublishaScientificPaper,CambridgeUniversityPress
3. HighmanN(1998),HandbookofWritingfortheMathematicalSciences,SIAM.Highman'sbook.
4. AdrianWallwork,EnglishforWritingResearchPapers,SpringerNewYorkDordrechtHeidelberg London,2011

COs, POs and PSOs Mapping

Course Code: 06CS801

Course Title: English for research paper writing

CourseOutcomes	ProgramOutcomes												ProgramSpecificOutcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct studies of difficult problems	Utilization of modern tools	Engineers and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-longlearning				
CO 1: : Student will learn how to improve their writing skills, and level of readability	2	2	1	1	3	2	2	3	2	2	1	1	**2**	**3**	**3**	**1**
CO 2 : Students will understand the concept of plagiarism, and how to avoid ambiguity and vagueness	2	2	2	1	3	2	2	3	2	2	2	1	**2**	**2**	**2**	**1**
CO 3: Students will learn about what to	2	3	2	1	3	2	2	3	2	3	2	1	**1**	**1**	**2**	**2**

write in each section of paper																
CO 4: Students will understand significance of each section of paper, and learn how to write it at the same time	1	-	2	1	1	1	-	-	1	-	2	1	**3**	**3**	**3**	**2**
CO 5: Ensure the good quality of paper at very first-time submission	1	2	2	1	2	2	1	3	1	2	2	1	**3**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map

POs&PSOsNo.	COsNo.&Titles	SOsNo.	Classroom Instruction(CI)	Self-Learning(SL)
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	CO 1: Student will learn how to improve their writing skills, and level of readability	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	Unit-1Self-grooming, Basic EtiquettesandPresentation Skill 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	Asmentionedin pagenumber above
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	CO 2 : Students will understand the concept of plagiarism, and how to avoid ambiguity and vagueness	SO2.1 SO2.2 SO2.3 SO2.4	Unit-2Confidence buildingskills,InterviewSkillsandResumeWriting 2.1,2.2,2.3,2.4,2.5,2.6, 2.7,2.8,2.9	
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	CO 3: Students will learn about what to write in each section of paper	SO3.1SO3.2 SO3.3 SO3.4 So3.5	Unit-3Public SpeakingSkills&ConversationalSkills 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9	
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	CO 4: Students will understand significance of each section of paper, and learn how to write it at the same time	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	Unit-4Functional GrammarandVocabularyBuilding 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	CO 5: Ensure the good quality of paper at very first-time submission	SO5.1	Unit-5 IndianWritinginEnglish& Hindi Statistics 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9	

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Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Course Code:	1MS801
Course Title :	Special function
Prequisite:	Students should have basic knowledge of complex numbers
Rationale:	The program aims to develop advanced problem-solving and analytical skills and prepares students for careers in academia, research, industry, or other sectors that require advanced mathematical expertise.

Course Outcome :

CO1-1MS801.1 understand the property of special function like Gaus hypergeometric legendra function with their integral representations.

CO2-1MS801.2. Understand the concept of bessel's function hermit function etc with its properties like recurrence relation orthogonal properties generating function etc.

CO3-1MS801.3. Understand how special function is useful in differential equation.

CO4-1MS801.4 explain the application and the usefulness of these special function

CO5-1MS801.5 classify and explain the function different types of differential eq

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies (Hours/Week)				
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)
Program Core (PCC)	1MS801	Special function	4	0	1	1	6

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.
Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks (PRA + ESA)**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+AT)		
PCC	1MS801	Special function	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1-1MS801.1 understand the properties of special function like Gauss hyper geometrc legendra function with their integral representations.

Approximate Hours

AKS University

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Curriculum of B. Sc. (Honours / By Research) Program

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Item	AppX Hrs
Cl	10
LI	0
SW	1
SL	1
Total	12

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO1.1 Understand the concept of Gamma functions. **SO1.2** Understand the relationships between beta and gamma functions. **SO1.3** Understand the concept of Beta function. **So1.4** Understand the multiplication formula **So1.5** Understand the concept of function.	-	**Unit-1.0 Gamma function and Beta function:** 1.1 Introduction of Gamma function. 1.2 The definition of Gamma functions. 1.3 Eulerian Definition. 1.4 Euler's Products. 1.5 Evaluation of Gamma functions. 1.6 Beta function: 1.7 Introduction 1.8 definition of Beta function. 1.9 Multiplication formulas. 1.10 Related functions.	**SL.1** Understand the complex numbers. **SL.2**knowledge of the gamma func **SL.3** Properties of Gamma functions. .

SW-1 Suggested Sessional Work (SW):

a. Assignment:
¡.Evaluation of Gamma and beta terms..
ii. Gauss 's multiplication formula.

iii. State and prove Beta function.

iv. Application of Gamma functions.

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO2-1MS801.2. Understand the concept of bessel's function hermit function etc with its properties like recurrence relation orthogonal properties generating function etc.

Approximate Hours

Item	AppX Hrs
Cl	10
LI	0
SW	1
SL	1
Total	12

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**

SO2.1 Understand the concept of bessel's functions. SO2.2 Learn about the concept of Recurrence relation. SO2.3 Understand the concept of Jn(x) SO2.4 Understand the Uses of Bessel's functions. SO2.5 Understand the concept of recurrence relation with example.		**Unit-2.0 Bessel Functions. :** 2.1 Introduction. 2.2 Definition of Bessel functions. 2.3 Definition of Jn(x) 2.4 Generating function of Jn(x). 2.5 Alternative forms of generating functions. 2.6 Bessel's differential equations. 2.7 Recurrence relation for Jn(x). 2.8 Bessel 's Integral. 2.9 tutorial 1 2.10 Application of bessel's functions.	**SL.1** Evaluation Bessel's differential equations. **SL.2** Knowledge of the Bessel's functions. **SL.3** Knowledge of some properties of bessel's functions.

SW-2 Suggested Sessional Work (SW):
a. Assignments:
i. Definition and Example of Bessel's functions.
ii. Define Alternative forms of generating functions.

iii. The Recurrence relation for Jn(x).
iv. Bessel's differential equations.

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO3-1MS801.3. Understand how special function is useful in differential equations.

Approximate Hours

Item	AppX Hrs
Cl	11
LI	0
SW	1
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)

SO3.1 Understand the principle of legendre polynomials. SO3.2 Understand the Laplaces first integral form. SO3.3 the concept of orthogonal properties.		**Unit-3.0** Legendre Polynomials.3.1 Introduction. 3.2 Recurrence relation. 3.3 the concept of legendre polynomials 3.4 Generating function for legendre polynomials 3.5 tutorial 1 3.6 Rodriguez formula. 3.7 Hypergeometric forms of Pn(x) 3.8 some other generating functions 3.9 Laplaces first integral form, 3.10 Legendre 's differential equations. 3.11 Orthogonal properties.	**SL.1** ● Knowledge of the generating functions for legendre polynomials. ● Understand an application of legendre polynomials.

SW-3 Suggested Sessional Work (SW):
a. Assignment:
ii. Application of legendre polynomials.
iii. Evaluation of legendre differential equations.
iv. State and prove Rodrigues formula.
V. Orthogonal properties.

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO4-1MS801.4 explain the application and the usefulness of these special function.

Approximate Hours

Item	AppX Hrs
Cl	10
LI	0
SW	1
SL	1
Total	12

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**

SO4.1 Understand the concept of harmite 's polynomials. SO4.2 understand the generating functions. SO4.3 Understand the importance of harmite 's polynomials.		**Unit -4 Hermite's Polynomials:** 4.1 Introduction 4.2 Recurrence relation. 4.3 Evaluation of Rodrigues Formula. 4.3 Generating function. 4.4 Bat'sman generating functions. 4.5 tutorial 1 4.6 Hermite's differential equations. 4.7 Evaluation of orthogonal properties. 4.8 some properties of harmite 's function. 4.9 Expansion of polynomials. 4.10 more generating functions .	**SL.1** ● knowledge of the harmite 's polynomials. ● Expansion of polynomials.,Recurrence relation.

SW-4 Suggested Sessional Work (SW):
a. Assignments:
i. Evaluation of Rodrigues formula for generating functions.
ii. Application of Hermite 's polynomials.
iii. The Expansion of polynomials.
iv. Calculation of Hermite 's differential equations.
V. More generating functions.

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO5-1MS801.5 The classify and explain the function different types of differential equations.

Approximate Hours

Item	AppX Hrs
Cl	9
LI	0
SW	1
SL	1
Total	11

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning(SL)**

SO5.1 Understand the concept of Rodrigues formula. SO5.2 Generaliged Laguerre polynomials. SO5.3 Orthogonal properties.		**Unit-5.0 Laguerre polynomials.** 5.1 Introduction . 5.2 simple Laguerre polynomials: 5.3 Introduction the Laguerre polynomials Ln(x) 5.4 Definition and Example of Laguerre polynomials. 5.5 Generating function. 5.6 Recurrence relation. 5.7. Laguerre difficult equations. 5.8 Rodrigues Formula.,Orthogonal properties. 5.9 Generaliged Laguerre polynomials: Rodrigues formula,Orthogonal properties, expansion of polynomials.	**SL.1** ● knowledge of the Recurrence relation and generating functions. ● knowledge of the expansion of polynomials.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
CO1-1MS801.1 Understand the properties of special function like Gauss hyper geometrc legendra function with their integral representations	. **10**	1	1	12
CO2-1MS801.2. Understand the concept of bessel's function hermit function etc with its properties like recurrence relation orthogonal properties generating function etc.	. **10**	1	1	12
CO3-1MS801.3. Understand how special function is useful in differential equations.	11	1	1	13
CO4-1MS801.4 Explain the application and the usefulness of these special function.	10	1	1	12
CO5-1MS801.5 The classify and explain the function different types of differential equations.	9	1	1	11

	Unit Titles	50	5 Marks Distribution	5	60	T
	UNIT-1 Gamma function and beta function.		03	01	0	0
	UNIT -2 Bessel's functions & Bessel'sdifferential equations.		02	05	0	1
	Unit-3Legendre Polynomials.		03	06	0	1
	Unit- 4 Harmite 's polynomials. &harmite differential equations.		-	10	0	1
	Unit 5 Laguerre polynomials.& Generaliged Laguerre polynomials.		03	02	-	0

- **Suggestion for End Semester Assessment**

Suggested Specification Table For(ESA)

egend: R: Remember, U: Understand, A: Apply The end of semester assessment for Introduction to Portland cement will be held with written

examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies

1. Improved Lecture
2. Tutorial
3. Presentation
4. Group Discussion
5. Online sources
6 .Seminar
7. Workshop

Suggested Learning Resources:

a) Books :

S. No.	Title	Author	Publisher	Edition
1	Special function	Rainville E.D	The Macmillan ,New York,	2nd edition, 1971
2	Special function and their applications	Lebdev	Prentice hall Englewood cliffs	New Jersey USA 1995
3	Special function with applications	Saran N. Sharma and trivedi	Pragti prakashan	Edition, 1986

Cos,POs and PSOs Mapping

Course Code : 1MS801

Course Title: Special function

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Advanced Mathematical Knowledge	Problem - solving Skills	Research Abilities	Quantitative Analysis	Teaching and Academia	Theoretical Understanding	Communication Skills	Operations Research	Application in Industry	Engineering and Technology	Government and Public Sector	Consulting	Understand the mathematical concepts and applications in the field of algebra	Handle the advanced techniques	Develop necessary skills and expertise in the field of research	Creates Mathematical Models

CO1-**1MS801understand the properties of special function like Gauss hyper geometrc legendra function with their integral representations**	2	1	2	2	1	2	3	2	1	1	1	1	1	2	1	2
CO2- **1MS801.2**. Understand the concept of bessel's function hermit function etc with its properties like recurrence relation orthogonal properties generating function etc	2	1	3	2	1	2	1	1	1	2	1	1	3	2	1	1
CO3-1MS801.3. Understand how special function is useful in differential equations	2	1	2	2	1	3	2	1	2	2	1	1	2	2	1	1
CO4-1MS801.4 Explain the application and the usefulness of these special function	2	1	2	2	2	1	2	2	3	2	2	2	2	1	1	1
CO5-1MS801.5 The classify and explain the function different types of differential equations.	2	2	3	2	2	2	2	2	2	1	1	3	1	1	2	1

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO1-1MS801.1**understand the properties of special function like Gauss hyper geometrc legendra function with their integral representations	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 Gamma function and beta function. 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8, 1.9,1.10	SL1.1 SL1.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO2-1MS801.2**. Understand the concept of bessel's function hermit function etc with its properties like recurrence relation orthogonal properties generating function etc .	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-2 Bessel's functions & Bessel's Differential equations. 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	SL2.1 SL2.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO3-1MS801.3**. Understand how special function is useful in differential equations.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-3 Legendre Polynomials. 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8,3.9,3.10,3.11	SL3.1 SL3.2

PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO4-1MS801.4** Explain the application and the usefulness of these special function	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-4 Harmite 's polynomials. &harmite differential equations 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8,4.9,4.10.	SL4.1 SL4.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO5-1MS801**.5 The classify and explain the function different types of differential equations.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-5 Laguerre polynomials.& Generaliged Laguerre polynomials. 5.1, 5.2, 5.3, 5.4, 5 .5, 5.6, 5.7, 5.8,5.9,	SL5.1 SL5.2

Curriculum Development Team

1. Dr.Sudha Agrawal, HOD, Department of Mathematics.
2. Dr.Ekta Shrivastava , Assistant Professor, Department of Mathematics.
3. Mr.Neelkanth Napit, Assistant Professor, Department of Mathematics.
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8. Ms. Arpana Tripathi, Assistant Professor, Department of Mathematics.

Course Code:	2MS801
Course Title :	Complex Analysis
perquisite:	Students should have basic knowledge of complex numbers
Rationale:	The program aims to develop advanced problem-solving and analytical skills and prepares students for careers in academia, research, industry, or other sectors that require advanced mathematical expertise.

Course Outcome :

CO1-2MS801.1 Understand the importance of algebra of complex numbers with regard to working within various number systems.

CO2-2MS801.2. Students will determine a given function which is on the closed contour ‘c’ and the value of integration of this function .

CO3-2MS801.3. Students will Calculate Residues in some special cases by using Residue theorem.

CO4-2MS801.4 Students will compute the Expansion of Analytic function as power series by using Taylor and Laurent theorem.

CO5-2MS801.5 .Students will create the concept of a Mapping or Transformation and their representation

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Scheme of Studies:

Board of Study	**Course Code**	**Course Title**	**Scheme of studies (Hours/Week)**					**Total Credits (C)**
			Cl	**LI**	**SW**	**SL**	**Total Study Hours (CI+LI+SW+SL)**	
Program Core (PCC)	2MS801	Complex analysis-l	4[3+1]	0	1	1	6	4

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Boar	Couse	Course Title	Scheme of Assessment (Marks)	

d of Study	Code		Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks (PRA + ESA)**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+AT)		
PCC	2MS801	Complex analysis-I	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

CO1-2MS801.1

Understand the importance of algebra of complex numbers with regard to working within various number systems.

Approximate Hours

Item	AppX Hrs
Cl	12

LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**

SO1.1 Understand the Algebra of complex numbers. **SO1.2** Understand the relationships between complex numbers structures with familiar numbers systems such as the integers and real numbers **SO1.3** Understand the concept of contur integration **So1.4** Understand the hypothesis of Cauchy's Theorem **So1.5** Understand the concept of function.	-	**Unit-1.0 The Complex Number systems, Analytic functions.** 1.1 Introduction of complex numbers 1.2 Geometric representation of complex numbers 1.3 limit, continuity and differentiability of complex function 1.4 Analytic function. 1.5 Tutorial-I 1.6 complex integration 1.7 Cauchy's Theorem. 1.8 Cauchy Gaursat theorem 1.9 Cauchy integral formula. 1.10 Cauchy integral formula for derivative of the function 1.11 Cauchy integral formula for Higher order derivatives. 1.12 Tutorial-II	**SL.1** Understand the complex numbers. **SL.2**knowledge of the difference and division between two complex numbers. **SL.3** Properties of Modulus and Argument of complex numbers.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Relationships between complex numbers structures with familiar numbers systems such as the Set of natural numbers, Set of rational numbers, Set of integers, Set of real numbers, Set of complex numbers.

ii. Geometric representation of complex numbers.

iii. State and proof cauchy Gaursat theorem.

iv. Cauchy integral formula for Higher order derivative.

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO2-2MS801.2

Students will determine a given function which is on the closed contur c ‘ and the value of integration of this function .

Item	AppX Hrs
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**

SO2.1 Understand the concept of Moderate 's theorem SO2.2 Learn about structure preserving maps between groups and their consequences. SO2.3 Understand the concept of Composition series SO2.4 Understand the Uses of Composition series in Jordan-Holder theorem SO2.5 Understand the Relation of Ring and Various polynomials		**Unit-2.0 Complex Integration:** 2.1 Morera's theorem 2.2 Cauchy's inequality 2.3 Liousville's theorem 2.4 Certain theorem on power series 2.5 Tutorial-I 2.6 Fundamental theorem of algebraic function 2.7the concept of Taylor's series 2.8 the concept of Taylor's theorem 2.9 Theorems on inequality 2.10 Expansion of analytic function as power series 2.11 the concept of Laurent theorem 2.12 Tutorial-I	**SL.1** Evaluation Elementary function of a complex variables **SL.2** Knowledge of the Analyticity of the sum function of a series **SL.3** Knowledge of some Elementary properties of complex numbers.

SW-2 Suggested Sessional Work (SW):
a. Assignments:
i. State and prove Morera 's theorem.
ii. State and prove cauchy inequality.
iii. State and prove Liousville's theorem.
iv. State and prove Fundamental theorem of algebra.

V. Taylor's series.

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO3-2MS801.3

Students will Calculate Residues in some special cases by using Residue theorem .

Approximate Hours

Item	AppX Hrs
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Understand the principal of Argument SO3.2 Rouche's theorem SO3.3 the concept of Maximum Modulus principal		**Unit-3.0 principal of Argument and Rouche's theorem** 3.1 Maximum Modulus principle. 3.2 Minimum Modulus principle. 3.3 the concept of Schwartz lemma. 3.4 Laurent's series. 3.5 Tutorial –I 3.6 Meromorphic function. 3.7 The poles and zeros of a Meromorphic function . 3.8 singular and classification of singularity . 3.9 some Theorems on poles . 3.10 Inverse function theorem 3.11 The concept of Argument principle. 3.12 Tutorial –II	**SL.1** Knowledge of the poles and zeros of a Meromorphic function. **SL.2** Understand an application of Rouche's theorem.

SW-3 Suggested Sessional Work (SW):
a. Assignments:
i. The concept of Argument principle.
ii. Application of Rouche's theorem .
iii. Definition of Meromorphic function.
iv. State and prove Maximum Modulus theorem.
V. Schwarz lemma.

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test

CO4-2MS801.4

Students will compute the Expansion of Analytic function as power series by using Taylor and Laurent theorem.

Approximate Hours

Item	AppX Hrs
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO4.1 Understand the concept of Residues at a singularity SO4.2 Residues at infinity SO4.3 Understand the importance of Residues theorem		**Unit -4 Residue Theory and Calculus of Residue.** 4.1 Understand the Residue. 4.2 Cauchy Residue theorem. 4.3 Evaluation of Integrals. 4.3 Branches of many valued function 4.4 Residue at infinity 4.5 Tutorial –I 4.6 The residue at a singularity. 4.7 Special reference to arg z, log z 4.8 Evaluation of definite Integrals by contour integration 4.9 some residue theorem 4.10 Residue at a simple poles 4.11 Integration round the unit circle 4.12 Tutorial –I	**SL.1** ● Calculation of Residues in some special cases. ● Evaluation of definite integral by contour integration.

SW-4 Suggested Sessional Work (SW):
a. Assignments:
i. Evaluation of definite integral by contour integration.
ii. Application of Residues theorem.
iii. State and prove cauchy residue theorem .
iv. Calculation of residues in some special cases.
V. Evaluation of integrals.

b. Mini Project:
Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

CO5-2MS801.5
Students will create the concept of a Mapping or Transformation and their representation.

Approximate Hours

Item	AppX Hrs
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Understand the concept of Mapping or Transformation. SO5.2 Product of two Bilinear Transformation. SO5.3 Conformal mapping.		**Unit-5.0 Understand the Bilinear Transformations & Conformal Mappings.** **5.1** Tthe concept of Mappings or Transformation. 5.2 Bilinear Transformation. 5.3 their properties and Classification. 5.4 Definition and Example of conformal mapping. 5.5 Tutorial -I 5.6 Space of analytic function. 5.7 Hurwitz theorem. 5.8 Montel's. theorem. 5.9 Riemann mapping. 5.10jacobian of a Transformation. 5.11 Some Elementary Transformation. 5.12 Tutorial -II	**SL.1** knowledge of the linear Transformation. **SL.2** The Representation of a conformal mapping.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
CO1-2MS801.1 Understand the importance of algebra of complex numbers with regard to working within various number systems.	. **12**	1	1	12
CO2-2MS801.2 Students will determine a given function which is on the closed contur c ‘ and also find the value of integration of this function .	. **12**	1	1	12
CO3-2MS801.3 Students will Calculate Residues in some special cases by using Residue theorem .	. **12**	1	1	12
CO4-2MS801.4 Students will compute the Expansion of Analytic function as power series by using Taylor and Laurent theorem.	12	1	1	12
CO5-2MS801.**5** Students will create the concept of a Mapping or Transformation and their representation.	12	1	1	12
Total Hours	60	5	5	70

Suggestion for End Semester Assessment

Suggested Specification Table For(ESA)

CO	Unit Titles	Marks Distribution			**Total Marks**
		R	**U**	**A**	
CO-1	Understand the importance of algebra of complex numbers with regard to working within various number systems.	03	01	01	05
CO-2	Students will determine a given function which is on the closed contur c ‘ and also find the value of integration of this function .	02	05	03	10
CO-3	Students will Calculate Residues in some special cases by using Residue theorem .	03	06	06	15
CO-4	Students will compute the Expansion of Analytic function as power series by using Taylor and Laurent theorem.	-	10	05	15
CO-5	Students will create the concept of a Mapping or Transformation and their representation.	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies

1. Improved Lecture
2. Tutorial
3. Presentation
4. Group Discussion
5. Online sources
6 .Seminar
7. Workshop

Suggested Learning Resources:

a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Complex variables and applications	R.V.Churchill,J.W. Brown	McGraw-Hill,New York,	2nd edition, 1989
23 ..	Fundamentals of complex analysis	S.Ponnuswamy,	Narosa Publishing house	4th edition, 1985
	Theory and Problems of complex variables	Lars.V.Ahlfors,	McGraw-Hill,New York McGraw Hill book company International	Edition, Singapore,1979

Cos,POs and PSOs Mapping

Course Title: B.Sc.(Mathematics) Mathematics
Course Code : 2MS801
Course Title: complex Analysis

Course Outcome																
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Advanced Mathematical Knowledge	Problem-solving Skills	Research Abilities	Quantitative Analysis	Teaching and Academia	Theoretical Understanding	Communication Skills	Operations Research	Application in Industry	Engineering and Technology	Government and Public Sector	Consulting	Understand and the mathematical concepts and applications in the field of algebra	Handle the advanced techniques	Develop necessary skills and expertise in the field of research	Creates Mathematical Models

CO1-2MS801.1 Understand the importance of algebra of complex numbers with regard to working within various number systems.	1	2	1	1	1	1	1	3	3		3	1	1	1	1	1
CO2-2MS801.2 Students will determine a given function which is on the closed contur c ‘ and also find the value of integration of this function .	1	2	2	1	3	2	2	2	2	2	3	2	1	1	1	1

CO3-2MS801.3 Students will Calculate Residues in some special cases by using Residue theorem .	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	2
CO4-2MS801.4 Students will compute the Expansion of Analytic function as power series by using Taylor and Laurent theorem.	2	2	1	3	21	2	3	1	1	2	1	1	1	2	2	1

CO5-2MS801.5 Students will create the concept of a Mapping or Transformation and their representation.	1	2	1	2	2	2	2	2	2	1	2	2	2	2	2	2

Legend: 1 – Low, 2 – Medium, 3 – High

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO1-2MS801.1** Understand the importance of algebra of complex numbers with regard to working within various number systems.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9, 1.10	SL1.1 SL1.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO2-2MS801.2** Students will determine a given function which is on the closed contur c ' and also find the value of integration of this function .	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-2 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	SL2.1 SL2.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO3-2MS801.3** Students will Calculate Residues in some special cases by using Residue theorem .	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-3 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	SL3.1 SL3.2
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO4-2MS801.4** Students will compute the Expansion of Analytic function as power series by using Taylor and Laurent theorem.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-4 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	SL4.1 SL4.2

PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO5-2MS801.5** Students will create the concept of a Mapping or Transformation and their representation.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-5 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	SL5.1 SL5.2

Curriculum Development Team

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(Revised as on 01 August 2023)

CourseCode: 1PH801

CourseTitle: **Classical Mechanics**

Pre-requisite: Studentshouldhavebasicknowledgeofmechanicsofsystemofparticles,D'Alembert'sprinciple,Lagrangianand Hamiltonian mechanics.

Rationale: The students studying Physics should possess foundational understanding about historical background of classical mechanics.

CourseOutcomes:

1PH801**.1.**Understandthemechanicsofsystemofparticles,D'Alembert'sprinciple,Lagrangianmechanics,&Euler'sequationofmotion.

1PH801**.2.**LearnaboutHamiltonianformulation,Hamilton'sEquationsofMotionand principleofleastaction.

1PH801**.3.**Learnabout CanonicalTransformations&Hamilton-Jacobitheory.

1PH801**.4.** LearnaboutRigidbodydynamicsincluding problems.

1PH801**.5.**UnderstandtheRelativistic Mechanicsanditsrelatedaspects.

SchemeofStudies:

Boardof Study	**Course Code**	**CourseTitle**	**Schemeofstudies(Hours/Week)**					**TotalCredits (C)**
			Cl	**LI**	**SW**	**SL**	**TotalStudyHours (CI+LI+SW+SL)**	
Program Core (PCC)	1PH801	**Classical Mechanics**	4	4	1	1	6	4

Legend: **CI:**ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)andothers),

LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworkshop, field or other locations using different instructional strategies)

SW: SessionalWork(includesassignment,seminar,miniprojectetc.),

SL: SelfLearning,

C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacher to ensure outcome of Learning.

SchemeofAssessment:

Theory

Board ofStudy	CourseCode	CourseTitle	**SchemeofAssessment(Marks)**							
			ProgressiveAssessment(PRA)						**EndSemesterAssessment (ESA)**	**Total Marks (PRA+ESA)**
			Class/HomeAssignment5 number 3markseach (CA)	ClassTest2 (2bestoutof3) 10markseach (CT)	Seminarone (SA)	Class Activityanyone (CAT)	ClassAttendance (AT)	TotalMarks (CA+CT+SA+CAT+AT)		
PCC	1PH801	**Classical Mechanics**	15	20	5	5	5	50	50	100

Course-CurriculumDetailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1PH801.**1.Understandthemechanicsofsystemofparticles,D'Alembert'sprinciple,Lagrangianmechanics ,&Euler'sequationofmotion.**

ApproximateHours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	1
Total	14

SessionOutcomes (SOs)	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO1.1 To understand the Newtonian mechanics of one and many particles systems and Conservation theorems for linear momentum, angular momentum and energy **SO1.2** To learn about the Constraints and their classification; Principle of virtual work; D'Alember's principle in generalized coordinates **SO1.3** To understand the Lagrangian and demonstrate Lagrange's equations; velocity dependent potential and dissipative function. Configuration space **SO1.4** To learn aboutHamilton's principle; Generalized momenta and Lagrangian formulation of the conservation theorems and Jacobi's integral. **SO1.5** To learn about Reduction to the equivalent one body problem; The equation of motion and first integrals.	**UNIT – I (Survey of Elementary Principles and Lagragian Formulation)** 1.1 Newtonian mechanics of one and many particles systems 1.2 Conservation theorems for linear momentum, angular momentum and energy 1.3 Constraints and their classification 1.4 Principle of virtual work; D'Alember's principle in generalized coordinates 1.5 The Lagrangian, Lagrange's equations 1.6 velocity dependent potential and dissipative function. 1.7 Configuration space, Hamilton's principle 1.8 Generalized momenta and Lagrangian formulation of the conservation theorems and Jacobi's integral 1.9 Reduction to the equivalent one body problem 1.10 The equation of motion and first integrals 1.11 The differential equation for the orbit 1.12 integration power law potentials	Survey of Elementary Principles related to mechanics

SW-1SuggestedSessionalWork(SW):

i. *Assignments:*

- Write conservation theorems for linear momentum, angular momentum and energy for a system of one or many particles.

ii. OtherActivities(Specify):

Present any one topic of this unit by power point presentation in front of departmental student and faculty.

1PH801.**2.LearnaboutHamiltonianformulation,Hamilton'sEquationsofMotionandPrincipleofleastaction.**

ApproximateHours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	1
Total	14

SessionOutcomes (SOs)	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO2.1 To understand The Kepler problem: inverse square law of force **SO2.2** To learn about Artificial satellites and Scattering in a central force field and Rutherford scattering **SO2.3**To learn about Legendre transformationsand the Hamilton's equations of motion **SO2.4** Conservation theorems and the physical significance of the Hamiltonian. Derivation of Hamilton's equations from a variational principle **SO2.5** The principle of least action.	**UNIT – II (Kepler Problems)** 2.1 The Kepler problem 2.2 inverse square law of force 2.3 Artificial satellites 2.4 Scattering in a central force field 2.5 Rutherford scattering 2.6 Legendre transformations 2.7 Hamilton's equations of motion 2.8 Conservation theorems 2.9 physical significance of the Hamiltonian 2.10 variational principle 2.11 Derivation of Hamilton's equations from a variational principle	1. Learn about motion and its different types And Kepler's laws

	2.12 The principle of least action.	

SW-2 SuggestedSessionalWork(SW):

a. Assignments:
i. Explain Legendre transformations.
ii. Discuss about physical significance of the Hamiltonian.

b. OtherActivities(Specify):
Present any one topic of this unit by power point presentation in front of departmental student and faculty.

1PH801**.3. Learn about Canonical Transformations & Hamilton-Jacobitheory.**

ApproximateHours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	1
Total	14

SessionOutcomes (SOs)	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO3.1 To learn about the equations of canonical transformations and generating functions **SO3.2** To understand Poisson's Brackets: their canonical invariance; Simple algebraic properties of Poisson Brackets **SO3.3** To learn about the equations of motion in Poisson's Brackets notation; Poisson's theorem **SO3.4** To understandAngular momentum PB's Hamilton's principal and characteristic functions **SO3.5** To understandHamilton-Jacobi equation; Action Angle variables	**UNIT – III (Canonical Transformations)** 3.1 The equations of canonical transformations 3.2 generating functions 3.3 Poisson's Brackets 3.4Poisson's Brackets: their canonical invariance 3.5 Simple algebraic properties of Poisson Brackets 3.6 The equations of motion in Poisson's Brackets notation 3.7Poisson's theorem 3.8 Angular momentum PB's Hamilton's principal 3.9 characteristic functions 3.10 The Hamilton-Jacobi equation 3.11 Action Angle variables (2)	1. Hamilton-Jacobi equation

SW-3SuggestedSessionalWork(SW):

5 *Assignments:*

Poisson's Brackets: their canonical invariance AdvantagesofuseofPPCin construction.

6 *OtherActivities(Specify):*

Present any one topic of this unit by power point presentation in front of departmental student and faculty.

1PH801**.4. LearnaboutRigidbodydynamicsincluding problems.**

ApproximateHours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	1
Total	14

SessionOutcomes (SOs)	**ClassroomInstruction (CI)**	**Self Learning (SL)**
SO4.1 To understand Theory of small oscillations, Equations of motion, Eigen frequencies and general motion. **SO4.2** Learn about Normal modes and coordinates. Applications to coupled pendulum and linear triatomic molecule. **SO4.3** Learn aboutRotating co-ordinate systems, Acceleration in rotating frames. Coriolis force and its terrestrial and astronomical applications. **SO4.4** Elementary treatment of Eulerian co-ordinates and transformation matrices. Angular momentum inertia tensor. **SO4.5** Understanding aboutEular equations of motion for a rigid body. Torque free motion for a rigid body. Symmetrical top and gyroscopic	**UNIT – IV (small oscillations and Moving coordinate systems)** 4.1 Theory of small oscillations 4.2 Equations of motion 4.3 Eigen frequencies and general motion 4.4 Normal modes and coordinates. 4.5 Applications to coupled pendulum 4.6 linear triatomic molecule 4.7 Rotating co-ordinate systems, 4.8Acceleration in rotating frames. 4.9 Coriolis force and its terrestrial and astronomical applications 4.10 Elementary treatment of Eulerian co-ordinates and transformation matrices 4.11 Angular momentum inertia tensor 4.12 Eular equations of motion for a rigid body. Torque free motion for a rigid body. Symmetrical top and gyroscopic forces.	1. Rotational motion and oscillations

forces.		

SW-4SuggestedSessionalWork(SW):

1. *Assignments:*

- WriteEular equations of motion for a rigid body.
- Describebrieflysymmetrical top and gyroscopic forces.

4 *OtherActivities(Specify):*

Present any one topic of this unit by power point presentation in front of departmental student and faculty.

1PH801.**5.UnderstandtheRelativistic Mechanicsanditsrelatedaspects.**

ApproximateHours

Item	AppXHrs
Cl	12

LI	0
SW	1
SL	1
Total	14

SessionOutcomes (SOs)	**ClassroomInstruction (CI)**	**Self Learning (SL)**

SO5.1 To understand **s**ymmetries of space and time **SO5.2**Learn about Invariance under Galilion transformation, Covariant four- dimensional formulation. 4-Vectors and 4-Scalars **SO5.3** Learn about relativistic generalisation of Newton's laws, 4-momenturn and 4-force **SO5.4** Learn about invariance under Lorentz transformation relativistic energy **SO5.5** To understand Lagrangian and Gange invariance Hamiltonian formulation in relativistic mechanics. Covariant Lagrangian, covariant Hamiltonian, Examples.	**UNIT – V (Relativistic Mechanics)** 5.1 Symmetries of space and time 5.2 Invariance under Galilion transformation 5.3 Covariant four- dimensional formulation 5.4 4-Vectors 5.5 4-Scalars 5.6 Relativistic generalisation of Newton's laws 5.7 4-momenturn 5.8 4-force 5.9 Invariance under Lorentz transformation relativistic energy 5.10Lagrangian and Gange invariance 5.11 Hamiltonian formulation in relativistic mechanics 5.12 Covariant Lagrangian	a. General theory and special theory of relativity with differences

SW-5SuggestedSessionalWork(SW):

1. *Assignments:*
   Explain Covariant four- dimensional formulation.
2. *OtherActivities(Specify):*
   Present any one topic of this unit by power point presentation in front of departmental student and faculty.

BriefofHourssuggestedfortheCourseOutcome

CourseOutcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Totalhour (Cl+SW+ Sl)
PH701.1.Understandthemechanicsofsystemofparticles,D'Alembert'sprinciple,Lagrangianmechanics,&Euler'sequationofmotion.	**12**	1	1	14
PH701.2.LearnaboutHamiltonianformulation,Hamilton'sEquationsofMotionandPrincipleofleastaction.	12	1	1	14
PH701.3.Learnabout CanonicalTransformations&Hamilton-Jacobitheory.	12	1	1	14
PH701.4. LearnaboutRigidbodydynamicsincluding problems.	12	1	1	14
PH701.5.UnderstandtheRelativistic Mechanicsanditsrelatedaspects.	12	1	1	**14**
TotalHours	**60**	**5**	**5**	**70**

SuggestionforEndSemesterAssessment

SuggestedSpecificationTable (ForESA)

CO	UnitTitles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Survey of Elementary Principles and Lagragian Formulation	03	04	03	10
CO-2	Kepler Problems	03	04	03	10
CO-3	Canonical Transformations	03	04	03	10
CO-4	Small oscillations and Moving coordinate systems	03	04	03	10
CO-5	Relativistic Mechanics	03	04	03	10
Total		15	20	15	50

Legend: R:Remember, U:Understand, A:Apply

TheendofsemesterassessmentforIntroductiontoPortlandcementwillbeheldwithwritten examination of 50 marks

Note.DetailedAssessmentrubricneedtobepreparedbythecoursewiseteachersforabovetasks. Teacherscanalsodesigndifferenttasksasperrequirement,forendsemesterassessment.

SuggestedInstructional/ImplementationStrategies:

- ImprovedLecture
- Tutorial
- CaseMethod
- GroupDiscussion
- RolePlay
- Visittocementplant
- Demonstration
- ICT Based Teaching Learning (VideoDemonstration/Tutorials CBT, Blog,Facebook,Twitter, Whatsapp, Mobile, Online sources)
- Brainstorming

SuggestedLearningResources:

(a)Books:

S. No.	Title	Author	Publisher	Edition& Year
1	Classical Mechanics	N. C. Rana and P.S. Jog	Tata McGraw Hill	1991
2	Classical Mechanics	H. Goldstein	Addision Wesley	1980
3	Mechanics	A Sommerfiels	Academi Press	1952
4	Introduction to Dynamics	I. Perceival and Richards	Cambridge Univ. Press	1982
5	Lecturenoteprovidedby DepartmentofPhysics,AKSUniversity,Satna(M. P.)			

Cos,POsandPSOsMapping

Course Code: 1PH801

CourseTitle:Classical Mechanics

CourseOutcomes	ProgramOutcomes												Prog	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSC
	Engineering knowledge	Problemanalysis	Design/developmentofsolutions	Conductinvestigationsofcomplexproblems	Modern toolusage	The engineerand society	Environment and sustainability:	Ethics	Individualandteamwork:	Communication:	Projectmanagement and finance:	Life-longlearning	Identify, formulate,andsolvePhysicsproblems.	Desidconxpers, asweoanandintdata
PH701.1.Understandthemechanicsofsystemofparticles,D'Alembert'sprinciple,Lagrangianmechanics,&Euler'sequationofmotion.	1	1	2	2	3	2	3	2	2	1	3	2	2	3
PH701.2.LearnaboutHamiltonianformulation,Hamilton'sEq	1	1	2	2	1	2	3	2	1	1	2	2	2	2

uationsofMotionandPrincipleofleastaction.														
PH701.3.LearnCanonicalTransformations& Hamilton-Jacobitheory.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**
PH701.4. LearnaboutRigidbodydynamicsincluding problems.	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**
PH701.5.UnderstandtheRelativistic Mechanicsanditsrelatedaspects.	**2**	**1**	**2**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**

Legend:1–Low,2–Medium,3– High

CourseCurriculumMap:

POs&PSOs No.	COsNo.&Titles	SOsNo.	ClassroomInstruction(CI)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	PH701.1.Understandthemechanicsofsystemofparticles,D' Alembert'sprinciple,Lagrangianmechanics,&Euler'sequationofmotion.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	**UNIT – I (Survey of Elementary Principles and Lagragian Formulation)** 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11
PO 1,2,3,4,5,6 7,8,9,10,11,12	PH701.2.LearnaboutHamiltonianformulation,Hamilton'sEquationsofMotionandPrincipleofleastaction.	SO2.1 SO2.2 SO2.3	**UNIT – II (Kepler Problems)** 2.1,2.2,2.3,2.4,2.5,2.6,2.7,

PSO1,2,3,4,5		SO2.4 SO2.5	2.8,2.9,2.10
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	PH701.3.LearnCanonicalTransformations&Hamilton-Jacobitheory.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	**UNIT – III (Canonical Transformations)** 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	PH701.4. LearnaboutRigidbodydynamicsincluding problems.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	**UNIT – IV (small oscillations and Moving coordinate systems)** 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 4.11, 4.12
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	PH701.5.UnderstandtheRelativistic Mechanicsanditsrelatedaspects.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	**UNIT – V (Relativistic Mechanics)** 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12

Curriculum Development Team

1. Dr. O .P. Tripathi, Head of the Department, of Physics, AKS University.
2. Dr. C. P. Singh, Assistant Professor, Dept. of Physics.
3. Dr. Lovely Singh, Assistant Professor, Dept. of Physics.
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5. Mr. Manish Agrawal, Assistant Professor, Dept of Physics.
6. Ms. Swati Kushwaha, Lab Assistant Dept. of Physics.

CourseCode:	2PH801
CourseTitle:	**Solid State Physics**
Pre-requisite:	To understand the fundamentals of intriguing phenomena such as direct lattice, reciprocal lattice, lattice vibration in solids, specific heat of metals, band formation in solids, effective mass, and superconductivity.
Rationale:	Thesolid-statephysics is thebranch of physics dealing with physicalpropertiesofsolidsparticularly crystals, including thebehavior of electronsin thesesolids.Thecoursesolidstatephysicsisbasicallydesignedforfundamentalunderstandingofseveral breakthrough phenomena such as crystal structure, lattice dynamics, variouscrystalbonding,freeelectronstheory,bandtheoryandsuperconductivityinsolids.

CourseOutcomes:

2PH801**.01:** Describe the mathematics concepts and their applications tocomplex numbers, complex functions, analytic functions, complex integration and theory of residues.problems of physics.

2PH801**.02:**Understand and analyze the concept of Numerical Solution of Linear and Non-Linear Equations, Ordinary Differential Equations and Function of complex variable.

2PH801**.03:** Identify the applications of complex variables, tensors and group theory.

2PH801**.04:**Understand the concept of Bessel's function, Hermite function etc., with its properties like recurrence relations, orthogonal properties, generating functions etc. Understand how special function is useful in differential equations.

2PH801**.05:** Evaluate the Fourier transform of a continuous function and be familiar with its basic properties. Solution of integral equation and their application. Solve differential & integral equations with initial conditions using Laplace transform.

SchemeofStudies:

Boardo f Study	Cours e Code	CourseTitle	Schemeofstudies(Hours/Week)					TotalCred its (C)
			CI	LI	SW	SL	TotalStudyHours (CI+LI+SW+SL)	
Program Core (PCC)	1PH801	Solid State Physics	4	0	1	1	6	4

Legend: **CI:**ClassroomInstruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)andothers),

LI: LaboratoryInstruction(IncludesPracticalperformancesinlaboratoryworkshop, field or other locations using different instructional strategies)

SW: SessionalWork(includesassignment,seminar,miniprojectetc.),

SL: SelfLearning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacher to ensure outcome of Learning.

SchemeofAssessment:

Theory

Board ofStudy	CouseCode	CourseTitle	SchemeofAssessment(Marks)							
			ProgressiveAssessment(PRA)						EndSemesterAssessment (ESA)	Total Marks (PRA+ESA)
			Class/HomeAssignment5number 3markseach (CA)	ClassTest2 (2bestoutof3) 10markseach (CT)	Seminarone (SA)	Class Activityanyone (CAT)	ClassAttendance (AT)	TotalMarks (CA+CT+SA+CAT+AT)		
PCC	2PH8	Solid State Physics	15	20	5	5	5	50	50	100

	01									

Course-CurriculumDetailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

2PH801**.01:** Describe the basic principles of semiconductor physics, including band theory, carrier transport, and semiconductor device behavior. **ApproximateHours**

Item	AppXHrs
Cl	08
LI	0
SW	1
SL	1
Total	10

SESSION OUTCOMES (SOs)	**CLASS ROOM INSTRUCTION (CI)**	**SELF LEARING**
SO 1.1Energy Bands, carrier concentration and Fermi levels for Intrinsic and extrinsic semiconductors	Module 1.1Understanding energy bands, carrier concentration, and Fermi levels in intrinsic and extrinsic semiconductors is crucial in semiconductor physics. Here's a breakdown for classroom instruction:Energy Bands (ValenceBand&Conduction Band), Intrinsic Semiconductor (Definition, Energy band diagram, Carrier Concentration& Fermi Level), Extrinsic Semiconductor (Definition, Doping, N-type Semiconductor,P-type Semiconductor,Energy Band Diagram,Carrier Concentration&Fermi Level)	**Role of Temperature:** Discuss how temperature influences carrier concentration by providing energy for electrons to move between bands (through thermal excitation).
SO 1.2 Direct and Indirect band semiconductors	1.2 Understanding the differences between direct and indirect bandgap semiconductors is essential in various fields, including material science, semiconductor physics, and electronic device engineering. It forms a foundational concept in the design and optimization of semiconductor devices for specific applications.	2: Connecting these concepts to real-world applications helps students understand the significance of direct and indirect bandgap materials in various technologies.
SO 1.3 Degenerate and compensated semiconductors	1.3: When teaching about degenerate and compensated semiconductors in a classroom setting, it's essential to cover the following points: **Basic Semiconductor Concepts:** Begin by explaining the basics of semiconductors, intrinsic and extrinsic semiconductors,	

	doping, and the behavior of charge carriers. **Degenerate Semiconductors:** Discuss the conditions under which semiconductors become degenerate, emphasizing the high concentration of charge carriers and the impact on the semiconductor's behavior and energy levels. **Compensated Semiconductors:** Explain how compensated semiconductors are created by intentionally adding impurities to balance the effects of dopants, resulting in a controlled carrier concentration. **Applications and Importance:** Highlight the significance of these concepts in practical applications such as in semiconductor devices, electronics, and how understanding these states helps in designing semiconductor materials with specific electrical properties.	
SO 1.4 Elemental (Si) and compound semiconductors (GaAs)	1.4: Elemental semiconductors like silicon (Si) and compound semiconductors like gallium arsenide (GaAs) are fundamental materials in the field of semiconductor physics and technology. When teaching about these materials in a classroom setting, it's essential to cover various aspects, including their properties, structures, and applications.	
SO 1.5 Replacement of group III element and Group V elements to get tertiary alloys such as AlxGa(1-x) As or GaPyAs(1-y) and quaternary InxGa(1-x)PyAs(1-y) alloys and their important properties such as band gap and refractive index changes with x and Y	1.5Replacement of group III element and Group V elements to get tertiary alloys such as AlxGa(1-x) As or GaPyAs(1-y) and quaternary InxGa(1-x)PyAs(1-y) alloys and their important properties such as band gap and refractive index changes with x and Y AlxGa(1-x)As: Band Gap: The bandgap of this alloy changes continuously with the composition x. For instance, as you increase the aluminum (Al) content (increase in x), the bandgap of the alloy will increase. It's used in semiconductor devices like LEDs, lasers, and solar cells. Refractive Index: The refractive index also changes with the composition x. Typically, as the bandgapincreases, the refractive index also tends to increase.	3: Discuss ongoing research or advanced concepts like strain engineering, defect control, and other methods used to further manipulate and optimize these materials for specific applications.

	GaPyAs(1-y): Band Gap: Similar to AlxGa(1-x)As, the bandgap of GaPyAs(1-y) changes with the composition y. As you increase the phosphorus (P) content (increase in y), the bandgap decreases. Refractive Index: The refractive index also changes with y, but it's not as directly correlated as with the bandgap. Quaternary Alloy: **InxGa(1-x)PyAs(1-y):** Band Gap: This quaternary alloy has a more complex composition, where both x (Indium) and y (Phosphorus) contribute to the bandgap. The bandgap can be tuned by varying both x and y. Refractive Index: Similar to the bandgap, the refractive index changes with variations in x and y. However, predicting the exact change in refractive index with these compositional changes might require more sophisticated modeling.	
SO 1.6 Doping of Si (Group III (n) and Group V (P) compounds) and GaAs (Group II (P) , IV (n-p) and VI (n compounds)	1.6: Doping is a fundamental process in semiconductor physics that involves intentionally introducing impurities into a semiconductor material to modify its electrical properties. The most commonly used semiconductors for doping include silicon (Si) and gallium arsenide (GaAs).	
SO 1.7 Diffusion of impurities (Thermal Diffusion, constant surface concentration)	1.7: Diffusion of impurities, particularly through thermal diffusion with constant surface concentration, is a phenomenon encountered in various scientific disciplines, including material science, chemistry, and physics. In a classroom setting, this topic is often covered in courses related to transport phenomena, physical chemistry, or materials science.) Overview of Thermal Diffusion with Constant Surface Concentration **1. Introduction to Diffusion:** Explain the concept of diffusion: the movement of particles from an area of high concentration to an area of low concentration. Describe the driving force behind diffusion: the tendency of particles to spread out and achieve a more uniform distribution. **2. Thermal Diffusion:**	Discuss numerical methods or computational approaches used to simulate and predict diffusion processes with constant surface concentration.

	Define thermal diffusion as the movement of particles due to a temperature gradient. Discuss Fick's laws of diffusion, particularly Fick's Second Law, which describes the rate of change of concentration of a diffusing substance. **3. Constant Surface Concentration:** Explain the scenario where the concentration of the diffusing substance at the surface remains constant. Explore scenarios like the diffusion of impurities in solids or gases with a fixed surface concentration. **4. Governing Equations:** Introduce the mathematical formulation for diffusion, emphasizing the equation that governs the concentration profile over time and space. Discuss boundary conditions that include the constant surface concentration. **5. Factors Affecting Diffusion:** Explore factors influencing the rate of diffusion, such as temperature, concentration gradient, surface area, and the medium through which diffusion occurs. **6. Applications and Examples:** Discuss real-world applications of thermal diffusion with constant surface concentration, such as doping semiconductors, chemical processing, and material synthesis. Provide examples or case studies illustrating how this phenomenon is utilized in various industries.	
SO 1.8 Constant total dopant diffusion&ion implantation	1.8: In a classroom setting, these concepts can be taught using theoretical explanations, diagrams, and possibly practical demonstrations or simulations. Here are some teaching approaches:	

	Theory and Principles: Explain the fundamental concepts behind dopant diffusion and ion implantation, covering topics such as diffusion mechanisms, concentration profiles, energy levels, and their impact on semiconductor behavior. Visual Aids and Diagrams: Use diagrams, graphs, and animations to illustrate the diffusion process and ion implantation setup. Visual aids can help students understand how dopants are introduced and distributed within the semiconductor material. Simulation Tools: Utilize simulation software or online tools that simulate dopant diffusion or ion implantation processes. Students can experiment with different parameters to observe their effects on dopant profiles and understand the practical implications. Real-life Examples: Discuss real-life applications of these processes in semiconductor manufacturing. Highlight how constant total dopant diffusion and ion implantation are critical steps in the production of electronic devices and integrated circuits.	

SW-1SuggestedSessionalWork(SW):

a. Assignments
b. Other Activity

Power Point Presentation

Conduct simple experiments or demonstrations (even on a small scale) to showcase the diffusion or ion implantation process. This can offer students a tangible understanding of these concepts.

2PH801**.02:** A course on Carrier Transport in Semiconductors typically covers fundamental concepts related to the movement of charge carriers (electrons and holes) within semiconductor materials. The course outcomes may include, but are not limited to: Understanding Semiconductor Basics, Carrier Statistics and Equilibrium, Carrier Transport Mechanisms&Semiconductor Devices and Applications.

ApproximateHours

Item	AppXHrs
Cl	7
LI	0
SW	2
SL	1
Total	10

SESSION OUTCOMES (SOs)	**CLASS ROOM INSTRUCTION (CI)**	**SELF LEARING**
SO 2.1 Carrier Drift under low and high fields in (Si and GaAs) saturation of drift velocity	2.1: Carrier drift refers to the movement of charge carriers, such as electrons or holes, in a semiconductor material in response to an applied electric field. The drift velocity of carriers in a material depends on various factors, including the magnitude of the electric field and the material properties.	1: In a classroom setting, the study of high-field effects in two-valley semiconductors involves theoretical concepts and mathematical models to describe carrier behavior under strong electric fields. This often includes discussions on the band structure of specific semiconductor materials, carrier scattering mechanisms, transport properties, and their practical

		implications in device design and technology.
SO 2.2 High field effects in two valley semiconductors	2.2 High field effects in two-valley semiconductors refer to the behavior exhibited by certain semiconductor materials when subjected to strong electric fields, particularly those with two distinct energy valleys in their band structure. Two-valley semiconductors often possess an anisotropic band structure, meaning they have multiple minima (valleys) in their energy bands, resulting in different effective masses for charge carriers in different directions. This characteristic becomes significant when these materials are subjected to high electric fields. When a high electric field is applied to a semiconductor, such as in a diode or transistor under strong biasing conditions, the electrons and holes experience an acceleration due to the force exerted by the field. In two-valley semiconductors, this acceleration can cause the carriers to occupy different valleys in the energy band.	2: Explain Solution of Laguarre and Hermite's equations
SO 2.3 Carrier Diffusion carrier injection	2.3: Carrier diffusion and carrier injection are fundamental concepts in semiconductor physics, particularly in understanding how charge carriers (electrons and holes) move within a semiconductor material.	
SO 2.4 Generation Recombination processes- Direct, indirect bandgap semiconductors	2.4: The generation and recombination processes in semiconductors are essential phenomena that influence their electrical properties. This explanation will focus on direct and indirect bandgap semiconductors and their associated generation and recombination processes.Direct Bandgap Semiconductors: Efficient light emission and absorption. Generation via optical absorption, excitation by light. Recombination through radiative and non-radiative processes. Indirect Bandgap Semiconductors:	

	Inefficient light emission and absorption. Generation through thermal effects and impact ionization. Recombination via Auger, trap-assisted processes.	
SO 2.5 Minority carrier Life Time	2.5: **"Minority carrier lifetime"** refers to the average time a minority carrier (either electrons in the P-type material or holes in the N-type material of a semiconductor) survives in a semiconductor device before recombination. This is a crucial parameter in the performance of semiconductor devices like transistors, diodes, and solar cells.	
SO 2.6 Drift and Diffusion of minority carriers (Haynes= Shockley Experiment)	2.6: In real semiconductor devices, both drift and diffusion occur simultaneously and influence the behavior of carriers. The net movement of carriers is the result of these two mechanisms acting together. The study of these mechanisms is crucial in understanding the behavior of semiconductor devices like diodes, transistors, and integrated circuits. This experiment conducted by Shockley and Haynes provided valuable insights into how minority carriers behave in semiconductor materials under the influence of electric fields and concentration gradients, forming the basis for the understanding of semiconductor physics and device operations.	
SO 2.7 Determination of conductivity (a) four probe and (b) van der Pauw techniques. Hall coefficient, minority carrier Life Time.	**Four-Probe Technique:**The four-probe technique is commonly used to measure the resistivity (and thereby conductivity) of thin films or small semiconductor samples. Here's a simplified explanation of the process: **Setup:** Four equally spaced probes are placed on the sample material. Two of the probes are used to pass a known current through the sample, while the other two measure the voltage across the sample. **Measurement:** By applying a known current through the outer probes and measuring the voltage with the inner probes, the resistance of the sample can be determined using Ohm's law ($R = V/I$). **Calculation of Conductivity:** Once the resistance is obtained, the conductivity (σ) can be calculated using the formula: $\sigma = 1 / (R * A)$, where A is the cross-sectional area of the sample and R is the resistance measured. **Van der Pauw Technique:**The van der Pauw method is another way to measure the resistivity and conductivity of a thin film or semiconductor material, particularly useful for	These techniques are typically taught with hands-on demonstrations, theoretical explanations, and possibly laboratory experiments to help students understand their applications in material characterization and semiconductor device analysis.

	irregularly shaped or non-uniform samples. **Setup:** Similar to the four-probe technique, four equally spaced probes are placed on the sample. However, the van der Pauw method involves passing a current between two probes and measuring the voltage between the other two. **Measurement:** By changing the current path and measuring voltages across different pairs of probes, a series of resistance measurements are taken. This data is then used to solve the van der Pauw equation to obtain the resistivity/conductivity of the material. **Hall Coefficient:**The Hall coefficient (RH) is a parameter that describes the relationship between the induced electric field and the applied magnetic field perpendicular to the current flow in a conducting material. It's determined by measuring the Hall voltage (VH) produced when a magnetic field is applied perpendicular to the current flow. The formula for Hall coefficient is given by: RH = VH / (IB), where VH is the Hall voltage, I is the applied current, and B is the magnetic field strength. **Minority Carrier Lifetime:** Minority carrier lifetime refers to the average time it takes for minority carriers (electrons in p-type material or holes in n-type material) to recombine in a semiconductor. It's a crucial parameter for semiconductor devices, as it affects their performance and efficiency.	

SW-2SuggestedSessionalWork(SW):

c. Assignments
d. Other Activity

Power Point Presentation

2PH801**.03:**Understanding the dielectric properties of materials is crucial in various fields, including electrical engineering, materials science, and telecommunications.

ApproximateHours

Item	AppXHrs
Cl	08
LI	0
SW	1
SL	1
Total	10

SESSION OUTCOMES (SOs)	**CLASS ROOM INSTRUCTION (CI)**	**SELF LEARING (SL)**
SO 3.1 Atomic and molecular Polariziblity	3.1 When teaching about atomic and molecular polarizability, instructors often cover several key points: Theory and Conceptual Understanding: Explain the concept of polarizability, emphasizing how atoms or molecules respond to external electric fields. Introduce terms like induced dipoles, electric fields, and the relationship between polarizability and atomic/molecular size. Factors Affecting Polarizability: Discuss factors influencing atomic and molecular polarizability, such as size, electron cloud distribution, and molecular geometry. Illustrate examples to showcase how different atoms or molecules exhibit varying polarizabilities. Measurement and Units: Introduce methods used to measure polarizability experimentally. Explain relevant units of polarizability, such as cubic angstroms ($Å^3$) or square Bohr radii (a.u.). Real-life Applications: Connect polarizability concepts to real-world applications, such as explaining the behavior of substances in electric fields, the optical properties of materials, or the formation of intermolecular forces.	Provide problems and examples for students to calculate or estimate polarizabilities and understand their significance in various contexts

	Mathematical Treatment (if applicable): For advanced courses, delve into mathematical models or equations that describe polarizability quantitatively, such as the relationship between induced dipole moment and electric field strength.	
SO 3.2 Claussius-Mossotti relation	3.2 The Clausius-Mossotti relation is an equation in physics that describes the polarizability of a dielectric material in an electric field. This relation is particularly important in understanding how materials respond to an external electric field and how this response affects their optical properties.	
SO 3.3 Types of polarizability	3.3 Polarizability refers to the ability of a molecule or atom to form instantaneous dipoles in the presence of an external electric field. In a classroom setting, the types of polarizabilities that might be discussed can include: **Atomic Polarizability:** This refers to the ability of individual atoms to polarize when subjected to an external electric field. It varies depending on the size of the atom and the distribution of its electron cloud. Larger atoms or atoms with more electrons tend to have higher polarizability. **Molecular Polarizability:** Molecules, composed of multiple atoms, can also exhibit polarizability. It depends on the arrangement of atoms within the molecule, the type of bonds present, and the overall geometry of the molecule. **Isotropic and Anisotropic Polarizability:** Isotropic polarizability is when the polarizability of a substance is the same in all directions, while anisotropic polarizability varies with direction. Anisotropic polarizability is common in crystals or elongated molecules where the electron cloud can be easily distorted along specific axes.	

	Electronic Polarizability: This relates to the movement of electrons within atoms or molecules in response to an external electric field. The more easily electrons can move, the higher the electronic polarizability. **Ionic Polarizability:** It refers to the ability of ions in a crystal lattice to shift their positions in response to an electric field. Ionic polarizability is significant in ionic compounds where ions are held together by electrostatic forces. **Static and Dynamic (Frequency-dependent) Polarizability:** Static polarizability refers to the polarizability when the frequency of the applied electric field is zero or very low, while dynamic polarizability considers the variation of polarizability with changing frequency of the electric field.	
SO 3.4 Dipolar polarizability and frequency dependence of dipolar polarizability	3.4 The dipolar polarizability refers to the ability of a molecule or an atom to form an induced dipole moment in response to an external electric field. This polarizability is a measure of how easily the electron cloud within the molecule or atom can be distorted by an external electric field.	
SO 3.5 Ionic and Electronic polarizability	3.5 Ionic and electronic polarizability are concepts in physics and chemistry that describe how a particle or a system responds to an external electric field by developing an induced dipole moment. Electronic Polarizability: Electronic polarizability refers to the ability of electrons within an atom or a molecule to shift from their equilibrium positions when subjected to an external electric field. In molecules, this is primarily associated with the	Discussing how the electronic structure of atoms or molecules influences their polarizability.

	distortion of the electron cloud around the atomic nuclei. Larger molecules with more electrons generally have higher electronic polarizability because the electrons are more loosely bound and can move more easily in response to an electric field. Ionic Polarizability: Ionic polarizability pertains to the ability of ions in a crystal lattice or ionic compound to rearrange under the influence of an external electric field. In ionic materials, the positive and negative ions can be displaced from their equilibrium positions, creating temporary dipoles within the material. Ionic polarizability is often significant in materials composed of ions, such as salts or crystals, where the ions are relatively large and can shift positions.	
SO 3.6 Hall Effect	3.6 Mathematical explanation about Hall Effect	
SO 3.7 Quantum Hall Effects	3.7 Explore the applications of QHE in metrology, particularly in defining a precise standard for resistance.	
SO 3.8 Magneto Resistance	3.8 Mathematical Explanation about Magneto Resistance	

SW-3SuggestedSessionalWork(SW):

e. Assignments
f. Other Activity

Power Point Presentation

Providing problems or exercises to help students understand the quantitative aspects of polarizability and how to calculate it for different systems.

Drawing comparisons between electronic and ionic polarizability, emphasizing their differences and similarities.

2PH801.**04:**Understanding how magnetic properties are utilized in various technological applications such as magnetic storage devices, sensors, motors, generators, medical imaging (MRI), and magnetic materials used in industries.

ApproximateHours

Item	AppXHrs
Cl	11
LI	0
SW	0
SL	2
Total	13

SESSION OUTCOMES (SOs)	**CLASS ROOM INSTRUCTION (CI)**	**SELF LEARING**
SO 4.1 Magnetic properties of solids	4.1 Definition of special functions Magnetic Materials: Materials can be classified based on their magnetic properties into three categories: Diamagnetic Materials: These materials have no permanent magnetic moment and are weakly repelled by both poles of a magnet. They create their own magnetic field in the opposite direction to an externally applied magnetic field. Paramagnetic Materials: These materials have unpaired electrons, leading to a weak attraction when placed in an external magnetic field. However, they don't retain magnetization when the field is removed. Ferromagnetic and Ferrimagnetic Materials: These materials have domains where the magnetic moments of the atoms align spontaneously. They exhibit strong attraction to magnetic fields and retain some magnetization even after the removal of the external field. Magnetic Moments and Domains: The microscopic behavior of magnetic materials involves understanding atomic magnetic moments. In ferromagnetic materials, these moments tend to align spontaneously in regions called domains. Application of an external magnetic field can align these domains, resulting in	

	macroscopic magnetization. Magnetic Hysteresis: When a ferromagnetic material is magnetized in one direction and then demagnetized, it doesn't return to its original state; it retains some residual magnetization. The relationship between the magnetic field and the magnetization of the material is described by a hysteresis loop. Curie Temperature: For ferromagnetic and ferrimagnetic materials, there's a temperature called the Curie temperature above which the material loses its permanent magnetic properties. Magnetic Susceptibility: This refers to how much a material can be magnetized under the influence of an external magnetic field. Applications: Discussing real-world applications of magnetic materials, such as in data storage devices (hard disks), electric motors, transformers, MRI machines, etc., can further illustrate the importance and relevance of understanding magnetic properties.	
SO 4.2Langevin equation	4.2In a classroom setting, instructors might introduce the Langevin equation while discussing concepts related to statistical physics, Brownian motion, or stochastic processes. Students often learn how to interpret the equation's components and how it relates to the behavior of particles undergoing random motion influenced by external forces and the surrounding medium. Understanding the Langevin equation can provide insights into the behavior of particles in diverse physical systems and how random fluctuations affect their motion.	
SO 4.3Quantum theory of Para magnetism	4.3In a classroom setting, teaching the quantum theory of paramagnetism might involve the following key points: Overview of Magnetism: Begin by discussing the basics of magnetism and its types (ferromagnetism, paramagnetism, and diamagnetism). Explain that paramagnetism arises from the	

	alignment of atomic or molecular magnetic dipoles in a material. Atomic Structure: Review the atomic structure, emphasizing the concept of electron spin and its relation to magnetism. Explain that unpaired electrons in an atom possess magnetic moments due to their intrinsic angular momentum or spin. Pauli Exclusion Principle: Discuss the Pauli Exclusion Principle, which states that no two electrons in an atom can have the same set of quantum numbers, particularly their spin. This leads to the existence of unpaired electrons in certain atoms or ions. Paramagnetic Materials: Introduce paramagnetic materials as substances containing atoms or ions with unpaired electrons. These unpaired electrons give rise to magnetic moments within the material. Zeeman Effect: Explain the Zeeman Effect, where the energy levels of atoms or ions with unpaired electrons split when exposed to an external magnetic field. This splitting occurs due to the interaction between the magnetic moment of the electron and the external field. Quantum Mechanical Model: Use the principles of quantum mechanics to describe how the magnetic moments of individual atoms or ions align with an external magnetic field. Discuss the quantization of angular momentum and the alignment of magnetic moments along the field or against it. Magnetic Susceptibility: Introduce the concept of magnetic susceptibility, which quantifies a material's response to an applied magnetic field. Paramagnetic materials have positive magnetic susceptibility, indicating their weak attraction to the magnetic field. Temperature Dependence: Explain how temperature influences paramagnetism. At higher temperatures, thermal energy disrupts	

	the alignment of magnetic moments, reducing the overall magnetic effect. Applications and Examples: Provide real-world examples of paramagnetic materials and their applications, such as in MRI machines, magnetic materials used in electronics, or certain chemical compounds.	
SO 4.4Curie law	4.4Understanding the Curie Law helps in comprehending the magnetic behavior of materials and is essential in fields like material science, condensed matter physics, and electrical engineering.	
SO 4.5Hund's rules	4.5Summarize Hund's rules, emphasizing their importance and practical implications.	
SO 4.6Para magnetism in rare earth and iron group ions	4.6Para magnetism in rare earth and iron group ions arises from the presence of unpaired electrons, allowing them to weakly attract to an external magnetic field. Understanding these properties is crucial in various scientific and technological applications, including magnetic materials, data storage, and medical imaging.	One way to demonstrate Para magnetism is by using a paramagnetic salt (e.g., gadolinium sulfate or ferric chloride). When a strong magnet is brought close to the sample, it shows attraction due to the alignment of its magnetic moments with the external magnetic field.
SO 4.7Elementary idea of crystal field effects	4.7Crystal field theory is a model used in chemistry to explain the behavior of transition metal complexes. It focuses on the interaction between the electrons of a transition metal ion and the surrounding ligands (ions or molecules) in a crystal lattice.	Demonstration: Visual Aids: Use diagrams or models to illustrate the crystal field splitting in different geometries (octahedral and
SO 4.8Curie- weiss law for susceptibility	4.8 Mathematical explanation about Curie- weiss law for susceptibility	

		tetrahedral) and how it correlates to observed colors. Spectral Data: Show spectral data, such as absorption spectra, to relate the energy gaps caused by crystal field splitting to the observed colors.
SO 4.9Heisenberg exchange interaction	4.9Discuss how the Heisenberg exchange interaction leads to an exchange energy between neighboring spins. The energy associated with this interaction depends on the relative orientation of the spins. When spins are aligned parallel (ferromagnetic alignment), the exchange energy is usually lower than when they are anti-aligned (antiferromagnetic alignment).	
SO 4.10 Mean field theory	4.10 Mean field theory is a concept used in various fields, such as physics, neuroscience, and materials science, to simplify complex systems by approximating the interactions among individual components. In the context of physics, it's often applied to describe the behavior of many interacting particles, such as atoms or spins in a magnetic material.	
SO 4.11 Neel point	4.11 The Neel point is a significant concept in the study of magnetism, particularly in the context of antiferromagnetic materials. It's named after Louis Neel, a French physicist who made notable contributions to the understanding of magnetism.	
SO 4.12 Nuclear magnetic resonance	4.12 In a classroom setting, teaching NMR in the context of magnetism involves several key concepts: Magnetic Moments: Atoms with an odd number of protons or neutrons have a non-zero nuclear spin, resulting in a magnetic moment. When placed in an external magnetic field, these nuclei align either parallel or antiparallel to the field.	

	Energy Levels: The nuclei have different energy states based on their alignment in the magnetic field. The energy difference between these states is directly proportional to the strength of the magnetic field. Resonance Condition: When the frequency of an applied electromagnetic field matches the energy difference between these states, the nuclei absorb energy and transition between energy levels. This is known as the resonance condition. Larmor Frequency: The frequency at which the magnetic moments precess around the magnetic field is called the Larmor frequency. It's directly proportional to the strength of the magnetic field and the gyromagnetic ratio of the nucleus. NMR Spectroscopy: By applying a varying magnetic field or radiofrequency pulses to the sample, and then detecting the resulting emitted radio waves, an NMR spectrometer can provide detailed information about the chemical environment and structure of molecules, aiding in chemical analysis. Applications: Explain various applications of NMR, such as in chemistry for structure determination, in medical diagnostics for imaging (Magnetic Resonance Imaging - MRI), and in physics for studying material properties and dynamics.	

SW-4SuggestedSessionalWork(SW):

g. Assignments
h. Other Activity

Power Point Presentation

2PH801**.05:** Students or participants should acquire a comprehensive understanding of the principles behind superconductivity, including the theories, properties, and phenomena associated with superconducting materials.

Item	AppXHrs
Cl	08
LI	0
SW	1
SL	1
Total	10

SESSION OUTCOMES (SOs)	CLASS ROOM INSTRUCTION (CI)	SELF LEARING
SO 5.1 Concept of superconducting state	Module 5.1 The superconducting state is a fascinating phenomenon observed in certain materials when they are cooled to extremely low temperatures. In this state, these materials exhibit zero electrical resistance and expel magnetic fields, allowing currents to flow perpetually without any loss of energy. This phenomenon was first discovered in 1911 by Heike KamerlinghOnnes when he observed the sudden disappearance of electrical resistance in mercury at very low temperatures. Key aspects of the superconducting state include: Zero Resistance: One of the most distinctive properties of superconductors is their ability to conduct electricity without any resistance. When a current starts flowing in a superconductor, it can continue indefinitely without losing any energy to resistance. Meissner Effect: Superconductors expel magnetic fields from their interiors when they transition into the superconducting state. This phenomenon is known as the Meissner effect and leads to the expulsion of magnetic flux lines, causing the superconductor to repel magnetic fields. Critical Temperature: Each superconductor has a critical temperature below which it transitions into the superconducting state. This temperature varies from material to material. Some superconductors require extremely low temperatures (near absolute zero), while others, called "high-temperature superconductors," exhibit superconductivity at temperatures achievable using more practical cooling methods, though still very low by everyday standards. Type I and Type II Superconductors: Superconductors can be categorized into Type I and Type II based on their response to magnetic fields. Type I superconductors expel all magnetic fields below their critical magnetic field strength. Type II superconductors allow partial penetration of magnetic fields even below their critical magnetic field strength. Applications: Superconductors have numerous practical applications, especially in fields such as medical imaging	

	(MRI machines), magnetic levitation trains (maglev), particle accelerators, sensitive detectors, and high-speed electronic circuits.	
SO 5.2 Persistent current& Critical temperature	5.2 Understanding these concepts can be fundamental in exploring the intriguing behavior of superconductors and their potential applications in various technological advancements.	
SO 5.3 Meissner's effect	5.3 Meissner's effect might be taught as a significant discovery in the field of superconductivity, explaining how superconductors behave in the presence of magnetic fields at low temperatures. Teachers may demonstrate this effect using simple experiments involving superconducting materials, magnets, and cooling agents to illustrate the expulsion of magnetic fields from the superconductor's interior when it transitions to a superconducting state.	
SO 5.4 Thermodynamics of the superconducting transitions	5.4 Understanding the thermodynamics of superconducting transitions is crucial in developing applications such as superconducting magnets, power transmission lines, and sensitive instrumentation, as superconductors offer unique and advantageous properties in these fields due to their zero resistance and other extraordinary characteristics.	
SO 5.5 Isotope effect	5.5 The isotope effect refers to the change in the reaction rate or properties of a chemical reaction due to the substitution of isotopes of the same element in the reactants. Isotopes are atoms of the same element that have different numbers of neutrons and, consequently, different atomic masses. There are two primary types of isotope effects: Kinetic Isotope Effect (KIE): This effect occurs when the rate of a chemical reaction is influenced by the substitution of isotopes. It's particularly noticeable in reactions involving the breaking or forming of chemical bonds, where the mass difference between isotopes influences the reaction rate. Typically, lighter isotopes often react faster than heavier isotopes due to their higher mobility and faster vibrational frequencies. Equilibrium Isotope Effect: This effect refers to the influence of isotopic substitution on the position of chemical equilibrium. It's observed in reactions where the isotopic composition affects the stability of reactants and products,	Mathematical proof of Einstein's Coefficients

	thereby altering the equilibrium position.	
SO 5.6 Manifestations of energy gap	5.6 The concept of an "energy gap" can manifest in various ways across different fields such as physics, electronics, and materials science. Here are a few manifestations or instances where the concept of an energy gap is important: Semiconductors and Electronics: In solid-state physics, semiconductors have an energy gap between their valence band (where electrons are tightly bound to atoms) and the conduction band (where electrons can move freely). This energy gap determines the conductivity properties of the material. When electrons gain enough energy (often through thermal or optical excitation), they can jump the energy gap and move into the conduction band, allowing the material to conduct electricity. This forms the basis of electronic devices like diodes and transistors. Photovoltaic Devices: Energy gaps are crucial in solar cells. When photons of light strike a semiconductor material, they can provide enough energy to electrons, allowing them to cross the energy gap and become free to conduct electricity. This process generates an electric current, converting light energy into electrical energy. Superconductors: In the field of superconductivity, there's an energy gap involved as well. Superconductors have a "superconducting gap" which is related to the energy required for electrons to pair up and move without resistance through the material. This gap prevents the scattering of electrons and allows for zero resistance electrical conduction at low temperatures. Optoelectronics: The energy gap also plays a significant role in optoelectronic devices such as light-emitting diodes (LEDs) and lasers. When electrons transition from a higher energy state to a lower one, they release energy in the form of light. The energy difference between these states determines the wavelength or color of the emitted light. Band Theory in Materials Science: In materials science, the concept of energy bands and gaps between them helps to explain the electrical properties of materials. Conductors have overlapping energy bands, insulators have a large energy gap between bands, while semiconductors have a small but finite energy gap.	

SO 5.7 London equation & penetration depth	5.7 The London equations describe how the supercurrent responds to changes in the vector potential in a superconductor. They illustrate that in a superconductor, the electromagnetic response to an applied field is immediate and there's no delay in the establishment of currents. This is why superconductors can expel magnetic fields and remain in a state of perfect diamagnetism (Meissner effect) when cooled below their critical temperature.	
SO 5.8 Two fluid model	5.8 The "two-fluid model" is a concept used in various scientific disciplines, particularly in physics and fluid dynamics. In the context of fluid dynamics, it refers to a theoretical framework that describes certain phenomena by considering two distinct fluids that interact with each other.	Elementary Proof of Fourier Sine & Fourier Cosine Transforms
SO 5.9 Flux quantization	5.9 The concept of flux quantization is often discussed in courses related to condensed matter physics, electromagnetism, or advanced topics in quantum mechanics. It's a fundamental aspect of superconductivity that showcases the unique behavior of materials at extremely low temperatures and has implications for various technological advancements. Teachers might use visual aids, demonstrations, and mathematical explanations to help students understand this concept.	
SO 5.10 single particle tunneling	5.10 This phenomenon has various real-world applications, especially in electronics and nanotechnology. For instance, it's crucial in the operation of tunneling diodes, where the tunneling effect is exploited for creating extremely fast and efficient electronic devices.	
SO 5.11 *dc* and *ac* Josephson effect	5.11 The DC and AC Josephson effects are fundamental phenomena in superconductivity that involve the flow of electrical current across a weak link between two superconducting materials. DC Josephson Effect: In the DC (direct current) Josephson effect, a supercurrent flows through a junction of two superconductors separated by a thin insulating barrier or a very thin normal conducting region. When two superconductors are brought into close proximity but are not physically connected, Cooper pairs (pairs of electrons bound together at low temperatures) can tunnel through the barrier between the superconductors without any resistance.	

	This tunneling of Cooper pairs results in the flow of a supercurrent, which is characterized by a constant phase difference between the wave functions of the superconductors. The current-voltage relationship in a Josephson junction is described by the Josephson equations, which relate the voltage across the junction to the phase difference between the superconducting wave functions. AC Josephson Effect: The AC (alternating current) Josephson effect occurs when an external electromagnetic field is applied to the Josephson junction. When an AC voltage is applied across the junction, the phase difference between the two superconductors oscillates with the frequency of the applied voltage. This leads to an alternating supercurrent, where the direction of the current periodically reverses in response to the changing phase difference induced by the applied AC voltage. The relationship between the applied voltage and the frequency of the supercurrent oscillations is described by the AC Josephson effect. Both DC and AC Josephson effects have numerous applications in superconducting electronics, including superconducting quantum interference devices (SQUIDs), high-speed digital circuits, and highly sensitive magnetometers. They are also used in metrology to create extremely precise voltage standards.	
SO 5.12 quantum interference	5.12 Quantum interference can be demonstrated using various experiments, simulations, or visual aids to help students comprehend this fascinating aspect of quantum mechanics. Explaining the concept through analogies and real-world examples often aids in students' understanding of this complex but intriguing phenomenon.	
SO 5.13 Cooper pairing	Cooper pairing relies on quantum mechanical principles, specifically the interaction between electrons and the condensation of these pairs into a coherent quantum state, where they behave collectively.	

SO 5.14 Interaction of electrons with acoustic and optical phonons	Quantum interference involving the interaction of electrons with acoustic and optical phonons is a fundamental concept in condensed matter physics, especially in the study of semiconductor materials. Electrons: In a crystal lattice, electrons behave as both particles and waves due to their quantum nature. When an electric field is applied or when electrons move through the lattice, they can interact with lattice vibrations known as phonons. Phonons: Phonons are quantized lattice vibrations or quasiparticles representing the collective motion of atoms in a crystal lattice. There are two main types: acoustic and optical phonons. Acoustic Phonons: These are associated with the elastic deformation of the crystal lattice. They have lower energies and longer wavelengths compared to optical phonons. Optical Phonons: These arise due to the displacement of ions with respect to the equilibrium positions in the lattice and have higher energies than acoustic phonons. Electron-Phonon Interaction: When electrons move through a crystal lattice, they can scatter off phonons, altering the electron's momentum and energy. This interaction is crucial for various physical phenomena observed in semiconductors, such as electrical resistivity, thermal conductivity, and electronic band structure modifications. Quantum Interference: Quantum interference occurs when the wave nature of electrons leads to constructive or destructive interference. This interference pattern is influenced by the paths electrons ta Electron-Phonon Scattering and Interference: The interaction of electrons with phonons introduces different scattering mechanisms. Depending on the momentum and energy transfer during scattering events, interference effects can arise. These effects can affect electron transport properties, like conductivity or mobility. Applications: Understanding electron-phonon interactions and quantum interference is crucial for developing semiconductor devices. It impacts the design and performance of transistors, diodes, and other electronic components. Manipulating these interactions can lead to	

	advancements in materials science and quantum technologies.	
SO 5.15 BCS theory of superconductivity	5.15 The Bardeen-Cooper-Schrieffer (BCS) theory is a fundamental explanation of superconductivity, developed by John Bardeen, Leon Cooper, and Robert Schrieffer in 1957. It provides a framework for understanding how certain materials conduct electricity without resistance at low temperatures.	
SO 5.16 High temperature superconductors and their applications	5.16 High-temperature superconductors (HTS) are a type of material that can conduct electricity with zero resistance at relatively higher temperatures compared to conventional superconductors. These materials, typically ceramics or compounds containing copper, can superconduct at temperatures above the boiling point of liquid nitrogen (77 Kelvin or -196 degrees Celsius). This is in contrast to conventional superconductors that require much colder temperatures, often near absolute zero.	

SW-5SuggestedSessionalWork(SW):

i. Assignments
j. Other Activity

Power Point Presentation

Discuss ongoing research efforts aimed at discovering new HTS materials with higher critical temperatures and better performance.

BriefofHourssuggestedfortheCourseOutcome

CourseOutcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Totalhour (Cl+SW+Sl)
97PH801.01: Describe the basic principles of semiconductor physics, including band theory, carrier transport, and semiconductor device behavior.	8	1	1	10
97PH801.02: A course on Carrier Transport in Semiconductors typically covers fundamental concepts related to the movement of charge carriers (electrons and holes) within semiconductor materials. The course outcomes may include, but are not limited to: Understanding Semiconductor Basics, Carrier Statistics and Equilibrium, Carrier Transport Mechanisms & Semiconductor Devices and	7	2	1	10

Applications.				
97PH801.03: Understanding the dielectric properties of materials is crucial in various fields, including electrical engineering, materials science, and telecommunications.	8	1	1	10
97PH801.04: Understanding how magnetic properties are utilized in various technological applications such as magnetic storage devices, sensors, motors, generators, medical imaging (MRI), and magnetic materials used in industries.	11	0	2	13
97PH801.05: Students or participants should acquire a comprehensive understanding of the principles behind superconductivity, including the theories, properties, and phenomena associated with superconducting materials.	8	1	1	10
TotalHours	42	05	6	53

SuggestionforEndSemesterAssessment

SuggestedSpecificationTable (ForESA)

CO	UnitTitles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Understanding the fundamental concepts of semiconductors, crystal structures, band theory, doping, and intrinsic/extrinsic semiconductor properties.	03	01	01	05
CO-2	Understanding the significance of carrier transport in the development of new semiconductor materials, devices, and technologies.	02	06	02	10
CO-3	Understanding dielectric properties is crucial in various fields like electrical engineering, materials science, and physics.	03	07	05	15
CO-4	Students gain a fundamental understanding of the principles behind magnetism, including the behavior of	-	10	05	15

	magnetic fields, magnetic forces, and magnetic materials.				
CO-5	Understanding the Basics: Gain a comprehensive understanding of the fundamental principles underlying superconductivity, including the Meissner effect, critical temperature, critical magnetic field, and Cooper pairs.	03	02	-	05
Total		11	26	13	50

Legend: R:Remember, U:Understand, A:Apply

TheendofsemesterassessmentforIntroductiontoPortlandcementwillbeheldwithwritten examination of 50 marks

Note.DetailedAssessmentrubricneedtobepreparedbythecoursewiseteachersforabovetasks. Teacherscanalsodesigndifferenttasksasperrequirement,forendsemesterassessment.

SuggestedInstructional/ImplementationStrategies:

- ImprovedLecture
- Tutorial
- GroupDiscussion
- RolePlay
- Demonstration
- ICT Based Teaching Learning (VideoDemonstration/Tutorials CBT, Blog,Facebook,Twitter, Whatsapp, Mobile, Online sources)
- Brainstormin

SuggestedLearningResources:

(a)Books:

S. No.	Title	Author	Publisher	Edition& Year
1	Introduction to Solid State Physics	L.V. Azaroff	Academic Press	Revisededition 21edition2020
2	Crystellographic Solid State Physics	Verma&Srivastava	Cambridge University Press	2014
3	Solid State Physics	A.J. Dekker	Dover publications,	2001

4	Principles of Condense Matter Physics	P.M. Chaiken& T.C. Lubensky	Dover Publications	2018

Cos,POsandPSOsMapping

CourseTitle:B.Sc.

Course Code:PH801

CourseTitle:Solid State Physics

CourseOutcomes	ProgramOutcomes												ProgramSpecificOutcome				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability:	Ethics	Individual and team work:	Communication:	Project management and finance:	Life-long learning	Theabilitytoapply technical&engineeringknowledgeforproductionqualitycement	Abilitytounderstand the daytoplantoperational problemsofcementmanuf	Abilitytounderstandthelatestcement manufacturing technology.	Ability to use the research based innovative kn	Engage in life-long learning and wi

														actur e		**ow led gef or S D Gs**	**ll h av e re co g ni ti o n**
CO 1: Understanding the fundamental concepts of semiconductors, crystal structures, band theory, doping, and intrinsic/extrinsic semiconductor properties.	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**	**3**
CO 2: Understanding the significance of carrier transport in the development of new semiconductor materials, devices, and technologies.	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**2**
CO 3: Understanding dielectric properties is crucial in various fields like electrical engineering, materials science, and physics.	**2**	**1**	**2**	**1**	**3**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**3**	**2**	**2**	**2**	**2**

CO4:Students gain a fundamental understanding of the principles behind magnetism, including the behavior of magnetic fields, magnetic forces, and magnetic materials.	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**	**3**
CO5:Understanding the Basics: Gain a comprehensive understanding of the fundamental principles underlying superconductivity, including the Meissner effect, critical temperature, critical magnetic field, and Cooper pairs.	**1**	**2**	**3**	**1**	**2**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**2**	**3**	**2**

Legend:1–Low,2–Medium,3– High

AKS University

Faculty of Basic Science

Curriculum of B. Sc. (Honours / By Research) Program

(Revised as on 01 August 2023)

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Curriculum of B. Sc. (Honours / By Research) Program

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CourseCurriculumMap:

POs&PSOs No.	COsNo.&Titles	SOsNo.	ClassroomInstruction (CI)	Self-Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO 1Understanding the fundamental concepts of semiconductors, crystal structures, band theory, doping, and intrinsic/extrinsic semiconductor properties.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	**UNIT-I (Semiconductor Materials)** 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12	Asmentionedin pagenumber 2to6
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO 2: Understanding the significance of carrier transport in the development of new semiconductor materials, devices, and technologies.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	**UNIT-II (Carrier Transport in Semiconductors)** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO 3: Understanding dielectric properties is crucial in various fields like electrical engineering, materials science, and physics.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	**UNIT-III (Dielectric Properties)** 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11, 3.12	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO 4: Students gain a fundamental understanding of the principles behind magnetism, including the behavior of magnetic fields, magnetic forces, and magnetic materials.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	**UNIT-IV (Magnetic Properties)** 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 4.11, 4.12	
PO 1,2,3,4,5,6	CO5:Understanding the Basics: Gain a	SO5.1	**UNIT-V**	

7,8,9,10,11,12 PSO1,2,3,4,5	comprehensive understanding of the fundamental principles underlying superconductivity, including the Meissner effect, critical temperature, critical magnetic field, and Cooper pairs.	SO5.2 SO5.3 SO5.4 SO5.5	**(Superconductivity)** 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12	

Curriculum Development Team

1. Dr. O .P. Tripathi, Head of the Department, of Physics, AKS University.
2. Dr. C. P. Singh, Assistant Professor, Dept. of Physics.
3. Dr. Lovely Singh, Assistant Professor, Dept. of Physics.
4. Dr. Saket Kumar, Assistant Professor, Dept. of Physics.
5. Mr. Manish Agrawal, Assistant Professor, Dept of Physics.
6. Ms. Swati Kushwaha, Lab Assistant Dept. of Physics.

Code: 1CH801

Course Name: Differaction Methods And Spectroscopy II

Pre-requisite: Students should have basic knowledge of symmetry, symmetry elements, and symmetry operation. They may also know about EMR, mode of vibration, M-L bond, coordination number, diffraction, Scattering and reflection.

Rationale: Up on completion of the course student shall be able to learn about system property analyzed using group theory. They reveal information on the hyperfine interactions and ESR, *acquainted with paramagnetic species.* Understand elucidation of the crystal structure by using x-ray.

CourseOutcomes:

Afterthe completionofthiscourse, thelearner will –

1CH801.1: Explain the symmetry and group theory provides a powerful framework to understand and analyze patterns, structures, and behaviors across various disciplines.

1CH801.2: Describe and apply the knowledge which helps in identifying and characterizing specific vibrationalfrequencies..

1CH801.3: Collectively aim to provide students with a comprehensive discussion of the theory, operation, data analysis, and applications of Raman spectroscopy.

1CH801.4:Students would gain a comprehensive apply the theoretical foundations, practical aspects, and diverse applications of ESR spectroscopy.

1CH801.5: Collectively aim to equip students with a comprehensive explanation of the theoretical principles, practical methodologies, and diverse applications of diffraction techniques.

UNIT-I

Symmetry and Group Theory: Schonflies symbols, representations of groups by matrices (representation for the C_n, C_{nv}, C_{nh}, etc groups to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use in spectroscopy.

UNIT-II Vibrational Spectroscopy

A- **Infrared Spectroscopy:** Review of linear harmonic oscillator, vibration energies of diatomic molecules, Zero point energy, force constants and bond strengths, anharmonicity, Morse potential energy diagrams, vibration-rotation spectroscopy, P,Q,R branch's, breakdown of Oppenhimer approximation, vibration of poly atomic molecules, selection rules, normal modes of vibrations, group frequencies, overtones, hot bands, factors affecting band positions and intensities, far IR region, metal ligand vibrations,

UNIT-III

Raman Spectroscopy:

Classical and quantum theories of Raman effect. Pure vibrational- rotational Raman Spectra, mutual exclusion principle, Resonance Raman Spectroscopy, coherent anti-stokes Raman Spectroscopy (CARS).

UNIT-IV

Magnetic Resonance Spectroscopy

a.Electron spin Resonance Spectroscopy

Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and McConnell relationship, measurement techniques, applications.

b.Nuclear Quadrupole Resonance Spectroscopy

Quadrupole nuclei, quadrupole moments, electric field gradient, coupling constant splitting. Applications.

UNIT-V

X-ray Diffraction

a. Bragg condition, Miller indices, Laue method, Bragg method, Debye-Scherrer method of X-ray structural analysis of crystals, index reflections, identification of unit cells from systematic absences in diffraction pattern..

b.Electron Diffraction

Scattering intensity vs. scattering angle, Wierl equation, measurement technique, elucidantion of structre of simplegas phase molecules. Low energy electron diffraction and structure of surfaces.

c. Neutron Diffraction

Scattering of neutrons by solids and liquieds, magnetic scattering, measurement techniques. Elucidation of structureof Magnetically ordered unit cell.

Scheme of Studies:

Board ofStudy	Course Code	CourseTitle	Scheme ofstudies(Hours/Week)					Total Credits(C)
			Cl	LI	SW	SL	Total Study Hours(CI+LI+SW+SL)	

ProgramCore(PCC)	1CH801	Diffraction Methods And Spectroscopy II	4	0	1	1	6	4

Legend: **CI:**Class room Instruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)Andothers),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different in structional strategies)
SW: Sessional Work (includes assignment, seminar,miniprojectetc.),
SL: Self Learning,
C: Credits.

Note: SW& SL has to be planned and performed under the continuous guidance and feed back of teacher to ensure outcome ofLearning.

Scheme of Assessment: Theory

Board ofStudy	Couse Code	CourseTitle	**SchemeofAssessment(Marks)**						
			ProgressiveAssessment(PRA)					**EndSemesterAssessment**	**Total Marks**
			Class/HomeAssignment 5number 3 markseach (CA)	Class Test2 (2bestout of3) 10 marks each(CT)	Seminarone (SA)	ClassAttendance (AT)	TotalMarks (CA+CT+SA+AT)	**(ESA)**	(PRA+ ESA)
PCC	1CH801	Diffraction Methods And Spectroscopy II	15	20	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

1CH801.1: Explain the symmetry and group theory provides a powerful framework to understand and analyze patterns, structures, and behaviors across various disciplines

Approximate Hours

Activity	**Apex Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction(CI)	Self Learning (SL)
SO1.1 Restate group operations, including, identity element, inverses, and their significance in defining groups. SO1.2 Describe mathematical representations of groups by matrices. SO1.3 Explain and apply the applications of group actions in permutation groups and geometry. SO1.4 Discuss the representation of character table for different point group. SO1.5 Explain and apply representation theory, character theory, and the relationship between groups and linear transformations		**Unit-1 Symmetry and GroupTheory** symmetry and symmetry elements Schonflies symbols of symmetry elements, Point group of molelcules. Identification of point group. Representations of groupsby matrices Matrices representation forthe C_n, C_{nv}, C_{nh}, etc group's symmetry operation. Irreversible reducible (IR) representation of point group Formation of character table for C_n, C_{nv}, C_{nh}, etc	Worked out C_n, C_{nv},C_{nh}, etc groups.

		group's. Reversible reducible (RR) representation of point group by character table. T1-Explanation the great orthogonality theorem (without proof) and T2- its importance. T3- Character tables and their use in spectroscopy. .	

SW-1Suggested Sessional Work(SW):

a. Assignments:
Discuss the Character table representation for C2V and C3V point group.
***b.** Mini Project:*
The great orthogonality theorem (without proof) and its importance.

***c.* *Other Activities (Specify)*:**
Character tables and their use in spectroscopy.

1CH801.2: Describe and apply the knowledge which helps in identifying and characterizing specific vibrational frequencies.

Activity	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning(SL)
SO2. Restate the classification of different types of vibrational modes in molecules. **SO2.2** Describe the fundamental principles of vibrational spectroscopy, including the interaction of light with molecular vibrations, the concept of infrared (IR) **SO2.3** Explain and apply Zero point energy, force constants and bond strengths **SO2.4** Restate the concept of anharmonicity, Morse potential energy diagrams, vibration-rotation spectroscopy, P, Q, R branch's . **SO2.5** Discuss factors affecting band positions and intensities, Classical and quantum theories of Raman effect..		**Unit-2.0 Infrared Spectroscopy** Classification of different types molecules vibrational modes in molecules (stretching, bending, torsional, etc.). degree of freedom IR activity. Review of linear harmonic oscillator, vibrational energies of diatomic molecules. Zero point energy, overtones, hot bands, factors affecting band positions, force constants and intensities, T1-Breakdown of Oppenhimer approximation, vibration of poly atomic molecules, selection rules. T2- Pure vibrational- rotational Raman Spectra, mutual exclusion principle. T3- factors affecting band positions and intensities, far IR region, metal ligand vibrations,	Resonance Raman Spectroscopy, coherent anti-stokes Raman Spectroscopy (CARS).

SW-2 Suggested Sessional Work (SW):

A .Assignments:

Discussion of Morse potential energy diagrams, vibration-rotation spectroscopy, P,Q,R branch's.

b. Mini Project:

Problem-solving exercises involving spectral interpretation, solving practical spectroscopic problems, and identifying unknown compounds from spectra.

c. Other Activities (Specify):

Write an essay on Resonance Raman Spectroscopy, coherent anti-stokes Raman Spectroscopy (CARS).

1CH801.3: Collectively aim to provide students with a comprehensive discussion of the theory, operation, data analysis, and applications of Raman spectroscopy

Activity	AppX Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning(SL)
SO3.1 Restate Classical and quantum theories of Raman effect **SO3.2** Discuss the Pure vibrational-rotational Raman Spectra. **SO3.3** Explain and apply mutual exclusion principle, Resonance **SO3.4** Discuss Raman Spectroscopy,coherent anti-stokes RamanSpectroscopy (CARS).		**Unit-3.0 Raman Spectroscopy**: 3.1Introduction of raman effect. Cause of raman effect. elastic collision. inelastic collision. Classical theories of Raman effect. Quantum theories of Raman effect. Pure vibrational-	(CARS). at

		rotational Raman Spectra, mutual exclusion principle, Resonance Raman Spectroscopy, T1-coherent anti-stokes Raman Spectroscopy (CARS). T2-. apply mutual exclusion principle, Resonance T3- Application of Raman spectroscopy	

SW-3 Suggested Sessional Work (SW):

a.Assignments:

Classical and quantum theories of Raman effect.

b.Mini Project:

Coherent anti-stokes Raman Spectroscopy (CARS).

c.Other Activities (Specify):

Explanatory note on importance of Raman Spectroscopy

1CH801.4: Students would gain a comprehensive apply the theoretical foundations, practical aspects, and diverse applications of ESR spectroscopy.

Activity	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning(SL)
SO4.1 Explain and apply materials with unpaired electrons, Introduction of ESR, basic principles of ESR **SO4.2** Restate Theory/origin of an ESR Signal, Zeeman effect magnetic moment and spin quantum number. **SO4.3** Discuss zero fields splitting and Kramer's degeneracy. **SO4.4**Explain and apply Isotropic and anisotropic hyperfine coupling constants, spin densities and McConnell relationship. **SO4.5** Discuss valuable insights into the molecular structure, dynamics, and composition of materials containing nuclei with a non-zero quadrupole moment,		**Unit-4.0 Magnetic ResonanceSpectroscopy- ESR Spectroscopy& NQR** Local environment of the molecule, Electron distribution within the molecule, Magnitude of magnetic moment, Identification of free radicals **4.4**. Determination of structure of molecules. Magnetic moment and spin quantum number, gyromagnetic ratio Lande g factor, bohr magneton. Factors affecting the 'g' value. zero field splitting Kramer's degeneracy, degeneracy of the electron spin states degeneracy of the electron spin states, **T1-** Hyperfine splitting: Selection Rule, Super hyperfine splitting , **T2-** Zero field splitting and Kremer degeneracy spin Hamiltonian, spin densities and McConnell relationship	Factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants

		T3-Quadrupole nuclei, quadrupole moments, electric field gradient, coupling constant splitting. Applications.	

SW-4 Suggested Sessional Work (SW):

e. **Assignments:**

Zero field splitting and Kramer's degeneracy

b. Mini Project:

Application of ESR and NQR

f. Other Activities (Specify):

Analysis of polynuclear hydrocarbons

1CH801.5: Collectively aim to equip students with a comprehensive explanation of the theoretical principles, practical methodologies, and diverse applications of diffraction techniques.

Activity	AppX Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning(SL)

SO5.1 Apply introduction of X-ray Diffraction determination crystallographic structure of materials. **SO5.2** Describe identification of unit cells from systematic absences in diffraction pattern.. **SO5.3** Analyzing the diffraction pattern produced when electrons interact with a crystal, **SO5.4**Explain and apply Low energy electron diffraction and structure of	.	**Unit-5.0 X-ray Diffraction , Electron Diffraction, Neutron Diffraction** Determination crystallographic structure of materials. Bragg condition, Miller indices, Laue method, Bragg method. Debye-Scherrer method of X-ray structural analysis of crystals, index reflections,	magnetic scattering, measurement techniques
surfaces. **SO5.5** Explain and apply basic ideas about Neutron DiffractionScattering of neutrons by solids and liquids'		Scattering intensity vs. scattering angle, Wierl equation, measurement technique, deduction of positions of atomsin the crystal lattice **5.8**Measurement technique, elucidation of structure of simplegas phase molecules. 5.9 LEED and structure of surfaces.**T1-** Scattering of neutrons by solids and liquids, **T2-**magnetic scattering, measurement techniques. T3-Elucidation of structure of Magnetically ordered unit cell.	

SW-5 Suggested Sessional Work (SW):

a. **Assignments:**

Identification of unit cells from systematic absences in diffraction pattern.

g. *Mini Project:*

Measurement technique, elucidation of structure of simple gas phase molecules

h. *Other Activities (Specify):*

Scattering of neutrons by solids and liquids, magnetic scattering

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning(Sl)	Total hour (Cl+SW+Sl)
1CH801.1: Understand the symmetry and group theory provides a powerful framework to understand and analyze patterns, structures, and behaviors across various disciplines	12	02	01	15
1CH801.2: Describe and apply the knowledge which helps in identifying and characterizing specific vibrational frequencies.	12	02	01	15
1CH801.3: Collectively aim to provide students with a comprehensive understanding of the theory, operation, data analysis, and applications of Raman spectroscopy.	12	02	01	15
1CH801.4:Students would gain a comprehensive understanding of the theoretical foundations, practical aspects, and diverse applications of ESR spectroscopy.	12	02	01	15
1CH801.5: Collectively aim to equip students with a comprehensive understanding of the theoretical principles, practical methodologies, and diverse applications of diffraction techniques.	12	02	01	15

Total Hours	60	10	05	75

Suggestion for End Semester Assessment

Suggested SpecificationTable(ForESA)

CO	UnitTitles	MarksDistribution			Total Marks
		R	U	A	
CO-1	Symmetry and Group Theory	03	01	01	05
CO-2	Vibrational Spectroscopy	02	06	02	10
CO-3	Raman Spectroscopy	03	07	05	15
CO-4	Magnetic Resonance Spectroscopy	-	10	05	15
CO-5	X-ray Diffraction , Electron DiffractionNeutron Diffraction	03	02	-	05
Total		11	26	13	50

Legend: R:Remember, U:Understand, A:Apply

TheendofsemesterassessmentforOrganic Chemistry I willbeheldwithwrittenexaminationof50 marks

Note.DetailedAssessmentrubricneedtobepreparedbythecoursewiseteachersforabovetasks. Teacherscanalsodesigndifferenttasksasperrequirement,forendsemesterassessment.

Suggested Instructional/Implementation Strategies:

37. ImprovedLecture
38. Tutorial
39. CaseMethod
40. GroupDiscussion
41. RolePlay
42. Visitto NCL, CSIR laboratories
43. Demonstration
44. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT, B log,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
45. Brainstorming

Suggested Learning Resources

(a) Books:

S.No.	Title	Author	Publisher	Edition& Year
1	Modern Spectroscopy	J. M. Hoilas	John Wiley.	Revised editionedition2 020
2	Applied Electron Spectroscopy for Chemical Analysis	Ed. H. Windawiand F. L. HO	Wiley Interscience.	New edition, 2021
3	NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry	R. V. Parish	Ellis Harwood.	New edition, 2021
4	Physical Mehtods in Chemistry	R. S. Drago	Saunders College.	Revised edition
5	Chemical Applicationsof Group Theory	F. A. Cotton.	--	Revised edition
6	Introduction to Molacular Spectroscopy	G. M. Barrow	McGRraw Hill.	Revised edition

SuggestedWebSources:

20. https://nptel.ac.in/course.html
21. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5
22. https://swayam.gov.in/explorer?category=Chemistry

ModeofDelivery:Lecture,demonstration,E-tutoring,discussion,assignments,quizzes, case study, power point;

LMS/ICT Tools: Digital Classrooms, DLMS, ZOOM, G-Suite,MSPower-Point, Online Resources

Course Title: Group theory and spectyroscvopy **Course Code : 76CH204**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Knowledge	Research Aptitude	Communication	Problem Solving	Individual and Team Work	Investigation of Problems	Modern Tool usage	Science and Society	Life-Long Learning	Ethics	Project Management	Environment and sustainability	The detailed functional knowledge of theoretical concepts and experimental aspects of chemistry	To integrate the gained knowledge with various contemporary and evolving areas in chemical sciences like analytical, synthetic, pharmaceutical etc.	understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomenon-based problems in chemical sciences.	Provide opportunities to excel in academics, research or Industry by research based innovative knowledge for sustainable development in chemical science

CO1: Explanation the symmetry and group theory provide a powerful framework to understand and analyze patterns, structures, and behaviors across various disciplines	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**
CO2: Describe and apply the knowledge which helps in identifying and characterizing specific vibrational frequencies.	**2**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**
CO3 Collectively aim to provide students with a comprehensive discuss the theory, operation, data analysis, and applications of Raman spectroscopy.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**

CO 4 Students would gain a comprehensive apply of the theoretical foundations, practical aspects, and diverse applications of ESR spectroscopy.	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO 5 Collectively aim to equip students with a comprehensive explanation of the theoretical principles, practical methodologies, and diverse applications of diffraction techniques.	**2**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend:1–Low,2–Medium, 3–High

&PSOsNo.	Cos No. & Titles	SOsNo.	Laboratory instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
,2,3,4,5,6),10,11,12	CO1: Understand the symmetry and group theory provide a powerful framework to understand and analyze patterns, structures,	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 Symmetry and Group Theory 1	Character tables spectroscopy. an the us i d ir e r

1,2, 3, 4	and behaviors across various disciplines .			. 1 , 1 . 2 , 1 . 3 , 1 . 4 , 1 . 5 , 1 . 6 , 1 . 7	
,2,3,4,5,6 ,9,10,11,12	**CO2**: Describe and apply the knowledge which helps in identifying and characterizing specific vibrational frequencies.	SO2 .1S O2.2 S O2.3 SO2.4		Unit-2 **Vibrational Spectroscopy** 2.7, 2.8,2.9	Resonance Raman Spectroscopy, coherent anti-stokes Raman

1,2, 3, 4		SO2.5			Spectroscopy (CARS).
,2,3,4,5,6 ,10,11,12 1,2, 3, 4	**CO3** Collectively aim to provide students with a comprehensive understanding of the theory, operation, data analysis, and applications of Raman spectroscopy	SO 3.1 SO 3.2 SO 3.3 SO3.4 SO3.5		Unit-3 :**Mössbauer Spectroscopy** 3.1, 3.2,3.3,3.4,3.5,3.6,3.7	Nature of M-L bond, coordination number, structure and detection of oxidation state.
,2,3,4,5,6 ,10,11,12 1,2, 3, 4	**CO 4** Students would gain a comprehensive understanding of the theoretical foundations, practical aspects, and diverse applications of ESR spectroscopy.	SO4 .1S O4.2 S O4.3 SO4 .4 SO4.5		Unit-4 : :**Magnetic Resonance Spectroscopy** 4.1, 4.2,4.3, 4.4,4.5, 4.6,4.7	Quadrupole nuclei, quadrupole moments, electric field gradient, coupling constant splitting. Applications
,2,3,4,5,6 ,10,11,12 1,2, 3, 4	**CO 5** Collectively aim to equip students with a comprehensive understanding of the theoretical principles, practical methodologies, and diverse applications of diffraction techniques.	SO5 .1S O5.2 S O5.3 SO5 .4 SO5.5		**Unit 5: X-ray Diffraction , Electron DiffracNeutron Diffraction** 5.1,5.2,5.3,5.4,5.5,5.6,5.7	Low energy electron diffraction and structure of surfaces. ,

Curriculum Development Team:

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Course Name: Chemistry of Materials,

Corse Code 2CH801

Pre-requisite: Students should have basic knowledge of the chemistry of the design, synthesis, and characterization of assemblies of molecules whose properties arise from interactions between them of Chemistry of Material.
Rationale: The students studying chemistry of Materials should possess foundational understanding about Nanmaterials , Thermotropic liquid crystal, Ionic conductors, and application , High Tc superconductivity and Molecular hyperpolarisability. This will provide applicable knoweledge about Ceramic structures , mechanical properties Dielectric susceptibility and dielectric constants chemistry of Material.

CourseOutcomes:

Afterthe completionofthiscourse, the learner will
2CH801.1 Apply the concept of *Ceramics*, Composites and Nanomaterials explain the characterization, properties and applications.
2CH801.2 Explain the Liquid crystals the positional order and bond orientation and Optical properties of liquid crystalsby Liquid crystals.
2CH801.3 Explain the mechanism of ionic conduction, interstitial jumps (Frenkel); vacancy mechanism, diffusion superionic conductors, phase transtions and mechanism of conduction in superionic conductors. Examples and applications of ionic conductors.
2CH801.4 Explain the High Tc superconductivity Preparation and characterization of 1-2-3 and 2-1-4 materials. Normal state properties, anisotropy, Tempature dependence of electrical resistance.
2CH801.5 Apply the knowledge of the Molecular rectifiers and transistors, artificial photosynthetic devices, optical storage memory and switches, sensors. Conducting organics, organic superconductors, magnetism in organic materials. Fullerenes, doped and superconductors.

UNIT I: *Ceramics*, Composites and Nanomaterials.Ceramic structures, mechanical properties, clay products. Refractories, characterization, properties and applications. Microscopic composites, dispersion-strengthened and particle-reinforced composites, macroscopic composites. Nanocrystalline phase, preparation procedures, properties and applications.

UNIT II: Liquid Crystals.Thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases. Molecular arrangement in smectic A and smectic C phases, optical properties of liquid crystals. Dielectric susceptibility and dielectric constants. Lyotropic phases and their description of ordering in liquid crystals.

UNIT III: Ionic Conductors.Types of ionic conductors, mechanism of ionic conduction, interstitial jumps (Frenkel); vacancymechanism, diffusion superionic conductors, phase transtions and mechanism of conduction in superionic conductors. Examples and applications of ionic conductors.

UNIT IV: High Tc Materials. High Tc superconductivity. Preparation and characterization of 1-2-3 and 2-1-4 materials. Normal state properties, anisotropy,
temperature dependence of electrical resistance, and optical phonon modes. Superconducting state; heat capacity;coherence length, elastic constants,

microwave absorption-pairing and multigap structure in high Tc materials. Applications of high Tc materials.

UNIT V: Organic Solids, Fullerenes, Molecular Devices.Conducting organics, organic superconductors, magnetism in organicmaterials. Fullerenes, doped, fullerenes as superconductors. Molecular rectifiers and transistors, artificial photosynthetic devices, optical storage memory and switches, sensors.Non-linear optical materials, non-linear optical effects. Molecular hyperpolarisability.

Scheme of Studies:

Board ofStudy	Course Code	CourseTitle	Scheme ofstudies(Hours/Week)					Total Credits(C)
			Cl	LI	SW	SL	Total Study Hours(CI+LI+SW+SL)	
ProgramCore(PCC)	**2CH801**	Chemistry of material	4	0	1	1	6	4

Legend: **CI:**Class room Instruction (Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial(T)and others),
LI: Laboratory Instruction (Include sPractica lperformancesi nlaboratory workshop,fieldorotherlocationsusingdifferentinstructionalstrategies)
SW: Sessiona lWork (include sassignment,seminar,miniprojectetc.),
SL: Self Learning,
C:Credits.

Note: SW&SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome ofLearning.

Scheme of Assessment: Theory

Board ofStudy	Couse Code	CourseTitle	SchemeofAssessment(Marks)						
			ProgressiveAssessment(PRA)					EndSemesterAssessment	Total Marks
			Class/HomeAssignment5 number 3 markseach	Class Test2 (2bestout of3) 10 marks each(CT)	Seminarone	ClassAttendance	TotalMarks		
					(SA)	(AT)	(CA+CT+SA+AT)	(ESA)	(PRA+ESA)

			(CA)						
PCC	**2CH801**	**Chemistry of material**	15	20	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

2CH801.1: Apply the concept of *Ceramics*, Composites and Nanomaterials explain the characterization, properties and applications.

Approximate Approximate Hours

Activity	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction(LI)**	**Class room Instruction(CI)**	**Self Learning (SL)**

SO1.1 Explain and Apply the mechanical properties Refractories, characterization, properties and applicatons. SO1.2 Apply the clay products characterization, properties and applicatons. SO1.3 Explain Microscopiccomposites, dispersion- strengthened. SO1.4 Explain the particle-reinforced composites, macroscopic composites. SO1.5 , Apply the concept ofmacroscopic composites.		Unit-1.0 *Ceramics*, Composites and Nanomaterials. properties and applicatons. characterization, propertiesand applications. , dispersion-strengthened. preparation procedures, properties and applications. Draw the Ceramic structures. Define the mechanical properties. Clay products. particle-reinforced composites. Microscopic composites. T-1Refractories, characterization, properties and Applications. Apply the concept of dispersion-strengthened.	Nanocrystalline phase, preparation procedures, propertiesand applications.

		Nano crystalline phase, preparation procedures.	

SW-1 SuggestedSessionalWork(SW):

a.Assignments: Discuss Microscopic composites, dispersion-strengthened and particle-reinforced composites,macroscopic composites.

b.Mini Project: Apply the project of clay products. Refractories, characterization, properties and applications.

c.Other Activities (Specify):
Note on applications of Nanocrystalline phase and macroscopic composites.

2CH801.2: Explain the Liquid crystals the positional order and bond orientation and Optical properties of liquid crystals by Liquid crystals.

Activity	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning(SL)
SO2.1 Describe & apply Cement:Manufacture – Wet Process and Dry process **SO2.2** Explain Analysis of majorconstituents, setting of cement, reinforced concrete. Cement industries in India **SO2.3** Explain Glass: Types, Composition, manufacture of Optical glass, colored glasses, lead glass and neutron absorbingglass. **SO2.4** Understand and apply Glass: Types, Composition, manufacture of Optical glass, colored glasses, lead glass and neutron absorbing glass. **SO2.5** Explain Fertilizers: Fertilizer industries in India, Manufacture of ammonia, ammonium salts, urea, superphosphate, triple superphosphate and nitrate salts.		Unit-2 Cement, Ceramics, Glass and FertilizersCement: Manufacture Wet Process and Dry process. Types of cement . Analysis of major constituents, setting of cement, reinforced concrete. Cement industries in India. Ceramics Important clays and feldspar,glazing and verification. Glass Types, Composition, manufacture of Optical glass, colored glasses,lead glass and neutron absorbing glass. Fertilizers Fertilizer industries in India, Manufacture of ammonia, ammonium salts, urea, superphosphate, triple superphosphate and nitrate salts.T1- manufacture of Fertilizers T2- Manufacture of ammonia, ammonium salts,T3- setting and hardning of cement	Types of cement .Glass: Types, Composition, manufacture of Optical glass, colored glasses, lead glass and neutron absorbingglass Fertilizers use

SW-2 Suggested Sessional Work (SW):

a.Assignments: .Thermotropic liquid crystals, positional order, bond orientational order.

b.Mini Project: Explain and apply the optical properties of liquid crystals.

c.Other Activities (Specify):
description of ordering in liquid crystals.

2CH801.3: Explain the mechanism of ionic conduction, interstitial jumps (Frenkel); vacancy mechanism, diffusion superionic
conductors, phase transtions and mechanism of conduction in superionic conductors. Examples and applications of ionic conductors.

Activity	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learnin g(SL)
SO3.1 Explain the Types of ionic conductors. **SO3.2 Discuss the** interstitial jumps (Frenkel); vacancy mechanism. **SO3.3 Explain the** Diffusion superionic conductors, **SO3.4** phase transtions and mechanism of conduction. superionic conductors. **SO3.5** Application of ionic conductors and examples.		**Unit-3.0** Ionic Conductors. mechanism of ionic conduction. Mechanism of Frenkel. Diffusion and mechanism of superionic conductors. Example and applications. vacancy mechanism. superionic Conductors phase transitions Types of ionic conductors interstitial jumps (Frenkel)T-1 Types of ionic conductors, mechanism of ionic conduction. T-2 mechanism of conduction in superionic conductors. T-3 applications of ionicconductors.	mechanism of conduction in superionic conductors. Examples and applications of ionic conductors.

SW-3 Suggested Sessional Work (SW):

a.Assignments: Types of ionic conductors, mechanism of ionic conduction.

b.Mini Project: Examples and applications of ionic conductors.

c.Other Activities (Specify): Apply the concept ofdiffusion superionic conductors, phase transtions and mechanism.

2CH801.4: Explain Preparation and characterization of 1-2-3 and 2-1-4 materials. Normal state properties, anisotropy, temperature dependence of electrical resistance, and optical phonon modes. Superconducting state; heat capacity; coherence length, elastic constants, microwave absorption-pairing and multigap structure in high Tc materials. Applications of high Tc materials.

Activity	AppX Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction(LI)	Class room Instruction (CI)	Self Learning(SL)
SO4.1 Explain High Tcsuperconductivity. **SO4.2** ExplainPreparation and characterization of 1-2-3and 2-1-4 materials. **SO4.3**Explain the anisotropy,temperature dependence of electrical resistance, and optical phonon modes. **SO4.4** Explain Superconducting state; heat capacity; coherence length, elastic constants. **SO4.5** Apply the concept of microwave absorption - pairing and multigap structure in high Tc materials. Applications of high Tc materials.		**Unit-4.0** High Tc Materials4.1The Preparation of Tc superconductivity. characterization of 1-2-3 and 2-1-4materials. Normal state properties. 4.4anisotropy and optical phononmodes. Discuss the microwave absorption-pairing. Draw the multigap structure. Applications of high Tc materials. optical phonon modes. Superconducting state; heat capacity. Explain the heat capacity ;coherence length, elastic constants. microwave	Superconducting sta Discuss the microwave absorption-pairing andmultigap structure in high Tc materials.

		absorption-pairing Draw the structure in high Tcmaterials.	

SW-4 Suggested Sessional Work (SW):

a.Assignments: Preparation and characterization of 1-2-3 and 2-1-4 materials.

b.Mini Project: Discuss theSuperconducting state; heat capacity

c.Other Activities (Specify): Importance andApplications of high Tc materials.

2CH801.5: Apply the knowledge of the Conducting organics, organic superconductors, magnetism in organic materials. Fullerenes, doped, fullerenes as superconductors. Molecular rectifiers and transistors, artificial photosynthetic devices, optical storage memory and switches, sensors. Non-linear optical materials, non-linear optical effects. Molecular hyperpolarisability.

Activity	**AppX Hrs**
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning(SL)
SO5.1 Explain organic superconductors, magnetism in organic materials. **SO5.2** Explain Fullerenes, doped, fullerenes as superconductors. **SO5.3** Explain and apply Molecularrectifiers and transistors, artificialphotosynthetic devices, opticalstorage memoryand switches, sensors. **SO5.4**Explain and apply the Non-linear optical materials, non-linear optical effects. **SO5.5** Explain and apply Molecularhyperpolarisability.	.	**Unit-5.0:** **5.1**Organic Solids,Fullerenes, Molecular Devices. Apply the knowledge of magnetism in organic materials. Fullerences as supercondors. Artificial photosyntheticdevices. optical storage memory and switches, sensors. Effects of non-linear optical materials. Hyperpolarisability molecular compounds. Non-linear optical materials, non-linear optical effects. Explain the Molecular hyperpolarisability. Discuss the Molecular rectifiers and transistors. Explain the artificial photosynthetic devices.	Explain the Fullerenes, doped, fullerenes as superconductors.

SW-5 Suggested Sessional Work (SW):

a.Assignments: Organic materials in magnetism of superconductors**.**

b.Mini Project: Artificial photosynthetic devices, optical storage memory and switches, sensors.

c.Other Activities (Specify):
Effects of Non-linear optical materials.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	SessionalWork (SW)	Self Learning(Sl)	Total hour (Cl+SW+Sl)
2CH801.1: Understand the concept ofheterocyclic chemistry composites and Nonmaterial's compound properties and application and Microscopic composites in chemistry of material.	12	02	01	15
2CH801.2: Explain Liquid crystals the positional order and bond orientation and Optical properties of liquid crystals by Liquid crystals.	12	02	01	15
2CH801.3:Describe the mechanism of ionic conduction diffusion superionic, and application byionic conductors.	12	02	01	15
2CH801.4 Explain the High Tc superconductivity Preparation and characterization of 1-2-3 and 2- 1-4 materials. Normal state properties, anisotropy, Tempature dependence of electrical resistance.	12	02	01	15
2CH801.5:. Apply the knowledge of the Molecular rectifiers and transistors, artificial photosynthetic devices, optical storage memory and switches, sensors. Conducting organics, organic superconductors, magnetism in organic materials. Fullerenes, doped and superconductors.	12	02	01	15
Total Hours	60	10	05	75

Suggestion for End Semester Assessment

Suggested Specification Table (ForESA)

CO	UnitTitles	MarksDistribution			Total Marks
		R	U	A	
CO-1	*Ceramics*, Composites and Nanomaterials.	03	01	01	05
CO-2	Liquid Crystals.	02	06	02	10
CO-3	Ionic Conductors.	03	07	05	15
CO-4	High Tc Materials	-	10	05	15
CO-5	Organic Solids, Fullerenes, MolecularDevices.	03	02	-	05
Total		11	26	13	50

Legend: R:Remember, U:Understand, A:Apply

The end of semester r as sessment for Organic Chemistry I will be held with written examination of 50 marks

Note.Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks.Teachers can also design different tasks as perrequirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

Improved Lecture/Tutorial/Case Method/Group Discussion /Role Play
Visitto NCL, CSIR laboratories
Demonstration
ICTBased Teaching Learning (Video Demonstration /Tutorials CBT, Blog, Facebook, Twitter, Whatsapp,Mobile, Online sources)Brainstorming

Suggested Learning Resources:

(j) Books:

S. No.	Title	Author	Publisher	Edition& Year
1	Material Science and Engineering-An Introduction	W.D. Callister	Wiley	1990
2	Solid State Physics	N.W. Ashcroft	N.D. Mermin, Saunders College	1998

3	Principles of the Solid State	H.V. Keer	Wiley Eastern.	2006
4	Materials Science	J.C. Anderson, K.D. Leaver, J.M. Alexander and R.D. Rawlings,	ELBS.	1994
5	Thermotropic LiquidCrystals.	G.W. Gray, editor, John Wiley.	Wiley	1993
6	Handbook of Liquid Crystals	Kelker and Hatz, Chemie Verlag.	Ke lker	1996

Suggested Web Sources:https://nptel.ac.in/course.html

https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5
https://swayam.gov.in/explorer?category=Chemistry

ModeofDelivery: Lecture,demonstration,E-tutoring,discussion, assignments,quizzes, case study, power point;

LMS/ICT Tools: Digital Classrooms, DLMS, ZOOM, G-Suite,MSPower-Point, Online Resources

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Course Title: Chemistry of Material **Course Code :2CH801**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Knowledge	Research Aptitude	Communication	Problem Solving	Individual and Team Work	Investigation of Problems	Modern Tool usage	Science and Society	Life-Long Learning	Ethics	Project Management	Environment and sustainability	The detailed functional knowledge of theoretical concepts and experimental aspects of chemistry	To integrate the gained knowledge with various contemporary and evolving areas in chemical sciences like analytical, synthetic, pharmaceutical etc.	understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomenon-based problems in chemical sciences.	Provide opportunities to excel in academics, research or Industry by research based innovative knowledge for sustainable development in chemical science

CO1 : Apply the concept of Ceramics, Composites and Nanomaterials explain the characterization, properties and applications.	3	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1
CO 2 : Explain the Liquid crystals the positional order and bond orientation and Optical properties of liquid crystals by Liquid crystals.	2	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1
CO3 :Explain the mechanism of ionic conduction, interstitial jumps (Frenkel); vacancy mechanism, diffusion superionic conductors, phase transtions and mechanism of conduction in superionic conductors. Examples and applications of ionic conductors.	2	2	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO 4: Explain the High Tc superconductivity Preparation and characterization of 1-2-	2	2	2	2	3	2	3	2	2	1	2	3	3	3	3	2

3 and 2-1-4 materials. Normal state properties, anisotropy, Temp ature dependence of electrical resistance.																
CO 5: Applythe knowledge of the Molecular rectifiers and transistors, artificial photosynthetic devices, optical storage memory and switches, sensors. Conducting organics, organic superconductors, magnetism in organic materials. Fullerenes, doped and superconductors.	2	-	-	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium, 3–High

POs &PSOsNo.	COsNo.& Titles	SOsNo.	LaboratoryInstruction(LI)	Classroom Instruction(CI)	Self Learning (SL)	Self Learning(SL)
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO-1:. Apply the concept of *Ceramics*, Composites and Nanomaterials explain the characterization, properties and applications. .	SO 1.1 SO 1.2 SO 1.3 SO 1.4 SO 1.5		Unit-1.0 *Ceramics*, Composites and Nanomaterials. 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	Nanocrystalline phase, preparation procedures, properties and applications.	Aromaticity in annulenes,Inclusion Compounds
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO 2 : Explain Liquid crystals the positional order and bond orientation and Optical properties of	SO 2.1 SO 2.2 SO 2.3 SO 2.4 SO		Unit-2 Liquid Crystals. 2.1,2.2,2.3,2.4,2.5,2.6, 2.7,2.8,2.9	positional order, bond orientational order.	Interconversion of Fischer, Newman, Sawhorse and flying wedge formulae. (practice) Conformational analysis, simple, acyclic systems.

	liquid crystals by Liquid crystals.	2.5				
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO3 : Explain the mechanism of ionic conduction, interstitial jumps (Frenkel); vacancy mechanism, diffusion superionic conductors, phase transtions and mechanism of conduction in superionic conductors. Examples and applications of ionic conductors.	SO 3.1 SO 3.2 SO 3.3 SO 3.4 SO3.5		Unit-3 :Ionic Conductors. 3.1, 3.2,3.3,3.4,3.5,3.6, 3.7,3.8,3.9	mechanism of conduction in superionic conductors. Examples and applications of ionic conductors	neration, structure, stability andreactivity of carbocations, carbanions Taftequation
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO 4: Explain the High Tc superconductivity Preparation and characterization of 1-2-3 and 2-1-4 materials. Normal state properties, anisotropy, Tempature	SO 4.1 SO 4.2 SO 4.3 SO 4.4 SO 4.5		Unit-4 :High Tc Materials. 4.1,4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	Discuss the microwave absorption-pairing and multigap structure in high Tc materials.	Nucleophilic substitution at an aliphatic trigonal carbon. Phase transfer catalysis

	dependence of electrical resistance.					
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO 5: : Apply the knowledge of the Molecular rectifiers and transistors, artificial photosynthetic devices, optical storage memory and switches, sensors. Conducting organics, organic superconductors, magnetism in organic materials. Fullerenes, doped and superconductors.	SO 5.1 SO 5.2 SO 5.3 SO 5.4 SO 5.5		Unit 5: Organic Solids, Fullerenes, Molecular Devices 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,,5.9	Explain the Fullerenes, doped, fullerenes as superconductors.	Alkylation, amination SRN1 mechanism

B.Sc. By Research (CS/PHY/CHEM/MATHS) Semester VII & VIII

Course Name: Research Project

Pre-requisite: Students should have fundamental of chemical analysis

Rational: Students will do research in selected area and interpret ate data

Course outcome: After completion of this course students will

CO1: Create new knowledge in Physical, Chemical & Mathematical Science

CO2; Explain data obtained during research

CO3: Present and evaluate research findings

CO4; Write research findings in form of research paper

CO5: Solve environmental issues which are based on chemical science

Guidelines for Project work

To provide expertise in research, project work will be allotted to students in 7th semester and it will be ended in last of 8th semester. Project topic will be selected by students in 7th semester after review of research papers according to chosen field in major course. The project work can be selected and carried out in any thrust areas of subject (Experimental or Theoretical) under the guidance of allotted supervisor of the department. The students must submit their thesis/ report in the department as per the date announced for the submission. In 7rd semester students will submit current report and final submission will be in 8th semester.

Internal assessment of the project work will be carried out by respective supervisor through power point presentation given by candidates at the end of each semester (RAC) in last of semester 7rd and 8th. External assessment of the dissertation work will be carried out by an external examiner (nominated by the RAC committee) through power-point presentation given by candidates

1. Research paper will contain a cover page, certificate signed by student and supervisor, table of contents, introduction, Objective, Literature review, methodology, results and discussions conclusion, and references. Along with plagiarism report and two research paper publish in scopus/web of science/UGC Care listed journals.

- The paper size to be used should beA-4 size.
- The font sizeshouldbe12 with Times New Roman.
- The text of the dissertation maybe typed in 1.5 (one and a half)space.
- Theprintoutofthedissertationshallbedoneonbothsidesofthepaper(insteadofsinglesideprinting)

2. The candidate shall be required to submit two soft bound copies of dissertation along with a CD in the department as per the date announced.
3. Thesis will be evaluated internally by the RAC with supervisor allotted to the student during the semester.
4. The candidate will defend her/his dissertation/project work through presentation before the External examiner at the end of semester and will be awarded credits.
5. In case, a student is not able to score passing marks in the thesis, he/she will have to resubmit her/his dissertation after making all corrections/improvements & this dissertation shall be evaluated as above. The candidate is required to submit the corrected copy of the dissertation in hardbound within two weeks after the viva-voce.