Curriculum Book

and
Assessment and Evaluation Scheme

based on

Outcome Based Education (OBE)

and
Choice – Based Credit System (CBCS)

in

Master of Technology
M.Tech. (Computer Science and Engineering)

2 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 Engineering and Technology
Department of Computer Science & Engineering**

H.O.D.
Department of Computer Science
& Application
AKS University, Satna (M.P.)

Dean
Faculty of Engineering & Technolog
AKS University
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Professor B.A. Chopade
Vice - Chancellor
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AKS University

Faculty of Engineering and Technology
Department of Computer Science & Engineering
Curriculum of M.Tech. (CSE) Program
(Revisedason01August2023)

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Foreword

I am thrilled to observe the updated curriculum of the Computer Science & Engineering Department for the M. Tech Computer Science & Engineering [CSE] Program, which seamlessly integrates the most recent technological advancements and adheres to the guidelines set forth by AICTE. The revised curriculum also thoughtfully incorporates the directives of NEP-2020 and the Sustainable Development Goals.

The alignment of course outcomes (COs), Programme Outcomes (POs), and Programme Specific Outcomes (PSOs) has been intricately executed, aligning perfectly with the requisites of NEP-2020 and NAAC standards. I hold the belief that this revised syllabus will significantly enhance the skills and employability of our students.

With immense satisfaction, I hereby present the revised curriculum for the M. Tech.in Computer Science & Engineering program for implementation in the upcoming session.

Er. Anant Soni
Pro Chancellor & Chairman
AKS University,

01 August 2023
Satna

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From the Desk of the Vice-Chancellor

AKS University is currently undergoing a process to revamp its curriculum into an outcome-based approach, to enhance the teaching and learning process. The foundation of quality of quality education lies in the implementation of a curriculum that aligns with both societal and industrial needs, focusing on relevant outcomes. This entails dedicated and inspired faculty members, as well as impactful industry internships. Hence, it is of utmost importance to begin this endeavor by crafting an outcome-based curriculum in collaboration with academia and industry experts. This curriculum design should be informed by the latest technological advancements, market demands, the guidelines outlined in the National Education Policy (NEP) of 2020, and sustainable goals.

I'm delighted to learn that the revised curriculum has been meticulously crafted by the Computer Science & Engineering Department, in consultation with an array of experts from the Computer Science industry, research institutes, and academia. This curriculum effectively integrates the principles outlined in the NEP-2020 guidelines, as well as sustainable goals. It also adeptly incorporates the latest advancements in Computer Science manufacturing technology.

Furthermore, the curriculum takes into account the specific needs of the Indian Computer Science industry, focusing on the production of cost-effective, high-quality Computer Science. It extends its reach to optimizing power consumption by including insights on waste heat recovery systems utilized in Computer Science plants. This inclusion not only imparts knowledge but also encourages students' independent thinking for potential enhancements in this area.

The curriculum goes beyond theoretical learning and embraces practical applications by incorporating the utilization of industrial and domestic waste in Computer Science production. To enhance students' skills, the curriculum integrates Hands-On Training, industrial visits, on-the-job training experiences, research, and progress. This well-rounded approach ensures that students receive a comprehensive education, fostering their skill development and preparing them for success in the Computer Science industry.

I am confident that the updated curriculum for Computer Science & Engineering will not only enhance students' technical skills but also contribute significantly to their employability. During the process of revising the curriculum, I am pleased to observe that the Computer Science & Engineering department has diligently adhered to the guidelines provided by the AICTE. Additionally, they have maintained a total credit requirement of 170 for the M. Tech Computer Science & Engineering program.

It's worth noting that curriculum revision is an ongoing and dynamic process, designed to address the continuous evolution of technological advancements and both local and global concerns. This ensures that the curriculum remains responsive and attuned to the changing landscape of education and industry. AKS University warmly invites input and suggestions from industry expert technocrats and Alumni students to enhance the curriculum and make it more student-centered. Your valuable insights will greatly contribute to shaping an education that best serves the needs and aspirations of our students.

AKS University, Satna   **_Professor B. A. Chopade_**
01 August 2023   *Vice-Chancellor*

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Preface

As part of our commitment to ongoing enhancement, the Department of Computer Science & Engineering consistently reviews and updates its M.Tech. Computer Science & Engineering program curriculum every three years. Through this process, we ensure that the curriculum remains aligned with the latest technological advancements, as well as local and global industrial and social demands.

During this procedure, the existing curriculum for the M.Tech. - Computer Science & Engineering [CSE] Program undergoes evaluation by a panel of technocrats, industry specialists, and academics. Following meticulous scrutiny, the revised curriculum has been formulated and is set to be implemented starting from August 01, 2023. This implementation is contingent upon the endorsement of the curriculum by the University's Board of Studies and Governing Body.

This curriculum closely adheres to the AICTE model syllabus distributed in May 2023. It seamlessly integrates the guidelines set forth by the Ministry of Higher Education, Government of India, through NEP- 2020, as well as the principles of Sustainable Development Goals. To foster the holistic skill development of students, a range of practical activities, including Hands-On Training, Industrial Visits, Project planning and execution, Report Writing, Seminars, and Industrial on-the-job training, have been incorporated. Furthermore, in alignment with AICTE's directives, the total credit allocation for the M. Tech Computer Science & Engineering program is capped at 169 credits.

This curriculum is enriched with course components in alignment with AICTE guidelines, encompassing various disciplines such as Fundamental Science Concepts: 24 credits, Engineering Science: 25 credits, Humanities and Social Sciences: 12 credits, Core Program Courses: 66 credits, Elective Program Courses: 9credits, Open Electives: 9 credits, Project and Practical Training: 17 credits, Seminars: 3 credits, Indian Knowledge System: 2 credits, Sustainable Development Goals: 2 credits.

To ensure a comprehensive learning experience, detailed evaluation schemes and rubrics have also been meticulously provided.

For each course, a thorough mapping of Course Outcomes, Program Outcomes, and Programme Specific Outcomes has been undertaken. As the course syllabus is meticulously developed, various elements such as session outcomes, laboratory instruction, classroom instruction, self-learning activities, assignments, and mini- projects are meticulously outlined.

We hold the belief that this dynamic curriculum will undoubtedly enhance the independent thinking, skills, and overall employability of the students.

Professor Akhilesh A. Waoo
Associate Dean and Head CS/IT

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Introduction

Department of Computer Science was established in the year 2012. The Computer Science department at AKS University, Satna is fully committed to prepare its students with a vision, creativeness and newness so that they can face the challenges of the corporate world. Highly qualified and experienced faculty members of the department play a major role in the university.

The department aims to provide its students with an updated curriculum to analyze, develop, and monitor computers & their various applications as a blend of theory, practical, projects and seminars. The main goals are to enhance problem-solving skills, innovative thinking, analytic, teamwork, developing good communication skills, and readiness to learn new technologies such as artificial intelligence, IOT, machine learning, cloud computing, network security, etc.

Vision

The aim of Computer Science Commuter Science & Engineering Department to proceeding the Information technology field, producing skilled graduates, conducting impactful research, and contributing to the betterment of society through technology.

Mission

M 01 : To produce skilled students, contribute to research and innovation, and address the societal challenges associated with technology.
M 02 : To promote innovation and research in computer science.
M 03 : To educating and training the next generation of technology leaders.
M 04 : To Actively engage with industry and the wider community.
M 05 : To support and nurture the entrepreneurial spirit and startup culture among its students and faculty.

Program Educational Activities (PEO)

PEO1: To produce students who have strong foundation of knowledge and skills in the field of computer science and engineering.
PEO2: To produce students who are employable in industries/public sector/research organizations or work as an entrepreneur.
PEO3: To produce students who can provide solutions to challenging problems in their profession by applying computer engineering theory and practices.
PEO4: To produce students who can provide leadership and are effective in multidisciplinary environment.

Program Outcomes (POs)

M.Tech Graduate will able to perform:
PO 1: Engineering knowledge: Use your understanding of physics, math, engineering fundamentals, and your chosen engineering specialty to solve challenging engineering challenges.
PO2: Problem analysis: Using the fundamental concepts of mathematics, the natural sciences, and engineering sciences, identify, formulate, study research material, and analyses difficult engineering problems in order to obtain justified findings.

PO3: Design/development of solutions: Designing complicated engineering problems' solutions and creating system elements or processes that satisfy the required requirements while taking into account factors like public health and safety, cultural, societal, and environmental considerations.

PO4: Conduct studies of difficult problems: Apply research-based knowledge and research techniques, such as experiment design, data analysis and interpretation, and information synthesis,

to provide reliable results and current technological context.

PO5: Utilization of modern tools: Develop, pick, and apply appropriate methods, resources, and modern IT and engineering tools, such as modelling and prediction, to complex engineering operations while being aware of the technologies' limitations.

PO6: Engineers and society: Assess societal, health, safety, legal, and cultural issues and the resulting obligations related to the professional practise of engineering by using reasoning informed by contextual knowledge.

PO7: Environment and sustainability: Understanding the effects of professional engineering solutions in societal and environmental contexts, as well as demonstrating an understanding of the need for sustainable development.

PO8: Ethics: Adhere to professional ethics, obligations, and standards of engineering practice. Apply ethical principles.

PO9: Individual and team work: Work effectively as an individual, a team member or a leader in different teams and in interdisciplinary situations.

PO10: Communication: Effectively communicate complex engineering tasks to the engineering community and the general public. This includes the ability to understand and produce effective reports and design documentation, deliver and receive clear directions, and make good presentations.

PO11: Project management and finance: Show knowledge and grasp of engineering and management principles and apply them to own work as a team member and leader to manage projects and in interdisciplinary settings.

PO12: Life-long learning: Recognize the need for, and possess the readiness and capacity for, autonomous and lifelong learning in the classroom

Program Specific Outcomes (PSOs)

On completion of M.Tech program, the students will achieve the following program specific outcomes: -

PSO1: 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 systems of various complexity.

PSO2: Utilize relevant methods and cutting-edge hardware and software engineering tools to develop and integrate computer systems and related technologies. This also encourages lifelong learning for the advancement of technology and its use in multidisciplinary settings.

PSO3: 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.

PSO4: Learn and use the most recent software innovations in the fields of engineering and computer science.

PSO5: Recognize and examine issues in real life, then offer creative software solutions

Consistency/Mapping of PEOs with Mission of the Department

PEO	M 1	M 2	M 3	M 4
PEO 1	3	2	3	2
PEO 2	2	2	2	3
PEO 3	2	3	2	1
PEO 4	2	2	3	3

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

GENERAL COURSE STRUCTURE & THEME

1. **Definition of Credit**

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

2. **Range of Credits:**

   The total number of credits proposed for the two-year M. Tech. in Computer Science is kept as 61 considering NAAC guidelines.

3. **Board of Studies:**
   a. Program Core Course: PCC
   b. Program Elective Course: PEC
   c. Open Elective Course :   OEC
   d. Research Course: REC
   e. Audit Course: AUC
   f. Project/Seminar/Dissertation   PRC

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M.Tech. CS&E
SCHEME

Semester I						
3-Week Orientation Programme						
S. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**
1.	20CSE111	Program Core I- Mathematical foundations of Computer Science	3	0	0	3
2.	20CSE112	Program Core II-Advanced Data Structures	3	0	2	4
3.	**Program Elective Course -I**					
	20CSE115-B	Machine Learning	3	0	2	4
	20CSE115-C	Wireless Sensor Networks				
	20CSE115-A	Introduction toIntelligent Systems				
4.	**Program Elective -II**					
	20CSE116-A	Data Science	3	0	0	3
	20CSE116-B	Distributed Systems				
	20CSE116-C	Advanced Wireless and MobileNetworks				
5.	20RM113	Research Methodology and IPR	2	0	0	2
6.	20RM114	Audit Course: English for Research Paper Writing	2	0	0	2
Total						**18**

Semester II						
S. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**
1.	20CSE211	Program Core III - Advance Algorithms	3	0	0	3
2.	20CSE212	Program Core IV - Soft Computing	3	0	2	4
3.	**Program Elective -III**					
	20CSE214-A	Data Preparation and Analysis	3	0	2	4
	20CSE214-B	Data Storage Technologies and Networks				
	20CSE214-C	Cloud computing				
	Program Elective -IV					
4.	20CSE215-A	Data Warehousing and Data Mining	3	0	0	3
	20CSE215-B	Microprocessors and computer architecture				
	20CSE215-C	Security in IoT Devices				
5.	20AU213	Audit Course: Constitution of India	2	0	0	2
6.	20CSE273	Mini Project with Seminar	0	0	2	2
Total						**18**

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S. No	Course Code	Course Title	L	T	P	Credits
Semester III					
1.	**Program Elective -V**		3	0	0	3
	20CSE301-A	Mobile Applications and Services/				
	20CSE301-B	Cryptography and Network Security				
2.	**Open Elective -I**		3	0	0	3
	20OE302-A	OptimizationTechniques				
	20OE302-B	Operations Research				
3.	20CSE371	Dissertation-I /Industrial Project	3	0	0	3
		Total				**9**

S. No	Course Code	Course Title	L	T	P	Credits
Semester IV					
1.	20CSE471	Dissertation II	0	0	16	16
		Total				**16**

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Semester-I

Course Code:	20CSE111

Course Title:	**Mathematical Foundation of Computer Science**
Pre-requisite:	Student should have basic knowledge of discrete mathematics.
Rationale:	To understand the mathematical fundamentals that is prerequisites for a variety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning. This helps to develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency. Students will study various sampling and classification problems.

Course Outcomes:

After completion of course, students would be able to:

20CSE111.1:- Understand the basic notions of discrete and continuous probability.
20CSE111.2:- Apply the statistical techniques with their own strengths and applications.
20CSE111.3:- Understand and apply the Graph theory is extensively used in computer science, particularly in the modeling and analysis of networks, algorithms, and data structures.
20CSE111.4:- Understand and apply the methods of statistical inference, and the role that sampling distributions play in those methods.
20CSE111.5:- Apply and perform correct and meaningful statistical analyses of simple to moderate complexity.

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)	
PCC	20CSE111	Mathematical Foundation of Computer Science	3	0	1	1	5	3

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.),

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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	Couse Code	Course Title	Scheme of Assessment (Marks)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Progressive Assessment (PRA)							
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test2 (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	20CSE111	Mathematical Foundation of Computer 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 show case their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) outercourse's conclusion.

20CSE111.1:- Understand the basic notions of discrete and continuous probability.

Approximate Hours

Item	Appx. Hrs.
Cl	13
LI	0
SW	2
SL	1
Total	16

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Understanding probability mass functions **SO1.2** Explain Applications of the univariate and multivariate Central Limit Theorem **SO1.3** Discuss Markov chains		**Unit-1. Probability** **(A) (12-Lectures)** **1.1** Probability mass function **1.2** Probability density function **1.3** cumulative distribution functions **1.4** Parametric families of distributions **1.5** Expected value **1.6** Variance **1.7** Conditional expectation **1.8** Applications of the univariate **1.9** Applications of the multivariate **1.10** Central Limit Theorem **1.11** Example of Central Limit Theorem, **1.12** Probabilistic inequalities **1.13** Markov chains.	1. Question based on Probability mass function and probability density function. 2. To learn about applications of the univariate and multivariate Central Limit Theorem

SW-1: Suggested Sessional Work (SW):
  g. Assignments:
   i. Probability mass function, Probability density function and cumulative Distribution functions.
   ii. Question based on Expected value, variance and conditional expectation.
   iii. Probabilistic inequalities, Markov chains.
  h. Mini Project: None
  i. Other Activities (Specify): Seminar

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20CSE111.2:- Apply the statistical techniques with their own strengths and applications.

Approximate Hours

Item	Appx. Hrs.
Cl	6
LI	0
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 Define random sample. **SO2.2** To understand sampling distributions of estimators. **SO2.3** To learn about Methods of Moments.		**Unit-2** : **Probability (B)** : **(06-Lectures)** **2.1** Random samples **2.2** sampling distributions of estimators **2.3** Methods of Moments **2.4** Example of Methods of Moments **2.5** Maximum Likelihood Estimators **2.6** Example of Maximum Likelihood Estimators	1. Methods of Moments and Maximum Likelihood.

SW-2 Suggested Seasonal Work (SW):

    a. **Assignments:**
        i. Sampling distributions of estimators.
        ii. Methods of Moments and Maximum Likelihood.
    b. **Mini Project:** None
    c. **Other Activities (Specify):** Seminar

20CSE111.3:- Understand and apply the Graph theory is extensively used in computer science, particularly in the modeling and analysis of networks, algorithms, and data structures.

Approximate Hours

Item	Appx. Hrs.
Cl	5
LI	0
SW	2
SL	1
Total	8

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 To Understand Statistical inference. **SO3.2** Explain Introduction to multivariate statistical models. **SO3.3** Discuss principal components analysis.		**Unit-3**: **Statistical inference : (05-Lectures)** **3.1** Statistical inference **3.2** Introduction to multivariate statistical models, **3.3** Regression and classification problems **3.4** Principal components analysis **3.5** The problem of overfitting model assessment.	1. To learn about Introduction to multivariate statistical models: regression and classification problems.

SW-3 Suggested Sessional Work (SW):

a. **Assignments:**

    i.   Introduction to multivariate statistical models: regression and classification problems.

    ii.   The problem of overfitting model assessment.

    iii.   principal components analysis.

        b. **Mini Project:** None

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

20CSE111.4:- Understand and apply the methods of statistical inference, and the role that sampling distributions play in those methods.

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Approximate Hours

Item	Appx. Hrs.
Cl	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 To Understand Optimization algorithms. **SO4.2** To learn genetic Optimization.		**Unit-4: Graph Theory : (10-Lectures)** **4.1** Isomorphism , **4.2** Planar graphs, **4.3** graph colouring **4.4** hamilton circuits **4.5** euler cycles **4.6** Permutations with repetition **4.7** Combinations with repetition **4.8** Permutations without repetition **4.9** Combinations without repetition **4.10** Specialized techniques to solve combinatorial enumeration problem.	1. Permutations and Combinations with and without repetition.

SW-4 Suggested Sessional Work (SW):

    a. Assignments:
     i. hamilton circuits andeuler cycles.
     ii. Permutations and Combinations with and without repetition.
  b. Mini Project: None
  c. Other Activities (Specify): Seminar

20CSE111.5:- Apply and perform correct and meaningful statistical analyses of simple to moderate complexity.

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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)
SO5.1 To understand Real life Problem in mathematics **SO5.2** To learn about Recent trends. **SO5.3** To understand programming in real world applications		**Unit 5: Computer science and engineering applications (11-Lectures)** **5.I** Computer science and engineering applications **5.2** Data mining **5.3** Network protocols **5.4** analysis of Web traffic **5.5** Computer security **5.6** Software engineering **5.7** Computer architecture **5.8** operating systems **5.9** distributed systems **5.10** Bioinformatics, **5.11** Machine learning.	1. Computer security, Software engineering, and Computer architecture

SW-5 Suggested Sessional Work (SW):

    a. Assignments:
        i. Network protocols and analysis of Web traffic.
        ii. Computer security, Software engineering, Computer architecture.
        iii. operating systems, distributed systems, Machine learning.
    b. Mini Project: None
    c. Other Activities (Specify): Seminar

Brief of Hours suggested for the Course Outcome

Course Out comes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
20CSE111.1:-Understand the basic notions of discrete and continuous probability.	13	02	01	16

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20CSE111.2:- Apply the statistical techniques with their own strengths and applications.	06	02	01	09
20CSE111.3:- Understand and apply the Graph theory is extensively used in computer science, particularly in the modeling and analysis of networks, algorithms, and data structures.	05	02	01	08
20CSE111.4:- Understand and apply the methods of statistical inference, and the role that sampling distributions play in those methods.	10	02	01	13
20CSE111.5:- Apply the perform correct and meaningful statistical analyses of simple to moderate complexity.	11	02	01	14
Total Hours	45	10	05	60

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	**U**	**A**	
20CSE111-1	Probability (A)	03	02	03	08
20CSE111-2	Probability (B)	03	01	05	09
20CSE111-3	Statistical inference	03	07	02	12
20CSE111-4	Graph Theory	03	05	05	13
20CSE111-5	Computer science and engineering applications	03	02	03	08
Total		15	17	18	50

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

The end of semester assessment for Mathematical Foundation of Computer Science 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.

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Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to software industry
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	Mathematical Foundation of Computer Science.	Y.N. Singh	New Age International (P) Limited, Publishers,	2005
2	Mathematical Foundations of Computer Science	Shahnaz Bathu	PHI Learning Private Limited, New Delhi	2010

Curriculum Development Team

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8. Ms. Pushpa Kushwaha, Assistant Professor, Department of Computer Science and Engineering.

CO, PO and PSO Mapping

Program: M.Tech(CSE)
Course Code: 20CSE111
Course Title: Mathematical Foundation of Computer Science

Course Outcomes	Program Outcomes												Program Specific Outcomes				
	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 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	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 systems of various complexity	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 in multidisciplinary settings	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	
20CSE111 1	2	2	3	3	2	1	1	1	1	1	1	3	2	2	3	2	3
20CSE111 2	2	3	2	3	2	2	1	1	1	1	1	3	2	3	2	3	3
20CSE111 3	2	2	2	3	2	2	1	1	1	1	1	3	2	2	2	2	3
20CSE111 4	2	2	3	2	2	2	1	1	1	1	1	3	2	2	3	2	2
20CSE111 5	2	2	3	2	2	2	1	1	1	1	1	3	2	2	3	2	2

Course Curriculum Map: Mathematical Foundation of Computer Science

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	20CSE111 1: Understand the basic notions of discrete and continuous probability.	SO1.1 SO1.2 SO1.3		Unit-1 Probability (A) 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	As mentioned above
PO 1,2,3,4,5,6,7,8,9,10,11,12 PSO 1,2, 3, 4, 5	20CSE1112: Apply the statistical techniques with their own strengths and applications.	SO2.1 SO2.2 SO2.3		Unit-2 Probability (B) 2.1, 2.2, 2.3, 2.4, 2.5, 2.6	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	20CSE1113: Understand and apply the Graph theory is extensively used in computer science, particularly in the modeling and analysis of networks, algorithms, and data structures.	SO3.1 SO3.2 SO3.3		Unit-3 Statistical inference 3.1,3.2,3.3,3.4,3.5,	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	20CSE1114: Understand and apply the methods of statistical inference, and the role that sampling distributions play in those methods.	SO4.1 SO4.2		Unit-4: Graph Theory 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 PSO 1,2, 3, 4, 5	20CSE1115: Apply the perform correct and meaningful statistical analyses of simple to moderate complexity.	SO5.1 SO5.2 SO5.3		Unit-5: Computer science and engineering applications 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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Semester-I

Course Code: 20CSE112

Course Title: Advanced Data Structures

Pre-requisite: UG level course in Data Structures

Rationale: The course aims to equip students with the ability to select appropriate data structures, comprehend the ADT/libraries, and apply them to devise algorithms for a specific problem. Students should also be capable of grasping the essential mathematical abstraction required to solve problems. The objective is to familiarize them with advanced paradigms and data structures used to solve algorithmic problems. They will acquire the skills to analyze the efficiency of the algorithms and offer proofs of correctness.

Course Outcomes:

20CSE112.1: Understand the implementation of symbol table using hashing techniques.
20CSE112.2: Need of randomization Data Structures, Algorithms and skip lists.
20CSE112.3: Develop and analyze algorithms for red-black trees, B-trees and Splay trees.
20CSE112.4: Develop algorithms for text processing applications and Dynamic programming Applications.
20CSE112.5: Identify suitable data structures and develop algorithms for computational geometry 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)	20CSE 112	Advanced Data Structures	3	2	1	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,

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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	Couse Code	Course Title	Scheme of Assessment (Marks)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Progressive Assessment (PRA)							
			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	20CSE112	Advanced Data Structures	15	20	5	5	5	50	50	100

Practical

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)					End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Progressive Assessment (PRA)						
			Class/Home Assignment 5 number 3 marks each (CA)	Viva1 (5)	Viva2 (5) (SA)	Class Attendance (AT)	Total Marks (CA+CT+SA+ CAT+AT)		
PCC	20CSE112	Advanced Data Structures	35	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

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progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

20CSE112.1: Understand the implementation of symbol table using hashing techniques.

Approximate Hours

Item	Appx. Hrs.
Cl	10
LI	4
SW	1
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Recognize difference among hashing and searching and Dictionaries **SO1.2** Explain implementation of Dictionaries **SO1.3** Use of hashing and hash function in hashing **O1.4** Discuss different collision resolution technique in hashing **SO1.5** Need of Re - Hashing and Extendible hashing	**LI01:** Write a program to implement the hashing concept. **LI02:** Write a program to implement Dictionaries	**Unit-1. Dictionaries and Hashing** 1.1 Definition, Dictionary, Abstract Data Type 1.2 Implementation of Dictionaries 1.3 Hashing: Review of Hashing, Hash Functions 1.4 Collision Resolution Techniques in Hashing 1.5 Separate Chaining 1.6 Open Addressing, Linear Probing 1.7 Quadratic Probing,	1. Study types of Dictionaries 2. Types of Hashing and collision in hashing.

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		1.8 Double Hashing 1.9 Re-hashing 1.10 Extendible Hashing	

SW-1 Suggested Sessional Work (SW):
a. Assignments:

1. What is difference in hashing and Dictionaries? Explain.
2. How hashing reduces search time? Explain with proper example.
3. Explain double hashing.

b. Other Activities (Specify):

Seminar and Tutorial

20CSE112.2: Need of randomization Data Structures, Algorithms and skip lists.

Approximate Hours

Item	Appx. Hrs.
Cl	7
LI	6
SW	1
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 Need for Randomizing Data Structures and Algorithms **SO2.2** Recall concepts of search operations in skip lists **SO2.3** Discuss update operation on skip lists **SO2.4** Use of Probabilistic Analysis in skip lists **SO2.5** Differentiate Probabilistic Analysis of Skip Lists and Deterministic Skip Lists	**LI01:** Write a program to implement search operation on skip list. **LI02:** Write a program to implement Randomized Quick Sort to understand Randomizing concept. **LI03.** Show Probabilistic analysis of	**Unit-2 Skip Lists** 2.1 Need for Randomizing Data Structures and Algorithms 2.2 Search Operations on Skip Lists 2.3 Update Operations on Skip Lists 2.4 Probabilistic Analysis of Skip Lists 2.5 Probabilistic Analysis of Skip Lists examples 2.6 Deterministic Skip Lists 2.7 Deterministic Skip	1. Explain different randomized functions and algorithms. 2. Study of different skip lists

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	Skip List.	Lists continues	

SW-2   Suggested Sessional Work (SW):
a.   Assignments:
    1. Discuss the Need for Randomizing Data Structures and Algorithms.
    2. Explain search and update operations on skip lists.
    3. Explain deterministic skip lists.
b.   Other Activities(Specify):
    Seminar and Tutorial

20CSE112.3: Develop and analyze algorithms for red-black trees, B-trees and Splay trees.

Approximate Hours

Item	Appx. Hrs.
Cl	9
LI	8
SW	1
SL	
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1. Recall Binary trees **SO3.2.** Differentiate Binary trees and Binary search trees. **SO3.3.** Discuss different types and properties of Binary and Binary search trees **SO3.4.** Explain Different applications of Trees **SO3.5.** Develop the concept of Binary trees	**LI01:** Write a program in traversal of Binary trees **LI02:** Write a program to implement AVL trees. **LI03:** Write a program to implement Red – Black trees **LI04:** Write a program to implement B – Trees	**Unit-3 : Flow Networks** 3.1 Binary Trees 3.2 Binary Search Trees 3.3 Binary Search Trees and its variations 3.4 AVL Trees Matrix 3.5 Red Black Trees Relation 3.6 Red Black Trees examples 3.7 2-3 Trees 3.8 B-Trees 3.9 Splay Trees	1. Design different types of Binary tree 2. Study different applications of tress.

SW-3   Suggested Sessional Work (SW):

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a. **Assignments:**
   1. Design a Binary search tree with the given nodes 10,20,45,32,21,45,64,3,6
   2. Differentiate Red Black Tree and AVL Trees
   3. Explain B – trees.

b. **Other Activities(Specify):**
   Seminar and Tutorial

20CSE112.4: Develop algorithms for text processing applications and Dynamic programming.
Approximate Hours

	Approximate Hours
Item	Appx. Hrs.
Cl	10
LI	6
SW	3
SL	2
Total	21

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 Recall Brute – force pattern Matching **SO4.2** Develop Knuth-Morris-Pratt Algorithm **SO4.3** Discuss all the three tries and compare them. **SO4.4** Explore the concept of Huffman coding **SO4.5** Use of Dynamic programming in longest common subsequence (LCS).	**LI01:** Write a program to implement The Knuth-Morris-Pratt Algorithm **LI02:** Write a program to implement The Boyer- Moore Algorithm **LI03:** Write a program to implement The Huffman Coding Algorithm	**Unit-4: Text Processing and Dynamic Programming** 4.1 Sting Operations 4.2 Brute-Force Pattern Matching 4.3 The Boyer-Moore Algorithm 4.4 The Knuth-Morris-Pratt Algorithm 4.5 Standard Tries 4.6 Compressed Tries 4.7 Suffix Tries 4.8 The Huffman Coding Algorithm 4.9 The longest	1. Study and compare different pattern matching algorithm 2. Learn different dynamic programming problems

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		common subsequence (LCS) problem 4.10 The longest common subsequence (LCS) problem using dynamic programming	

SW-4 Suggested Sessional Work (SW):

a. Assignments:
1. Explain Boyer- Moore Algorithm.
2. Discuss different tires and applications.
3. Discuss the Longest common subsequence problem with dynamic programming.

b. Other Activities (Specify):
Seminar and Tutorial

20CSE112.5: Identify suitable data structures and develop algorithms for computational Geometry Problems.

Approximate Hour

Item	Appx. Hrs.
Cl	9
LI	6
SW	1
SL	1
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1. Define One Dimensional Range Searching	**LI01:** Write a program to implement	**Unit 5: Computational Geometry** 5.1 One Dimensional Range Searching	1. Study different types of trees application.

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SO5.2 Differentiate One Dimensional Range Searching and Two Dimensional Range Searching **SO5.3** Constructing and searching priority search trees **SO5.4** Explore Quad – tress, K-D trees and priority range trees. **SO5.5** Discuss recent trends of Hashing	Two Dimensional Range Searching **LI02**: Write a program to implement Quad - trees **LI03:** Write a program to implement Constructing a Priority Search Tree	Two Dimensional Range searching 5.2 Constructing a Priority search tree 5.3 Searching Priority Search trees 5.4 Priority range trees 5.5 Quad - trees 5.6 K – D trees 5.7 Recent Trends in Hashing 5.8 Trees, and various computational geometry methods for efficiently solving the new evolving problem 5.9 Trees, and various computational geometry methods for efficiently solving the new evolving problem continues	2. Explore computational geometry methods

SW-5   Suggested Sessional Work (SW):
a. Assignments:
   1. Explain different range searching methods.
   2. Write Recent Trends in Hashing
   3. Explain K – D trees
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)
20CSE112.1: Understand the implementation of symbol table using hashing techniques.	10	4	1	1	16

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20CSE112.2: Need of randomization Data Structures, Algorithms and skip lists.	07	6	1	1	15
20CSE112.3: Develop and analyze algorithms for red-black trees, B-trees and Splay trees.	09	8	1	1	19
20CSE112.4: Develop algorithms for text processing applications and Dynamic programming Applications.	10	6	1	1	18
20CSE112.5: Identify suitable data structures and develop algorithms for computational Geometry problems.	09	6	1	1	17
Total Hours	45	30	5	5	85

Suggestion for End Semester Assessment

Suggested Specification Table(ForESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
20CSE112.1	Understand the implementation of symbol table using hashing techniques.	04	03	03	10
20CSE112.2	Need of randomization Data Structures, Algorithms and skip lists.	03	04	03	10
20CSE112.3	Develop and analyze algorithms for red-black trees, B-trees and Splay trees.	03	03	04	10
20CSE112.4	Develop algorithms for text processing applications and Dynamic Programming Applications	02	03	05	10

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20CSE112.5	Identify suitable data structures and develop algorithms for computational Geometry Problems.	-	03	07	10
Total		12	16	22	50

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

The end of semester assessment will be held with written examination of 50 marks.

Suggested Learning Resources:

a. Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Data Structures and Algorithm Analysis in C++	Mark Allen Weiss	Pearson	2nd Edition, 2004
2	Algorithm Design	M T Goodrich, Roberto Tamassia,	John Wiley	2002
3	"Algorithm Design"	by Kleinberg and Tardos	Pearson New International	1st Edition, Kindle Edition

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COs, POs and PSOs Mapping

Program: M. Tech(CSE)
Course Code: 20CSE112
Course Title: Advanced Data structures

Course Outcomes	Program Outcomes												Program Specific Outcome				
	PO 1 Engineering knowledge	PO 2 Problem analysis	PO 3 Design/development of solutions	PO 4 Conduct studies of difficult problems	PO 5 Utilization of modern tools	PO 6 Engineers and society	PO 7 Environment and sustainability	PO 8 Ethics	PO 9 Individual and team work	PO 10 Communication	PO 11 Project management and finance	PO 12 Life-longlearning	PSO 1 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 systems of various complexity	PSO 2 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 in multidisciplinary settings	PSO 3 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.	PSO 4 Learn and use the most recent Artificial Intelligence and Data Science technologies in the fields of engineering and computer science	PSO 5 Recognize and examine issues in real life, then offer creative software solutions with the help of AI and Data Science Technologies.
20CSE112.1: Understand the implementation of symbol table using hashing techniques.	3	3	2	2	1	2	1	1	1	1	1	3	2	3	1	2	2
20CSE112.2: Need of randomization Data Structures, Algorithms and skip lists.	3	2	2	2	1	2	1	1	1	1	1	3	2	2	2	2	2
20CSE112.3: Develop and analyze algorithms for red-black trees, B-trees and Splay trees.	3	3	3	3	1	2	1	1	1	1	1	3	1	1	2	2	2
20CSE112.4: Develop algorithms for text processing applications and Dynamic programming applications.	3	2	2	2	1	2	1	1	1	1	1	3	2	3	1	2	2
20CSE112.5: Identify suitable data structures and develop algorithms for computational geometry problems.	3	3	3	3	2	2	1	1	1	1	2	2	2	3	1	1	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Advanced Data Structures

POs & PSOs No.	COs No.& Titles	SOs No.	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: Understand the implementation of symbol table using hashing techniques.**	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	Unit-1: Dictionaries and Hashing 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	**CO2: Need of randomization Data Structures, Algorithms and skip lists.**	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	Unit-2: Skip Lists 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: Develop and analyze algorithms for red-black trees, B-trees and Splay trees.**	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	Unit-3**:** Trees 3.1,3.2,3.3,3.4,3.5,3.6,3.7,2.8,2.9	As mentioned in page number above
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	**CO.4: Develop algorithms for text processing applications and Dynamic programming applications.**	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	Unit-4: Text Processing and Dynamic Programming 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 PSO 1,2, 3, 4, 5	**CO.5: Identify suitable data structures and develop algorithms for computational geometry problems.**	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	Unit-5: Computational Geometry 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10	

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Semester-I

Course Code:	20CSE115-B
Course Title:	Machine Learning
Pre-requisite:	Student should have basic knowledge of python programming.
Rationale:	Problem solving skills can help people develop more skills and build a Promising career.

Course Outcomes:

20CSE115-B 1: Students should be familiar with various characteristics of the machine learning.

20CSE115-B .2: Learn how algorithm works for data processing and instance generation.

20CSE115-B .3: Create genome sequence by using machine learning algorithm.

20CSE115-B .4: Implement classification and regression process techniques for data processing.

20CSE115-B .5: Apply statistics in machine learning for probabilistic analysis.

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)	
PEC	20CSE115-B	Machine Learning for Data Science	3	2	2	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 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 Learning.

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Scheme of Assessment: Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Progressive Assessment (PRA)							
			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)		
PEC	20CSE115-B	Machine Learning for Data Science	15	20	5	5	5	50	50	100

Practical

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)					End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Progressive Assessment (PRA)						
			Class/Home Assignment 5 number 3 marks each (CA)	Viva1 (5)	Viva2 (5) (SA)	Class Attendance (AT)	Total Marks (CA+CT+SA+ CAT+AT)		
PEC	20CSE115-B	Machine Learning for Data Science	35	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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20CSE115-B 1: Students should be familiar with various characteristics of the machine learning.

Approximate Hours

Item	Appx. Hrs.
CI	9
LI	4
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Understanding the basics of neuron. **SO1.2** Understanding various components of perceptron. **SO1.3** Understanding multilayer perceptron. **SO1.4** Understanding feedforward nature of neural network. **SO1.5** Understanding back propagation feature of neural network.	**LI.1.1.** Write a program for Multilayer Perceptron (MLP) Model. **LI.1.2.** Write a program for Feed Forward Neural Network.	**Unit-1.0 Supervised Learning** 1.1 Linear models 1.2 Linear Regression 1.3 Logistic Regression 1.4 Generalized Linear Models 1.5 Support Vector Machines 1.6 Nonlinearity and Kernel Methods 1.7 Beyond Binary Classification 1.8 Multi-Class/ Structured Outputs 1.9 Ranking	1. Learning basics of neural network and activation function.

SW-1 Suggested Sessional Work (SW):
a. Assignments:
   1. Sigmoid Neurons
   2. McCulloch Pitts Neuron
b. Mini Project:
   Feed Forward Neural Networks
c. Other Activities (Specify):
   NA

20CSE115-B .2: Learn how algorithm works for data processing and instance generation.

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Approximate Hours

Item	Appx. Hrs.
CI	9
LI	10
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 Understanding basics of activation functions. **SO2.2** Understanding different variants of activation functions. **SO2.3** Understanding principal component analysis and its interpretation. **SO2.4** Understanding parameters and hyperparameters in neural network.	**LI.2.1.** Write a program for ReLU activation function. **LI.2.2.** Write a program for Leaky ReLU activation function. **LI.2.3.** Write a program for Tanh activation function **LI.2.4.** Write a program for Softmax activation function **LI.2.5.** Write a program for Sigmoid activation function	**Unit-2.0 Unsupervised Learning** 2.1 Clustering 2.2 K-means 2.3 Kernel K-means 2.4 Dimensionality Reduction 2.5 PCA and Kernel PCA 2.6 Matrix Factorization 2.7 Matrix Completion 2.8 Generative Models 2.9 Mixture Models and Latent Factor Models	1. Learning various parameters and hyperparameter of activation function.

SW-2 Suggested Sessional Work (SW):
a. Assignments:
   1. Gradient Descent (GD)
   2. Momentum Based (GD)
b. Mini Project:
   Principal Component Analysis and its interpretations.

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

20CSE115-B .3: Create genome sequence by using machine learning algorithm.

Approximate Hours	
Item	Appx. Hrs.
CI	9
LI	8
SW	2
SL	1
Total	20

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 Understanding basics of auto encoders. **SO3.2** Understanding different variants of auto encoder. **SO3.3** Understanding encoder decoder model. **SO3.4** Understanding basic concepts of batch normalization.	**LI.3.1.** Write a Program for demonstrating Regularization. **LI.3.2.** Write a program for implementing Sparse Auto Encoder. **LI.3.3.** Write a program for demonstrating Batch Normalization. **LI.3.4.** Write a program for Denoising Auto Encoder.	**Unit-3.0 Statistical Learning Theory** 3.1 Introduction 3.2 Machine Learning Algorithms 3.3 Model Selection 3.4 Statistical Learning Theory 3.5 Ensemble Methods 3.6 Boosting 3.7 Bagging 3.8 Stacking 3.9 Random Forests	1. Learning regularization and normalization in auto-encoder.

SW-3 Suggested Sessional Work (SW):
a. **Assignments:**
    1. Denoising auto encoders
    2. Sparse auto encoders
b. **Mini Project:**
    Encoder Decoder Models
c. **Other Activities (Specify):**
    NA

20CSE115-B .4: Implement classification and regression process techniques for data processing.

Approximate Hours	
Item	Appx. Hrs.

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CI	9
LI	4
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 Understanding basics of convolutional neural network. **SO4.2** Understanding different variants of convolutional neural network. **SO4.3** Understanding basics of recurrent neural network. **SO4.4** Understanding different variants of recurrent neural network.	**LI.4.1.** Write a program for implementing Convolutional Neural Network. **LI.4.2.** Write a program for Implementing Recurrent Neural Network.	**Unit-4.0 Sparse Modeling** 4.1 Introduction 4.2 Estimation 4.3 Sparse Statistical Model 4.4 Sparse Expert Models 4.5 Dense Model 4.6 Modeling Sequence 4.7 Time-Series Data 4.8 Deep Learning 4.9 Feature Representation Learning	1. Learning convolutional neural and recurrent neural network.

SW-4 Suggested Sessional Work (SW):

a. Assignments:
   1.   Introduction to CNNs
   2.   Introduction to RNNs
b. Mini Project:
   Back propagation through time (BPTT)
c. Other Activities (Specify):
   NA.

20CSE115-B .5: Apply statistics in machine learning for probabilistic analysis.

Approximate Hours

Item	Appx. Hrs.
CI	9
LI	4
SW	2
SL	1

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Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1 Understanding basics of image processing through deep learning models. **SO5.2** Understanding the procedure and significance of natural language processing. **SO5.3** Understanding the development of speech recognition system. **SO5.4** Understanding video processing system.	**LI.5.1.** Write a program to Count frequency of characters in a given file. **LI.5.2.** Can you use Character frequency to tell whether the given file is a Python program file, C program file or a text file?	**Unit-5.0 Scalable Machine Learning** 5.1 Introduction 5.2 Online Learning 5.3 Distributed Learning 5.4 Semi-Supervised Learning 5.5 Active Learning 5.6 Reinforcement Learning 5.7 Inference in Graphical Models 5.8 Bayesian Learning and Inference 5.9 Applications in IOT	1. Learning core applications of deep learning algorithms.

SW-5 Suggested Sessional Work (SW):
a. Assignments:
   1. Image Processing
   2. Speech Recognition
b. Mini Project:
   Natural Language Processing
c. 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)
20CSE115-B .1**:** At the end of this chapter the student will be familiar with various characteristics of the machine	9	4	2	1	16

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learning.					
20CSE115-B .2: At the end of this chapter the student will learn how algorithm works for data processing and instance generation.	9	10	2	1	22
20CSE115-B .3: At the end of this chapter the student will create genome sequence by using machine learning algorithm.	9	8	2	1	20
20CSE115-B .4: At the end of this chapter the student will implement classification and regression process techniques for data processing.	9	4	2	1	16
20CSE115-B .5: At the end of this chapter the student will apply statistics in machine learning for probabilistic analysis.	9	4	2	1	16
Total Hours	45	30	10	5	90

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution	Total

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		R	U	A	Marks
20CSE115-B.1	Students should be familiar with various characteristics of the machine learning.	02	05	01	08
20CSE115-B.2	Learn how algorithm works for data processing and instance generation.	02	03	05	10
20CSE115-B.3	Create genome sequence by using machine learning algorithm.	02	03	07	12
20CSE115-B.4	Implement classification and regression process techniques for data processing.	01	03	07	10
20CSE115-B.5	Apply statistics in machine learning for probabilistic analysis.	01	05	05	10
Total		13	26	13	50

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

The end of semester assessment for Deep Learning will be held with written examination of 50 marks.

Suggested Learning Resources:

a. Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Deep Learning	Ian Goodfellow	MIT press	2016, 4th Edition
2	Learning deep architectures for AI.	Bengio, Yoshua	Now Publishers	2009, 3rd Edition
3	Deep Learning	Rajiv Chopra	Khanna Book Publishing	2020, 5th Edition

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COs, POs and PSOs Mapping

Program: M.Tech(CSE)

Course Code : 20CSE115-B

Course Title: Machine Learning

Course Outcomes	Program Outcomes												Program Specific Outcome				
	PO 1 Engineering knowledge	PO 2 Problem analysis	PO 3 Design/development of solutions	PO 4 Conduct studies of difficult problems	PO 5 Utilization of modern tools	PO 6 Engineers and society	PO 7 Environment and sustainability	PO 8 Ethics	PO 9 Individual and team work	PO 10 Communication	PO 11 Project management and finance	PO 12 Life-longlearning	PSO 1 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 systems of various complexity	PSO 2 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 in multidisciplinary settings	PSO 3 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.	PSO 4 Learn and use the most recent Artificial Intelligence and Data Science technologies in the fields of engineering and computer science	PS0 5 Recognize and examine issues in real life, then offer creative software solutions with the help of AI and Data Science Technologies.
20CSE115-B 1: Students should be familiar with various characteristics of the machine learning.	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1	2
20CSE115-B 2: Learn how algorithm works for data processing and instance generation.	1	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1	3
20CSE115-B .3: Create genome sequence by using machine learning algorithm.	2	2	1	1	1	2	2	2	1	2	1	2	1	1	2	2	2
20CSE115-B 4: Implement classification and regression process techniques for data processing.	3	2	2	2	3	2	3	2	2	1	2	3	3	3	3	2	2
20CSE115-B 5: Apply statistics in machine learning for probabilistic analysis.	-	-	-	1	1	3	3	3	1	1	2	2	3	3	1	3	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Machine Learning

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: Students should be familiar with various characteristics of the machine learning.	SO1.1 SO1.2 SO1.3 SO1.4	LI.1.1, LI1.2	Unit-1 Introduction to Deep Learning 1.1,1.2,1.3,1.4,1.5,1.6,1.7	As mentioned in page number above
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 2: Learn how algorithm works for data processing and instance generation.	SO2.1 SO2.2 SO2.3 SO2.4	LI.2.1, LI2.2, LI2.3, LI.2.4, LI.2.5	Unit-2 Activation functions and parameters 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: Create genome sequence by using machine learning algorithm.	SO3.1 SO3.2 SO3.3 SO3.4	LI3.1, LI3.2, LI3.3, LI.3.4	Unit-3 Auto-encoders & Regularization 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 4: Implement classification and regression process techniques for data processing.	SO4.1 SO4.2 SO4.3 SO4.4	LI4.1, LI.4.2	Unit-4 Deep Learning Models 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 PSO 1,2, 3, 4, 5	CO 5: Apply statistics in machine learning for probabilistic analysis.	SO5.1 SO5.2 SO5.3 SO5.4	LI.5.1, LI5.2	Unit-5 Deep Learning Applications 5.1,5.2,5.3,5.4,5.5,5.6	

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Semester-I

Course Code: 20CSE115-C

Course Title: Wireless Sensor Network

Pre-requisite: Wireless Communication

Rationale: Introduce students to the advanced methods of designing and analyzing algorithms. The student should be able to choose appropriate algorithms and use it for a specific problem. To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems. Students should be able to understand different classes of problems concerning their computation difficulties. To introduce the students to recent developments in the area of algorithmic design.

Course Outcomes:

20CSE115-C.1: Analyze the complexity/performance of different algorithms.

20CSE115-C.2: Analyze different paradigms to solve graph problems.

20CSE115-C.3: Determine the appropriate data structure for solving a particular set of problems.

20CSE115-C.4: Categorize the different problems in various classes according to their complexity

20CSE115-C.5: Students will have an insight of recent activities in the field of the advanced data structure. **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+T)	
PEC	20CSE115-C	Wireless Sensor Network	3	2	2	2	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,

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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	Couse Code	Course Title	Scheme of Assessment (Marks)							End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Progressive Assessment (PRA)								
			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)			
PEC	20CSE115	Wireless Sensor Network	15	20	5	5	5	50		50	100

Practical

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Progressive Assessment (PRA)							
			Class/Home Assignment 5 number 3 marks each (CA)	Viva1 (5)	Viva2 (5) (SA)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)			
Major	011TI01	Introduction to Information technology and ICT Tools	35	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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20CSE115-C.1: Analyze the complexity/performance of different algorithms.

Approximate Hours	
Item	Appx. Hrs.
Cl	9
LI	6
SW	1
SL	1
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Recall Sorting Techniques. **SO1.2** Compare DFS and BFS **SO1.3** Develop Dijkasra's shortest path algorithm. **SO1.4** Identify the Correctness of algorithms. **SO1.5** Discuss Amortize analysis with the help of examples	1. Investigate a real-world problem that can be addressed using wireless sensor networks (WSNs). Describe the problem and explain why WSNs are a suitable solution. 2. Identify and analyze three different applications of WSNs in various fields (e.g., environmental monitoring, healthcare, industrial automation). For each application, describe the specific benefits of using WSNs. 3. Measure and evaluate the performance of a simple WSN setup using key performance metrics such as	**Unit-1.** **Introduction to Wireless Sensor Networks:** 1.1 Motivations, Applications, 1.2 Performance metrics, 1.3 History and Design factors 1.4 Network Architecture: 1.5 Traditional layered stack, 1.6 Cross-layer designs, 1.7 Sensor Network Architecture 1.8 Hardware Platforms: Motes, 1.9 Hardware parameters	1. Analysis of Time and space complexity BFS and DFS 2. Study of different sorting algorithms

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	latency, energy consumption, packet delivery ratio, and throughput.		

SW-1 Suggested Sessional Work (SW):

a. Assignments:

1. Explain Different Sorting techniques with code.
2. Discuss DFS and BFS with time complexity Analysis.
3. Explain amortized analysis.

b. Other Activities (Specify):

Seminar and Tutorial

20CSE115-C.2: Analyze different paradigms to solve graph problems.

Approximate Hours

Item	Appx. Hrs.
Cl	9
LI	6
SW	1
SL	1
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
2.1 Recall different Greedy concept of problem solving. **SO2.2** Develop algorithm to analysis maximum weight maximal independent set	1. Compare the performance metrics of two different WSN protocols (e.g., Zigbee vs. Bluetooth Low Energy) in a controlled environment.	**Unit-2 Introduction to ns-3** 2.1 Introduction to Network Simulator 3 (ns-3), 2.2 Description of the ns-3 2.3 Core module 2.4 Simulation example. 2.5 MAC Protocol 2.6 Analysis: 2.7 Asynchronous 2.8 Duty-Cycled. X-MAC 2.9 Analysis (Markov Chain)	1. Study of different greedy problems. 2. Study applications of Minimum 3. Spannin g trees**.**

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SO2.3 Discuss different applications of Minimum spanning trees **SO2.4** Explain Maximum matching by augmenting paths **SO2.5** Analyze Edmond's Blossom algorithm to Compute augmenting path	2. Create a timeline detailing the key milestones in the development of WSNs. Highlight major breakthroughs and technological advancements 3. Examine the primary design factors affecting WSNs (e.g., energy efficiency, scalability, reliability). Provide a detailed report on how these factors influence the design and deployment of WSNs.		

SW-2 Suggested Sessional Work (SW):
a. Assignments:
   1. Write an Algorithm to compute maximum matching.
   2. Explain Edmond's Blossom algorithm to compute the augmenting path.
   3. Discuss applications of Minimum spanning trees.

b. Other Activities(Specify):
   Seminar and Tutorial

20CSE115-C.3: Determine the appropriate data structure for solving a particular set of Problems.

Approximate Hours

Item	Appx. Hrs.
Cl	9
LI	6
SW	1
SL	1
Total	17

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1. Recall Maxflow-mincut theoram **SO3.2.** Describe Ford – Fulkeson Method to compute maximum flow. . **SO3.3.** Explain Edmond-Karp Maximum flow algorithm. **SO3.4.** Discuss Strassen's algorithm for matrix multiplication **SO3.5.** Describe LUP - decomposition.	1. Simulate a traditional layered network stack for a WSN using a network simulation tool. Analyze the interaction between different layers. 2. Implement a cross-layer design approach in a WSN simulation. Compare the performance with a traditional layered stack approach. 3. Map the components of a traditional WSN architecture to the OSI model layers. Provide examples for each layer and discuss their roles.	**Unit-3: Medium Access Control Protocol design** 3.1 Fixed Access, 3.2 Random Access, 3.3 WSN protocols: 3.4 Synchronized, 3.5 Duty-Cycled 3.6 Introduction to Markov Chain: 3.7 Discrete time 3.8 Markov Chain 3.9 Definition, properties, classification and analysis	1. Study and test Edmord – Karp maximum flow algorithm. 2. Study of matrix multiplication.

SW-3   Suggested Sessional Work (SW):

a.   Assignments:
   1. Explain LUP-decomposition
   2. Discuss the relationship between time complexities of basic matrix operations.
   3. Explain the Edmond-Karp maximum-flow algorithm

 b. Other Activities(Specify): Seminar and Tutorial

20CSE115-C.4: Categorize the different problems in various classes according to their complexity.

Approximate Hours

Item	Appx. Hrs.
Cl	9
LI	6
SW	1
SL	1
Total	17

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

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SO4.1. Explain Floyd – Warshall Algorithm **SO4.2.** Explore Different Real life examples on Dynamic programming **SO4.3.** Describe Chinese Remainder theorem with Example. **SO4.4.** Identify Difference between base-representation and modulo-Representation. **SO4.5.** Explore concepts of algorithm for different Mathematical Problems.	1. Analyze a specific protocol used in the traditional layered stack of WSNs (e.g., IEEE 802.15.4). Discuss its functionality and performance. 2. esign and implement a cross-layer optimization technique for a specific WSN application. Measure its impact on network performance. 3. Study a real-world implementation of cross-layer design in WSNs. Describe the design, challenges, and benefits observed.	**Unit-4: Security** 4.1 Possible attacks, 4.2 Countermeasures, 4.3 SPINS, 4.4 Static key distribution 4.5 Dynamic key distribution 4.6 Routing Analysis: 4.7 Analysis of opportunistic routing 4.8 Markov Chain 4.9 Advanced topics in wireless sensor networks.	1. Study different Dynamic programming example 2. Study examples on Chinese Remainder Theorem

SW-4 S u g g e s t e d Sessional Work (SW):

a. Assignments:
1. Discuss Fast Fourier Transform algorithm.
2. Explain Schönhage-Strassen Integer Multiplication algorithm.
3. Explain Schönhage-Strassen Integer Multiplication algorithm.

b. Other Activities(Specify): Seminar and Tutorial

20CSE115-C.5: **Students will have an insight of recent activities in the field of the advanced data structure.**

Approximate Hours

Item	Appx. Hrs.
Cl	9
LI	6
SW	1
SL	1
Total	17

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1. Describe Geometry of the feasibility region **SO5.2.** Explain simplex algorithm **SO5.3.** Identify and Proof of NP, NP completeness Problem **SO4.4.** Explain Randomized algorithm **SO5.5.** Discuss Approximation Algorithms	4. Design a basic sensor network architecture for a given application scenario. Justify your design choices and discuss potential improvements. 5. Compare different sensor network architectures (e.g., flat, hierarchical, and hybrid). Discuss their advantages and disadvantages. 6. Configure and program a specific type of mote (e.g., TelosB, MicaZ). Conduct a simple experiment to collect and transmit sensor data.	**Unit 5: Routing Protocols** 5.1 Introduction, 5.2 MANET Protocols 5.4 Routing Protocols for WSN 5.5 Resource-aware routing, 5.6 Data-centric, 5.7 Geographic Routing, 5.8 Broadcast, Multicast 5.9 Opportunistic	1. Differentiate among NP,NP-hard and NP-completeness 2. Use knowledge of advanced algorithm and apply in real world Problems.

SW-5 Suggested Sessional Work (SW):
a. Assignments:
   1. Explain Randomized algorithm.
   2. Differentiate NP and NP – completeness.
   3. Take suitable example and explain approximation algorithm
b. **Other Activities (Specify):**
    Seminar and Tutorial

Brief of Hours suggested for the Course Outcome

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Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+LI+SW+Sl)
20CSE115-C .1: Analyze the complexity/performance of different algorithms.	9	6	1	1	16
20CSE115-C .2: Analyze different paradigms to solve graph problems.	9	6	1	1	16
20CSE115-C .3: Determine the appropriate data structure for solving a particular set of problems.	9	6	1	1	16
20CSE115-C .4: Categorize the different problems in various classes according to their complexity.	9	6	1	1	16
20CSE115-C .5: Students will have an insight of recent activities in the field of the advanced data structure.	9	6	1	1	16
Total Hours	45	30	5	50	85

Suggestion for End Semester Assessment

Suggested Specification Table (ForESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
20CSE115-C.1	Sorting and Graphs	02	03	03	08
20CSE115-C.2	Matroids	02	03	05	10
20CSE115-C.3	Flow Networks	02	03	07	12

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20CSE115-C.4	Shortest Path in Graph	-	3	7	10
20CSE115-C.5	Linear Programming	-	05	05	10
	Total	06	17	27	50

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

The end of semester assessment for wireless sensor network will be held with written examination of 50 marks.

Suggested Learning Resources:

a. Books:

S. No.	Title	Author	Publisher	Edition &Year
1	"Introduction to Algorithms"	by Cormen, Leiserson, Rivest, Stein	Mit Press	Third Edition
2	"The Design and Analysis of Computer Algorithms"	by Aho, Hopcroft, Ullman	Addison - Welsley	Paperback – 1 January 1974
3	"Algorithm Design"	by Kleinberg and Tardos	Pearson New International	1st Edition, Kindle Edition

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COs, POs and PSOs Mapping

Program: M. Tech (CSE)
Course Code: 20CSE115-C
Course Title: Wireless Sensor Network

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	PSO 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 systems of various complexity	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 in multidisciplinary settings	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.
20CSE115-C 1: Analyze the complexity/performance of different algorithms.	1	3	2	2	2	2	3	1	2	1	3	2	2	3	1	2	2
20CSE115-C 2: Analyze different paradigms to solve graph problems.	2	3	2	2	1	2	3	1	1	1	2	2	2	2	2	2	2
20CSE115-C 3: Determine the appropriate data structure for solving a particular set of problems.	2	3	3	2	1	3	3	1	1	2	3	3	1	1	2	2	2
20CSE115-C 4: Categorize the different problems in various classes according to their complexity.	3	2	3	2	1	3	3	1	2	1	3	3	2	3	1	2	2
20CSE115-C 5: Students will have an insight of recent activities in the field of the advanced data structure	2	2	3	2	1	3	3	1	1	1	2	2	2	3	1	1	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Wireless Sensor Network

POs & PSOs No.	COs No.& Titles	SOs No.	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: Analyze the complexity/performance of different algorithms.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	Unit-1 : Sorting and Graphs 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO2: Analyze different paradigms to solve graph problems.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	Unit-2 : Matroids 2.1, 2.2, 2.3, 2.4, 2.5, 2.6,	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO3: Determine the appropriate data structure for solving a particular set of problems.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	Unit-3 **:** Flow Networks 3.1,3.2,3.3,3.4,3.5,3.6,3.7	As mentioned in page number above
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO4: Categorize the different problems in various classes according to their complexity.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	Unit-4: Shortest Path in Graph 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.1 1,4.12	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO5: Students will have an insight of recent activities in the field of the advanced data structure	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	Unit-5 : Linear Programming 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5. 11,5.12	

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Semester-I

Course Code: 20CSE115-A

Course Title: Introduction to Intelligent Systems

Pre- requisite: Data Structures and Data Management or Data Structures

Rationale: The aim of the course is to introduce to the field of Artificial Intelligence (AI) with emphasis on its use to solve real world problems for which solutions are difficult to express using the traditional algorithmic approach. It explores the essential theory behind methodologies for developing systems that demonstrate intelligent behavior including dealing with uncertainty, learning from experience and following problem- solving strategies found in nature.

Course Outcomes:

20CSE115-A .1: Demonstrate knowledge of the fundamental principles of neural network.
20CSE115-A .2: Apply Fuzzy Logic.
20CSE115-A .3: Use various AI algorithms
20CSE115-A .4: Familiarize knowledge representation in intelligent system
20CSE115-A .5: Comprehend the use of learning system.

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			C l	L I	S W	S L	Total Study Hours (CI+LI+SW+SL)	
PEC	20CSE 115-A	Introduction to Intelligent System	3	2	2	1	8	4

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

(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.

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Scheme of Assessment: Theory

Board of Study	Course	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/HomeAssignment5 number 3 markseach (CA)	Class Test2 (2 best out of 3) 10 markseach (CT)	Seminar one	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
PE C	20CSE115-A	Introduction to Intelligent System	15	20	5	5	5	50	50	100

Practical

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)	Viva1 (5)	Viva2 (5) (SA)	Class Attendance (AT)	Total Marks (CA+CT+SA+ CAT+AT)		
PEC	20CSE115-A	Introduction to Intelligent System	35	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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20CSE115-A .1: Demonstrate knowledge of the fundamental principles of neural network.

Approximate Hours

Item	Appx. Hrs.
Cl	8
LI	6
SW	2
SL	1
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Understand the concept of neural network. **SO1.2** Compare types of neural network **SO1.3** Apply types of neural network in real life problems	1. Choose an example of an ANN from a research paper or a real-world application. Re-implement the network and dataset, then replicate the results. Discuss any challenges faced during the replication process. 2. Implement the back-propagation algorithm from scratch. Use it to train a simple feedforward neural network and evaluate its performance on a small dataset. 3. Study a real-world application	**Unit-1.0** Biological foundations to intelligent systems I. 1.1 Artificial neural networks 1.2 Examples of ANN 1.3 Back-propagation networks 1.4 Example of BP network 1.5 Radial basis function networks 1.6 Examples of RBNN 1.7 Recurrent networks 1.8 Examples of RNN	1. Search devices using neural network 2. Numerical based on neural Network

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	of an RBFN from literature. Re-implement the network and dataset, then replicate the results. Discuss the practical advantages and limitations of using an RBFN for this application.		

SW-1 Suggested Sessional Work (SW):

Assignments:

    i.   Numerical based on back propagation.

    ii.   Numerical based on radial basis.

    iii. Numerical based on recurrent network.

20CSE115-A .2: Apply Fuzzy Logic.

Approximate Hours

Item	AppX Hrs
Cl	9
LI	6
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
O2.1 Understand the concept of Fuzzy Logic **SO2.2** Use the fuzzy logic in problems **SO2.3** Demonstrate the use of genetic algorithm	1. Implement a simple fuzzy logic system for a real-world application (e.g., temperature control or traffic light control). Define the input and output variables, membership functions, and rules. Test the	**Unit-2.0** Biological foundations to intelligent systems II. 2.1. Fuzzy logic 2.2. Comparing Fuzzy logic and digital logic 2.3. Fuzzy Arithmetic 2.4. Numerical based	1. How Fuzzy logic is used to solve real life problems. 2. Numerical based on Fuzzy Logic

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system with different input values and analyze the results. 2. Solve numerical problems involving fuzzy arithmetic, such as calculating the fuzzy mean or fuzzy variance of a dataset with fuzzy values. Provide detailed steps and explanations. 3. Implement and visualize basic operations on fuzzy sets (e.g., union, intersection, complement). Use these operations to solve a problem involving multiple fuzzy sets.	on Fuzzy Arithmetic 2.5. Properties of Fuzzy Sets 2.6. Membership Functions. 2.7. Inference System 2.8. Genetic Algorithm 2.9. Fuzzy neural network	

SW-1 Suggested Sessional Work (SW):

Assignments:
   i.   Numerical based on Fuzzy logic.
   ii.   Numerical based on Membership Function.
   iii.   Numerical based on Genetic algorithm.

20CSE115-A .3: Use various AI algorithms.

Approximate Hours

Item	Appx. Hrs.
Cl	10
LI	6
SW	2
SL	1
Total	19

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

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SO3.1 Understand the concept of graph and search tree **SO3.2** Use various search algorithms **SO3.3** Apply various search algorithms	1. Implement different ways to represent a graph (adjacency matrix, adjacency list). Create a sample graph and demonstrate each representation with it. 2. Implement the iterative deepening search algorithm. Test it on a problem such as the 8-puzzle and compare its performance with BFS and DFS. 3. Implement a heuristic search algorithm (such as A*). Solve a problem using this algorithm and analyze its performance compared to traditional search methods.	**Unit-3.0** Search Methods 3.1. Basic concepts of graph 3.2. Basic concepts of search tree. 3.3. breadth-first search 3.4. depth-first search 3.5. iterative deepening search 3.6. Heuristic search methods 3.7. best-first search 3.8. admissible evaluation functions 3.9. hill-climbing search 3.10. Optimization and search such as stochastic annealing and genetic algorithm.	1. Compare and analyze all search algorithm.

SW-1 Suggested Sessional Work (SW):

Assignments:
  i.   Numerical based on Fuzzy logic.
  ii.   Numerical based on Membership Function.
  iii. Numerical based on Genetic algorithm.

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20CSE115-A .4: Familiarize knowledge representation in intelligent system.

Approximate Hours

Item	Appx Hrs.
Cl	10
LI	6
SW	2
SL	1
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO4.1 Understand the concept of knowledge representation **SO4.2** Use of frames and scripts **SO4.3** Apply formal logic and inference	1. Analyze and implement techniques for handling ambiguity in knowledge representation. Use examples like word sense disambiguation to showcase the techniques. 2. Create a frame-based knowledge representation system for a specific application (e.g., animal taxonomy). Define the frames, slots, and slot values, and demonstrate how inheritance works in the system. 3. Implement a script-based system for a common activity (e.g., dining at a restaurant). Define the	4.1. Unit-4.0 Knowledge representation and 4.2. logical inference 4.3. Issues in 4.4. knowledge 4.5. representation 4.6. Structured 4.7. representation: frames 4.8. Example of FRAMES 4.9. Scripts 4.10. Example of Scripts 4.11. semantic networks 4.12. conceptual graphs 4.13. Formal logic and logical inference 4.14. Knowledge-based systems structures 4.15. its basic components	1. Compare and analyze all search algorithm.

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	scripts and sub-scripts, and simulate the system with different scenarios		

SW-1 Suggested Sessional Work (SW):

Assignments:
i.   Questions based on frames.
ii.   Questions based on scripts.
iii.   Questions based on formal logic.

20CSE115-A .5: Comprehend the use of learning system.

Approximate Hours

Item	Appx. Hrs.
Cl	08
LI	06
SW	02
SL	01
Total	17

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

SO5.1 Understand the concept of Reasoning under uncertainty
 	
SO5.2 Demonstrate the use of learning techniques
	1. Implement a Naive Bayes classifier for text classification (e.g., spam detection). Evaluate its performance on a dataset and analyze how it handles uncertain data.
	2. Implement the Dempster-Shafer theory for a given problem, such as sensor fusion. Combine evidence from multiple sources and perform reasoning to reach a conclusion.
	3. Implement
		Unit-5.0 Learning Techniques
		  5.1. Reasoning under uncertainty.
		  5.2. Learning Techniques on uncertainty reasoning
		  5.3. Bayesian reasoning
		  5.4. Certainty factors
		  5.5. Dempster-Shafer Theory of Evidential reasoning
		  5.6. A study of different learning and evolutionary algorithms
		  5.7. Statistical learning
		  5.8. Induction learning
			1. Compare and analyze all learning Techniques.

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	clustering algorithms (e.g., k-means, hierarchical clustering) on a dataset with uncertain data. Analyze the clustering results and their robustness to uncertainty.		

SW-1 Suggested Sessional Work (SW):

Assignments:
   i.   Different types of learning techniques.
   ii.   Use of Dempster-Shafer Theory of Evidential reasoning

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instructions (LI)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
20CSE115-A 1: Demonstrate knowledge of the fundamental principles of neural network	08	6	02	01	17
20CSE115-A .2: Apply Fuzzy Logic.	09	6	02	01	18
20CSE115-A .3: Use various AI algorithms	10	6	02	01	19
20CSE115-A .4: Familiarize knowledge representation in intelligent system	10	6	02	01	19
20CSE115-A .5: Comprehend the use of learning system.	08	6	02	01	17
Total Hours	45	30	10	5	90

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Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
20CSE115-A .1	Biological foundations to intelligent systems I.	03	02	03	08
20CSE115-A .2	Biological foundations to intelligent systems II.	03	01	05	09
20CSE115-A .3	Search Methods	03	07	02	12
20CSE115-A .4	Knowledge representation and logical inference.	03	05	05	13
20CSE115-A .5	Learning Techniques.	03	02	03	08
	Total	15	17	18	50

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

The end of semester assessment for Introduction to Intelligent System 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. Case Method
4. Group Discussion
5. Role Play
6. Visit to IT Industry
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	Artificial Intelligence: Structures and strategies for Complex Problem Solving	Luger G.F. and Stubblefield W.A.	Addison Wesley	6th edition 2008

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| 2 | Artificial Intelligence: A Modern Approach | Russell S. and Norvig P | Prentice-Hall | 3rd Edition 2009 |
| 3 | Lecture note provided by Dept. of CS&E, AKS University, Satna. | | | |

B. Alternative NPTEL/SWAYAM/MOOC Course (if any):

S. No.	NPTEL Course Name	Instructor	Host Institute
1.	Artificial Intelligence	Prof. Bhushan Trivedi	GLS University
2.	Artificial Intelligence: Search Methods for Problem Solving	Prof. Deepak Khemani	IIT Madras
3.	Fuzzy Logic and Neural Networks	Prof. Dilip Kumar Pratihar	IIT Kharagpur

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CO, PO and PSO Mapping

Course Title: M.Tech (CSE)
Course Code:20CSE115-A
Course Title: Introduction to Intelligent System

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	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-long learning	The ability to apply technical & engineering knowledge for production quality cement with the available raw material resource.	Ability to understand the day to plant operational problems of cement manufacture and provide economical solution to enhance the production without compromising quality of cement.	Ability to understand the latest cement Manufacturing Technology and it application in Conservation of electrical and thermal energy in Portland Cement Manufacture	Ability to use the research based innovative knowledge for sustainable development in cement manufacture
20CSE115-A 1: Demonstrate knowledge of the fundamental principles of neural network.	2	2	3	3	2	1	1	1	1	1	1	3	2	2	3	3
20CSE115-A 2: Apply Fuzzy Logic.	2	3	2	3	2	2	1	1	1	1	1	3	2	3	2	3
20CSE115-A .3: Use various AI Algorithms	2	2	2	3	2	2	1	1	1	1	1	3	2	2	2	3
20CSE115-A .4: Familiarize knowledge representation in intelligent system	2	2	3	2	2	2	1	1	1	1	1	3	2	2	3	2
20CSE115-A .5: Comprehend the use of learning system.	2	2	3	2	2	2	1	1	1	1	1	3	2	2	3	2

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: Demonstrate knowledge of the fundamental principles of neural network.	SO1.1 SO1.2 SO1.3		Unit-1.0 Biological foundations to intelligent systems I. 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8	As Mentioned in Page no. above
PO: 1,2,3,4,5,6,7,8,9,10,11,2 PSO:1,2,3,4	CO2: Apply Fuzzy Logic.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2 Biological foundations to intelligent systems II. 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 PSO:1,2,3,4	CO3: Use various AI algorithms	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3: Search Methods 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10	
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO:1,2,3,4	CO4: Familiarize knowledge representation in intelligent system	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4: Knowledge representation and logical inference 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 PSO:1,2,3,4	CO5: Comprehend the use of learning system.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit-5: Learning Techniques 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8	

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Semester-I

Course Code: 20CSE116-A

Course Title: Data Science

Pre- requisite: Strong background in mathematics, OOPs and SQL

Rationale: A data science course can offer you valuable skills, career opportunities, and the ability to make data-driven decisions, making it a compelling choice for individuals interested in this field.

Course Outcomes:

After completion of the course

20CSE116-A.1**:** Student will demonstrate knowledge of the fundamentals of data science.

20CSE116-A.2 Student will be able to apply data insights in business model to enhance the scope of the business.

20CSE116-A.3**:** Student will use various machine learning algorithms.

20CSE116-A.4**:** Student will familiarize about the knowledge representation in intelligent system and in data centric applications.

20CSE116-A.5**:** Student will comprehend the use of data analytics and data visualization

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)	
PEC	20CSE116-A	Data Science	3	0	1	1	5	3

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.

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Scheme of Assessment:

Board of Study	Course title	Course Title	Scheme of Assessment (Marks)							End Semester Assessment	Total Marks (PRA+ ESA)
			Progressive Assessment (PRA)								
			Class/Home Assignment 5 number 3 marks each	Class Test 2 10 marks each (CT)	Semina r one	Class Activity any one	Class Attendance	Total Marks			
PEC	20CSE 116-A	Data 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.

20CSE116-A.1: Student will demonstrate knowledge of the fundamentals of data science

Approximate Hours

Item	Appx. Hrs
CI	11
LI	0
SW	1
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Understand the concept of data science. **SO1.2** Compare various data analysis tools and data visualization **SO1.3** Student will be able to apply types of AI and Machine Learning in real life problems	.	**Unit-1 Introduction to Cloud Computing** 1.1 Introduction to core concept and technologies of data science 1.2 Terminology of data science 1.3 Data science process 1.4 Data science toolkit	1. Practice on data science toolki 2. Utilizing various data science technologies

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		1.5 Types of data 1.6 Examples of Data science 1.7 Application of data science	

20CSE116-A.2: Student will apply data insights in business model to enhance the scope of the business.

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 data collection and management **SO2.2** Use the API in data collection **SO2.3** Demonstrate multiple data sources	.	**Unit-2 Data collection and Management** 2.1 Introduction to Data collection and management 2.2 Sources of data 2.3 Data collection and APIs 2.4 Exploring and fixing data 2.5 Data storage and management 2.6 Using multiple data sources	1. How data is colleted to solve real life problems. 2. Exploring and fixing data

20CSE116-A.3: Student will use various machine learning algorithms.

Approximate Hours

Item	Appx Hrs
Cl	11
LI	0
SW	1
SL	1
Total	13

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(Revised as on 01 August 2023)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1 Understand the concept of data analysis **SO3.2** Use statistical approach exploratory data analysis **SO3.3** Apply various Machine Learning algorithms	.	**Unit-3 Security Issues in Cloud Computing and Identity & Access management** 1. Introduction to data science 2. Terminology and concepts 3. Introduction to statistics 4. Central tendencies and distributions 5. Variance, Distribution properties and arithmetic 6. Samples/CLT	1. Analyze statistical concept and implement it in data science
		7. Basic machine learning algorithms	

20CSE116-A.4: Student will familiarize about the knowledge representation in intelligent system and in data centric applications.

Approximate Hours

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

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO4.1 Understand the concept and purpose of data visualization **SO4.2** Use of data encoding and visual encoding **SO4.3** Apply data visualization techniques	.	**Unit-4 Security Management in the Cloud and Privacy Issues** 1. Introduction to data visualization 2. Types of data visualization	1. Compare and analyze all methods of visualization

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		3. Data types 4. Data encodings 5. Retinal variables 6. Mapping variables to encodings 7. Visual encodings	

20CSE116-A.5: Students will comprehend the use of data visualization tools and techniques.

Approximate Hours

Item	Appx Hrs
Cl	5
LI	0
SW	1
SL	1
Total	7

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
O5.1 Understand the concept of reasoning under uncertainty **SO5.2** Demonstrate the use of learning techniques **SO5.3** Understand the trends of data collection. **SO5.4** Demonstrate various visualization techniques. **SO5.5** Explore application development methods of data science	.	**Unit-5 Applications of Data Science** 1. Uses of data science and machine learning. 2. Technologies for visualization 3. Introduction to Bokeh (Python) 4. Recent trends in various data collection and analysis techniques. 5. Application development methods used in data science	1. Compare and analyze all visualization techniques. 2. Compare and analyze application development methods of used in data science.

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)
20CSE116-A.1: Student will be able to Demonstrate knowledge of the fundamentals of data science.	11	1	1	13
20CSE116-A.2: Student will be able to apply data insights in Business model to enhance the scope of the business.	12	1	1	14
20CSE116-A3: Student will be able to use various machine Learning algorithms.	11	1	1	13
20CSE116-A.4: Student will Familiarize about the knowledge representation in intelligent system and in data centric applications.	6	1	1	8
20CSE116-A.5: Students will be able to comprehend the use of data visualization tools and techniques.	5	1	1	7
Total Hours	**45**	**5**	**5**	**55**

Suggested Specification Table (ForESA)
Suggested Instructional/Implementation Strategies:

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

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Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Doing Data Science, Straight Talk From The Frontline	Cathy O'Neil and Rachel Schutt	O'Reilly Media	4th Edition, 2008
2	Mining of Massive Datasets. v2.1	Jure Leskovek, Anand Rajaraman and Jeffrey Ullman	Cambridge University Press	3rd Edition, 2009

Curriculum Development Team

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2. Dr. Pramod Singh, Associate Professor, Department of Computer Science and Engineering.
3. Mr. Lokendra Gaur, Assistant Professor, Department of Computer Science and Engineering.
4. Ms. Pragya Shrivastava, Assistant Professor, Department of Computer Science and Engineering.
5. Mr. Vinay Kumar Dwivedi, Assistant Professor, Department of Computer Science and Engineering.
6. Ms. Pinki Sharma, Assistant Professor, Department of Computer Science and Engineering.
7. Ms. Pushpa Kushwaha, Assistant Professor, Department of Computer Science and Engineering.
8. Ms. Shruti Gupta, Assistant Professor, Department of Computer Science and Engineering.

COs, POs and PSOs Mapping

Program: M. Tech. (CSE)
Course Code: 20CSE116-A

Course Title: Data Science

Course Outcomes	Program Outcomes												Program Specific Outcomes				
	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4	PSO5
	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	Understand fundamental concepts in statistics, mathematics and Computer Science. Demonstrate an understanding of various analysis tools and software used in data science.	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 in multidisciplinary settings.	Apply laboratory-oriented problem solving and be capable in data visualization and interpretation. Solve case studies by applying various technologies, comparing results and analysing inferences. Develop problem solving approach and present output with effective presentation and communication skills.	Design and develop tools and algorithms. Contribute in existing open sources platforms. (iii) Construct use case based models for various domains for greater perspective.	Cater to/ provide solutions particular domain specific problems by having in depth domain knowledge. Exposure to emerging trends and technologies to prepare students for industry. Develop skills required for social interactio.
20CSE116-A 1	3	2	3	2	3	3	1	1	1	1	1	3	2	2	3	2	3
20CSE116-A 2	2	3	2	3	3	2	1	2	1	1	1	3	2	3	2	1	3
20CSE116-A 3	3	3	3	3	3	2	1	1	2	1	1	3	2	2	2	2	3
20CSE116-A 4	3	2	3	2	3	2	1	2	1	1	1	3	2	2	3	2	2
20CSE116-A 5	2	2	3	2	2	2	1	1	1	1	1	3	2	2	3	3	2

Course Curriculum Map: Data Science

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: Student will be able to Demonstrate knowledge of the fundamentals of data science	SO1.1 SO1.2 SO1.3		Unit-1 Introduction to Cloud Computing 1.1,1.2,1.3,1.4,1.5,1.6,1.7	
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 2: Student will be able to apply data insights in business model to enhance the scope of the business.	SO2.1 SO2.2 SO2.3		Unit-2 Data collection and Management. 2.1, 2.2, 2.3, 2.4, 2.5, 2.6	
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO:1,2,3,4	CO 3: Student will be able to use various machine learning algorithms.	SO3.1 SO3.2 SO3.3		Unit-3 Security Issues in Cloud Computing and Identity & Access management. 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7	As Mentioned in Page no. above to ___
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 4: Student will familiarize about the knowledge representation in intelligent system and in data centric applications.	SO4.1 SO4.2 SO4.3		Unit-4 Security Management in the Cloud and Privacy Issues. 4.1, 4.2, 4.3, 4.4,4.5, 4.6, 4.7	
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 5: Students will be able to comprehend the use of data visualization tools and techniques.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit-5 Applications of Data Science 5.1, 5.2, 5.3, 5.4, 5.5.	

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Semester-I

Course Code:	20CSE116-B
Course Title:	Advanced Wireless and Mobile Networks
Pre-requisite:	Strong foundation in Computer Networks.

Rationale: The students should get familiar with the wireless/mobile market and the future needs and challenges. To get familiar with key concepts of wireless networks, standards, technologies and their basic operations. To learn how to design and analyse various medium access. To learn how to evaluate MAC and network protocols using network simulation software tools. Thestudentsshouldgetfamiliarwiththewireless/mobilemarketandthefutureneedsand challenges.

Course Outcomes:

After completion of the course, students would be able to:

20CSE116-B 1 Remember the foundational concepts of networking and wireless networking, including various types of wireless networks, standards, operations, and use cases.
20CSE116-B Understand the principles underlying the design of WLAN, WPAN, WWAN, and Cellular networks, based on their knowledge of propagation and performance analysis.
20CSE116-B 3 Apply their knowledge of wireless network protocols by simulating wireless networks and troubleshooting network issues.
20CSE116-B 4 Analyze and evaluate the trade-offs between wire line and wireless links when designing wireless networks, considering factors such as reliability, bandwidth, and cost.
20CSE116-B 5 Create and develop mobile applications that address real-world problems by leveraging their knowledge of wireless networking and mobile technologies.

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)	
PEC	20CSE116-B	Advanced Wireless and Mobile Networks	3	0	1	1	5	3

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.),

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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)						End Semester Assessment	Tota l Mark s
			Progressive Assessment (PRA)							
			Class/HomeAssignment5 number 3 marks each (CA)	Class Test 2 (2 best out Of 3) 10 marks each (CT)	Semin ar one (SA)	Class Activ ity any one (CA T)	Class Attendan ce (AT)	Total Marks (CA+CT+SA + CAT+AT)	(ES A)	(PR A+ ES A)
PR C	20CS E116 -B	Advance d Wireless and Mobile Network S	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.

20CSE116-B .1: Remember the foundational concepts of networking and wireless networking, including various types of wireless networks, standards, operations, and use cases.

Approximate Hours

Item	Appx. Hrs.
Cl	11
LI	0
SW	1
SL	1
Total	13

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Describe key wireless physical layer concepts. **SO1.2** Explain the challenges in mobile computing, such as resource poorness, bandwidth, and energy constraints. **SO1.3** Compare multiple access technologies (CDMA, FDMA, TDMA) and their applications in wireless networks. **SO1.4** Analyze the impact of fading effects in indoor and outdoor WLANs on wireless communication. **SO1.5** Design a wireless LAN deployment strategy considering hidden node and exposed terminal problems.	.	**Unit-1.0 Foundation of Wireless Networking:** 1.1 Wireless Networking Trends 1.2 Key Wireless Physical Layer Concepts 1.3 Multiple Access Technologies-CDMA, FDMA, TDMA 1.4 Spread Spectrum technologies 1.5 Frequency reuse 1.6 Radio Propagation and Modeling 1.7 Challenges in Mobile Computing: Resource poorness, Bandwidth, energy etc 1.8 WIRELESSLOCALAREANETWORKS: IEEE 802.11 Wireless LANs Physical & MAC layer, 802.11 MAC Modes (DCF& PCF) IEEE802.11standards, Architecture&protocols, 1.9 Infrastructurevs 1.10 Ad-hoc Modes, Hidden Node & Exposed Terminal Problem, Problems 1.11 Fading Effects in Indoor and outdoor WLANs, WLAN Deployment issues.	1. Use network simulation software (e.g., NS-3, OPNET) to create a simulated wireless LAN environment. 2. Choose a real-world case study related to wireless networking, such as the deployment of a Wi-Fi network in a university or a company.

SW-1 Suggested Sessional Work (SW):

a. **Assignments**:
   1. Wireless Networking Trends.

b. **Mini Project:**
   1. Design and implement a wireless network using IEEE 802.11 standards, analyzing its performance in both infrastructure and ad-hoc modes.

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

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1. Conduct a field survey to assess and address challenges in mobile computing, including resource constraints, bandwidth limitations, and energy efficiency in wireless networks.

20CSE116-B .2: Understand the principles underlying the design of WLAN, WPAN, WWAN, and Cellular networks, based on their knowledge of propagation and performance analysis.

Approximate Hours

Item	Appx. Hrs.
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Identify the differences between 1G, 2G, 2.5G, 3G, and 4G cellular networks **SO1.2** Explain the concept of frequency reuse in cellular architecture. **SO1.3** Propose handoff strategies to improve coverage and capacity in cellular systems **SO1.4** Analyze the interference and system capacity issues in cellular networks. **SO1.5** Evaluate the use of spread spectrum technologies in wireless cellular networks.	.	**Unit-2.0 Introduction to Wireless Cellular Networks:** 1.1 WIRELESS CELLULAR NETWORKS: 1G and 2G, 2.5G, 3G, and 4G 1.2 Mobile IPv4 1.3 Mobile IPv6 1.4 TCP over Wireless Networks 1.5 Cellular architecture 1.6 Frequency reuse 1.7 Channel assignment strategies 1.8 Hand off strategies 1.9 Interference and system capacity 1.10 Improving coverage 1.11 Improving capacity in cellular systems 1.12 Spread spectrum Technologies.	1. Explore concepts like "Channel assignment strategies" or "Handoff strategies" by setting up scenarios and observing the results. 2. Analyze the impact of different strategies on network efficiency and performance.

SW-2 Suggested Sessional Work (SW):

    a. Assignments:
        1. Analyze the evolution of wireless cellular networks from 1G to 4G, highlighting key

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technological advancements and their impact on mobile communication.

 b.   **Mini Project:**
   1.   Design and simulate a mobile IPv6-based network deployment to demonstrate seamless mobility and address management in a wireless environment.

 c.   **Other Activities (Specify):**
   1.   Conduct a research paper review on "Improving coverage and capacity in cellular systems" by evaluating strategies and technologies aimed at enhancing the performance of cellular networks, such as MIMO (Multiple Input Multiple Output) and small cell deployments.

20CSE116-B .3: Apply their knowledge of wireless network protocols by simulating wireless networks and troubleshooting network issues.

Approximate Hours

Item	Appx. Hrs.
CI	11
LI	0
SW	1
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 Define the components of WiMAX, including its physical layer and media access control. **SO3.2** Explain the concept of Media Independent Handover in IEEE 802.21. **SO3.3** Design a wireless sensor network with considerations for its physical, MAC layer, and network layer. **SO3.4** Analyze power management strategies in wireless sensor networks. **SO3.5** Develop a mobility and networking plan for a WiMAX deployment.	.	**Unit-3: Basics of** WiMAX **and WSN:** 3.1. WiMAX (Physical layer, Media access control, Mobility and Networking) 3.2. IEEE802.22 3.3. Wireless Regional Area Networks 3.4. IEEE 802.21 Media Independent Handover Overview 3.5. WIRELESS SENSOR NETWORKS 3.6. Introduction 3.7. Application, Physical 3.8. MAC layer 3.9. Network Layer 3.10. Power Management 3.11. Tiny OS Overview	1. Explore the physical, MAC layer, and network layer protocols commonly used in WSNs. 2. Investigate power management strategies in WSNs to prolong the lifespan of battery-powered sensors and the use of the Tiny OS operating system.

 SW-3 Suggested Sessional Work (SW):
a.   **Assignments**:
   1.   Wireless Sensor Networks (Introduction, Applications, Physical, MAC layer, Network Layer, Power Management, Tiny OS.
b.   **Mini Project:**

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1. Design and implement a WiMAX-based communication system focusing on the physical and MAC layers.

c. **Other Activities (Specify):**
   1. Conduct a case study on the practical applications of Wireless Sensor Networks in agriculture or environmental monitoring

20CSE116-B .4: Analyze and evaluate the trade-offs between wireline and wireless links when designing wireless networks, considering factors such as reliability, bandwidth, and cost.

Approximate Hours

Item	AppXHrs
Cl	6
LI	0
SW	1
SL	1
Total	8

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4. Define the characteristics of Wireless PANs, Bluetooth, and Zigbee**.** **SO4.2** Explain the role of wireless sensors in PANs. **SO4.3** Implement security techniques to address vulnerabilities in wireless networks. **SO4.4** Analyze security mechanisms in Wi-Fi networks. **SO4.5** Evaluate the impact of DoS attacks on wireless communication		**Unit-4: Basics of WPAN:** 4.1 WIRELESSPANs 4.2 Bluetooth AND Zigbee 4.3 Introduction to Wireless Sensors 4.4 Definition and Overview 4.5 Types of Wireless Sensors Applications 4.6 Advantages and Limitations	1. Investigate how Bluetooth or Zigbee technology is employed in this application. 2. Assemble the necessary components and follow online tutorials or guides to build the sensor system.

SW-4Suggested Sessional Work (SW):

a. **Assignments**:
   1. Analyze the advantages and disadvantages of Bluetooth and Zigbee for personal area network applications.
b. **Mini Project:**
   1. Design a home automation system using Zigbee technology to control lights and appliances wirelessly.
c. **Other Activities (Specify):**
   1. Conduct a hands-on experiment to measure the energy efficiency of different wireless sensors and compare the results.

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20CSE116-B .5: Create and develop mobile applications that address real-world problems by leveraging their knowledge of wireless networking and mobile technologies.

Approximate Hours

Item	Appx. Hrs.
Cl	5
LI	0
SW	1
SL	1
Total	7

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1 Describe the IEEE 802.11x and IEEE 802.11i standards for wireless networks. **SO5.2** Explain the concepts related to Vehicular Adhoc Networks. **SO5.3** Apply advanced security techniques to protect wireless networks. **SO5.4** Analyze the vulnerabilities associated with wireless network security. **SO5.5** Create a proposal for the implementation of IEEE 802.11x and IEEE 802.11i standards in a specific wireless network scenario.		**Unit5: Security in wireless Networks:** 5.1 SECURITY: Security in wireless Networks 5.2 Vulnerabilities 5.3 Security techniques, Wi-Fi Security 5.4 DoS in wireless communication. 5.5 Advanced Topics: IEEE 802.11x and IEEE 802.11i standards, Introduction to Vehicular Ad-hoc Networks	1. Study the IEEE 802.11x and IEEE 802.11i standards in depth. 2. Create a comparative analysis of these standards, highlighting their key features, differences, and security enhancements.

SW-5 Suggested Sessional Work(SW):

a. **Assignments**:
   1. Research and report on the latest Wi-Fi security protocols and technologies.
   2. Investigate and document techniques to mitigate Denial of Service (DoS) attacks in wireless communication.
b. **Mini Project:**
   1. Develop a practical demonstration or simulation of a wireless network security concept, such as a WPA3-protected Wi-Fi network or a defense mechanism against a specific wireless DoS attack.
c. **Other Activities (Specify):**
   1. Attend seminars or workshops related to the IEEE 802.11x and IEEE 802.11i standards, gaining in-depth knowledge about their applications and security features.

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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)
20CSE116-B .1: Remember the foundational concepts of networking and wireless networking, including various types of wireless networks, standards, operations, and use cases.	11	1	1	13
20CSE116-B .2: Understand the principles underlying the design of WLAN, WPAN, WWAN, and Cellular networks, based on their knowledge of propagation and performance analysis.	12	1	1	14
20CSE116-B .3: Apply their knowledge of wireless network protocols by simulating wireless networks and troubleshooting network issues.	11	1	1	13
20CSE116-B .4: Analyze and evaluate the trade-offs between wireline and wireless links when designing wireless networks, considering factors such as reliability, bandwidth, and cost.	6	1	1	8
20CSE116-B .5: Create and develop mobile applications that address real-world problems by leveraging their knowledge of wireless networking and mobile technologies.	5	1	1	7
Total Hours	**45**	**5**	**5**	**55**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	**U**	**A**	
20CSE116-B.1-1	Foundation of Wireless Networking	03	01	01	05
20CSE116-B.1-2	Introduction to Wireless Cellular Networks	02	06	02	10
20CSE116-B.1-3	Basics of WiMAX and WSN	03	07	05	15
20CSE116-B.1-4	Basics of WPAN	-	10	05	15
20CSE116-B.1-5	Security in wireless Networks	01	02	02	05
	Total	11	26	13	50

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

The end of semester assessment for Advanced Wireless and Mobile Networks will be held with written

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examination of 50 marks.

Note: Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks.

Teacher scan 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 IT industry
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	Advanced Wireless Networks - Cognitive, Cooperative & Opportunistic 4G Technology 2e: Cognitive, Cooperative and Opportunistic 4G Technology Hardcover – Import, 5 June 2009	S.G Glisic	John Wiley & Sons Inc	2016
2	Advanced Wireless Networks Technology And Business Models	Glisic Savo G	John Wiley & Sons Inc	2016
3	Lecture notes provided by Dept. of Computer Science and Engineering, AKS University, Satna.			

Curriculum Development Team

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2. Dr. Pramod Singh, Associate Professor, Department of Computer Science and Engineering.
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6. Mr. Vinay Kumar Dwivedi, Assistant Professor, Department of Computer Science and Engineering.
7. Ms. Pinki Sharma, Assistant Professor, Department of Computer Science and Engineering.

Cos, POs and PSOs Mapping

Course: M.Tech (Computer Science and Engineering)

Course Code: 20CSE116-B

Course Title: Advanced Wireless and Mobile Networks

Course Outcomes	Program Outcomes												Program Specific Outcome				
	PO 1 solutions	PO 2 Problem analysis	PO 3 Design/development of	PO 4 Conduct studies of	PO 5 Utilization of modern tools	PO 6 Engineers and society	PO 7 Environment and finance	PO 8 Ethics	PO 9 Individual and team work	PO 10 Communication	PO 11 Project management and	PO 12 Life-long learning	PSO 1	PSO 2	PSO 3	PSO 4	PS0 5
20CSE116-B. 1	-	-	-	-	1	1	1	2	3	3	1	-	2	3	3	1	2
20CSE116-B. 2	-	1	1	-	-	2	2	2	3	3	2	-	2	2	2	1	3
20CSE116-B. 3	-				-	-	-	-	2	3	1	-	1	1	2	2	2
20CSE116-B. 4	-	-	-	-	-	-	-		1	3	-	-	3	3	3	2	2
20CSE116-B. 5	-	-	1	-	-	1	-	-	1	3	-	-	3	3	1	3	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Data Science

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	**20CSE116-B. 1**	SO1.1 SO1.2 SO1.3		Unit-1 Introduction to Cloud Computing 1.1,1.2,1.3,1.4,1.5,1.6,1.7	
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	**20CSE116-B. 2**	SO2.1 SO2.2 SO2.3		Unit-2 Data collection and Management. 2.1, 2.2, 2.3, 2.4, 2.5, 2.6	
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO:1,2,3,4	**20CSE116-B. 3**	SO3.1 SO3.2 SO3.3		Unit-3 Security Issues in Cloud Computing and Identity & Access management. 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7	As Mentioned in Page no. above ———
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	**20CSE116-B. 4**	SO4.1 SO4.2 SO4.3		Unit-4 Security Management in the Cloud and Privacy Issues. 4.1, 4.2, 4.3, 4.4,4.5, 4.6, 4.7	
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	**20CSE116-B. 5**	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit-5 Applications of Data Science 5.1, 5.2, 5.3, 5.4, 5.5.	

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Semester-I

Course Code: 20RM113

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:

20RM113.1: Understand research problem formulation.

20RM113.2: Analyze research related information and Follow research ethics

20RM113.3: Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

20RM113.4: 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.

20RM113.5: UnderstandthatIPRprotectionprovidesanincentivetoinventorsforfurtherresearch work and investment in R & D, which leads to creation of new and better products, and in turn brings about, 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)**	
REC	20RM113	Research Methodology and IPR	2	0	2	1	5	2

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.

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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	Couse Code	Course Title	Scheme of Assessment (Marks)						End Semester Assessment	Total Marks
			Progressive Assessment (PRA)							
			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)
REC	20RM113	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.

20RM113.1**:** Understand research problem formulation.

   •

Approximate Hours

Item	Appx Hrs
Cl	8
LI	0
SW	2
SL	1
Total	11

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

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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-1** 1.1 Meaning of research problem, 1.2 Sources of research problem 1.3 Criteria Characteristics of a good research 1.4 problem, Errors in selecting a research problem 1.5 Scope and objectives of research problem. 1.6 Approaches of investigation of solutions for research problem data collection, 1.8 analysis, interpretation, Necessary instrumentations	1. Write a Process of research problem identification

SW-1 Suggested Sessional Work (SW):

a. Assignments:
   (i)   Discuss about Errors in selecting a research problem
b. Presentation

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c. Pictorial representation of different components of computer:

20RM113.**2:** Analyze research related information and Follow research ethics and Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity

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 Effective literature studies. SO2.2 To learn different approaches. SO2.3 Explain Plagiarism. SO2.4 Explain research ethics. SO2. 5 To understand Effective technical writing, SO2.6 know the Format of research proposal SO2. 7 Develop a Research Proposal SO2. 8 know about presentation of research proposal SO2.9 To understand the assessment of research proposal.	.	**Unit-2** **2.1** Effective literature studies **2.2** Approaches, analysis **2.3** Plagiarism, 2.4 Research ethics, 2.5 Effective technical writing, 2.6 How to write report. 2.7 Developing a Research Proposal, Format of research proposal presentation and assessment by a review committee	1. Write a Review 2. Design a research proposal

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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?

20RM113.**3:** 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	6
LI	0
SW	2
SL	1
Total	9

Session Out comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 To Understand Nature of Intellectual Property **SO3.2** To understand Patents, Designs, Trade and Copyright **SO3.3** Explain the process of patenting **SO3.4** To understand the development of technological research **SO3.5** To Understand Procedure for grants of patents, Patenting under PCT.	.	**Unit-4 :** 3.1 Nature of Intellectual Property. 3.2 Patents, Designs, Trade and Copyright 3.3 Process of Patenting and Development technological research 3.4 innovation, 4.5patenting, development. 3.6 International cooperation on Intellectual Property Procedure for grants of patents, Patenting under PC Trade and	i. Prepare a intellectual property proposal ii. Draw a classification diagram of RAID

		Copyright	

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.

20RM113.**4:** Understand that IPR protection provide sensitive to inventors for further research work and investment in R & D, which leads to creation of new and

Approximate Hours

Item	Appx Hrs
Cl	5
LI	0
SW	2
SL	1
Total	8

Session Outcomes(SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 Explain Patent Rights **SO4.2** Discuss Licensing and transfer of technology **SO4.3**Discuss about Patent information and databases **SO4.4** Understand Geographical Indications	....	Unit4: 4.1 Patent Rights: Scope of Patent Rights 4.2 Licensing and 4.3 transfer of technology 4.4 Patent information 4.5 databases Geographical Indications Learn by example Case Study Writing patent	i. Learn about scope of patent rights

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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.

20RM113.5: To better products, and in turn brings about, economic growth and social Benefits

Approximate Hours

Item	AppXHrs
Cl	7
LI	0
SW	2
SL	2
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO5.1 Understand Administration of Patent System **SO5.2** Explain new developments in IPR **SO5.3** Discuss about IPR of Biological Systems, Computer Software etc. **SO5.4** Understand Traditional knowledge Case Studies, IPR and IITs.		**Unit-5: New Developments in IPR** 5.1 Administration of Patent System. 5.2 New developments in IPR; 5.3 IPR of Biological Systems, 5.4Computer Software etc. Traditional knowledge Case Studies IPR and IITs Learn by example Understand the system	1. Learn about IPR

SW-5Suggested Seasonal Work (SW):

    d. Assignments:

        (ii)   Write a case study on Patents.

    e. Presentation:

    f. Other Activities (Specify): Group discussion

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour(Cl+SW+Sl)
20RM113.1 At the end of this chapter the student will Understand research problem formulation.	8	2	1	**11**
20RM113.2 At the end of this chapter the student will Analyze research related information and Follow research ethics	7	2	1	**10**
20RM113.3 At the end of this chapter the student will Understand that today's world	6	2	1	**9**
20RM113.4 At the end of this chapter the student will know about Intellectual Property Right	5	2	1	**8**
20RM113.5 At the end of this chapter the student will Understand that IPR Protection	4	2	1	**7**
Total Hours	30	10	5	45

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Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
20RM113.-1	Unit-1	03	02	03	08
20RM113.-2	Unit-2	03	01	05	09
20RM113.-3	Unit-3	03	07	02	12
20RM113.-4	Unit-4	03	05	05	13
20RM113.-5	Unit-5	03	02	03	08
Total		15	17	18	50

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

The end of semester assessment 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:

2. Improved Lecture
3. Tutorial
4. Case Method
5. Group Discussion
6. Role Play
7. Data center
8. Demonstration
9. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, WhatsApp, Mobile, Online sources)
10. Brainstorming

Suggested Learning Resources:

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
Curriculum Development Team

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COs, POs and PSOs Mapping

Course Title: M.Tech (CSE)
Course Code: 20RM113
Course Title: Research Methodology and IPR

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	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 systems of various complexity	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 in multidisciplinary settings	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.
20RM113.1 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	2
20RM113.2 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	3
20RM113.3 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	2
20RM113.4 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	3
20RM113.5 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	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** At the end of this chapter the student will Understand research problem formulation.	SO1.1 SO1.2 SO1.3 SO1.4		Unit-1 Introduction to Data Science 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	As mentioned in page number above
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	**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 Statistical Thinking1 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 PSO 1,2, 3, 4, 5	**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 Statistical Thinking2 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	**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 Exploratory Data Analysis and Visualization 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	**CO5** at the end of this chapter the student will Understand that IPR Protection	SO5.1 SO5.2 SO5.3 SO5.4		Unit-5 Introduction to Bayesian Modeling 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8	

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Semester I

Course Code:	20RM114
Course Title:	English for Research Paper Writing
Pre- requisite:	Students should have basic knowledge of presenting themselves and 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.

Course Outcomes

20RM114 1: Student will learn how to improve their writing skills, and level of readability
20RM1142: Students will understand the concept of plagiarism, and how to avoid ambiguity and vagueness
20RM1143: Students will learn about what to write in each section of paper
20RM1144: Students will understand significance of each section of paper, and learn how to write it at the same time.
20RM1145: 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)	
REC	20RM114	English for Research Paper Writing	2	0	0	1	3	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.

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Scheme of Assessment: Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)						End Semester Assessment	Total Marks
			Progressive Assessment (PRA)							
			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)
REC	20RM114	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.

20RM114 1: Student will learn how to improve their writing skills, and level of readability

Approximate Hours

Item	Appx Hrs.
Cl	6
LI	0
SW	0
SL	1
Total	7

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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. SO1.3 Examine 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: Preparation of Research Paper 1.1 Steps to introduce to the technique of reading research paper 1.2 Breaking up of sentences, 1.3 structuring paragraphs 1.4 Making the paper concise and 1.5 removing redundancy 1.6 Concept of Ambiguity and Vagueness	Reading research papers on relevant topics

20RM114.2: Students will understand the concept of plagiarism, and how to avoid ambiguity and vagueness

Approximate Hours

Item	Appx Hours
Cl	6
LI	0
SW	0
SL	1
Total	7

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

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SO2.1: Students learn to create a contrast between previous and present work. SO2.2: Learn paraphrasing	.	UNIT 2 – Paraphrasing and checking Plagiarism 2.1 Clarifying Who Did What, Highlighting Your Findings,	
Tool SO2.3: Use of plagiarism check tool SO2.4: Students understand the concept of hedging and criticizing		2.2 Hedging and Criticizing, Paraphrasing and Plagiarism, 2.3 : Clarification of previous work and their order 2.4 : Highlighting your work 2.5 : Paraphrasing and its tools 2.6 : Plagiarism Check and its tools	

20RM114.3: Students will learn about what to write in each section of paper

Approximate Hours

Item	Appx Hours
Cl	6
LI	0
SW	0
SL	1
Total	7

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 : Key skills to write an Abstract and 3.3 Key skills to write an Introduction. 3.4 : Skills to write Review of Literature. 3.5 : Key skills to write Methodology. -I 3.6 : Key skills to write Methodology. -II	

20RM114.4: Students will understand significance of each section of paper, and learn how to write it at the same time.

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Approximate Hours

Item	Appx Hours
Cl	6
LI	0
SW	0
SL	1
Total	7

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 4.2. Results of research findings-II 4.3 : Drawing conclusion of the research 4.4 : Discussion on the result of paper-I 4.5 : Discussion on the result of paper-I 4.6 : Final check of the paper	

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20RM114.5: Ensure the good quality of paper at very first-time submission

Item	Appx Hours
Cl	6
LI	0
SW	0
SL	1
Total	7

Session Outcomes (SOs)	(LI)	Class room Instruction (CI)	(SL)

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| 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
5.1 : Useful Phrases for effective research paper writing-II
5.1 : Useful Phrases for effective research paper writing-III
 5.2 : Paper submission techniques-I
5.2: Paper submission techniques-II
5.2: Paper submission techniques-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)
20RM114 1: Student will learn how to improve their writing skills, and level of readability	6	0	1	7
20RM114.2: Students will understand the concept of plagiarism, and how to avoid ambiguity and vagueness	6	0	1	7
20RM114.3: Students will learn about what to write in each section of paper	6	0	1	7
20RM114.4: Students will understand significance of each section of paper, and learn how to write it at the same time.	6	0	0	7
20RM114.5: Ensure the good quality of paper at very first-time submission.	6	0	1	7
Total Hours	30	0	05	35

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
120RM114.1	Unit 1: Preparation of Research Paper	03	02	03	08
120RM114.2	Unit 2: Paraphrasing and checking Plagiarism	03	01	05	09

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120R M114. 3	Unit 3: Planning Sections of a Paper	03	07	02	12
120R M114. 4	Unit 4: Finalizing the Research Paper	03	05	05	13
120R M114. 5	Unit 5: Research Paper Publication	03	02	03	08
	Total	15	17	18	50

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

The end of semester assessment for communication skills 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 Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)

2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press

3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York DordrechtHeidelberg London, 2011

Curriculum Developemnt Team
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• Ms. Pragya Shrivastava, Assistant Professor, Department of Computer Science and Engineering.
• Mr. Vinay Kumar Dwivedi, Assistant Professor, Department of Computer Science and Engineering.

Program: M.Tech(CSE)

Course Code : 20RM114

Course Title: English for Research Paper Writing

Course Outcomes	Program Outcomes												Program Specific Outcome				
	PO 1 — Engineering knowledge	PO 2 — Problem analysis	PO 3 — Design/development of solutions	PO 4 — Conduct studies of difficult problems	PO 5 — Utilization of modern tools	PO 6 — Engineers and society	PO 7 — Environment and sustainability	PO 8 — Ethics	PO 9 — Individual and team work	PO 10 — Communication	PO 11 — Project management and finance	PO 12 — Life-longlearning	PSO 1 — 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 systems of various complexity	PSO 2 — 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 in multidisciplinary settings	PSO 3 — 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.	PSO 4 — Learn and use the most recent Artificial Intelligence and Data Science technologies in the fields of engineering and computer science	PS0 5 — Recognize and examine issues in real life, then offer creative software solutions with the help of AI and Data Science Technologies.
20RM114 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	2
20RM114 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	3
20RM114 3: Students will learn about what to write in each section of paper	2	3	2	1	3	2	2	3	2	3	2	1	1	1	2	2	2
20RM114 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	2
20RM114 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	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	1: 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-1 Self-grooming, Basic Etiquettes and Presentation Skill 1.1,1.2,1.3,1.4,1.5,1.6	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	2: CO2: Students will understand the concept of plagiarism, and how to avoid ambiguity and vagueness	SO2.1 SO2.2 SO2.3 SO2.4		Unit-2 Confidence building skills, Interview Skills and Resume Writing 2.1, 2.2, 2.3, 2.4, 2.5, 2.6	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	3: CO3: Students will learn about what to write in each section of paper	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	As mentioned in page number above
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	4- CO4: 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-4 Functional Grammar and Vocabulary Building 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 PSO 1,2, 3, 4, 5	CO 5: The Understanding of Indian Culture and English Language will be developed through the study of Dramas and Poems written by Indian Writers	SO5.1		Unit-5 **Indian Writing in English & Hindi** Statistics 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10, 5.11,5.12,5.13,5.14,5.15	

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Semester-II

Course Code:	20CSE211
Course Title:	Advanced Algorithms
Pre-requisite:	UG level course in Algorithm Design and Analysis
Rationale:	Introduce students to the advanced methods of designing and analyzing algorithms. The student should be able to choose appropriate algorithms and use it for a specific problem. To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems. Students should be able to understand different classes of problems concerning their computation difficulties. To introduce the students to recent developments in the area of algorithmic design.

Course Outcomes:

20CSE211.1: Analyze the complexity/performance of different algorithms.

20CSE211.2: Analyze different paradigms to solve graph problems.

20CSE211.3: Determine the appropriate data structure for solving a particular set of problems.

20CSE211.4: Categorize the different problems in various classes according to their complexity

20CSE211.5: Students will have an insight of recent activities in the field of the advanced data structure. **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+T)**	
Program Core (PCC)	20CSE211	Advanced Algorithms	3	0	2	1	6	3

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 teachers ensure outcome of Learning.

Scheme of Assessment:Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Progressive Assessment (PRA)							
			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	20CSE211	Advanced Algorithms	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.

20CSE211.1: Analyze the complexity/performance of different algorithms.

Approximate Hours

Item	Appx. Hrs.
Cl	8
LI	0
SW	2
SL	1
Total	11

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Recall Sorting techniques. **SO1.2** Compare DFS and BFS **SO1.3** Develop Dijkasra's shortest path algorithm. **SO1.4** Identify the correctness of algorithms. **SO1.5** Discuss Amortize analysis with the help of examples		**Unit-1. Sorting and Graphs** 1.1 Review of various sorting algorithms. 1.2 topological sorting 1.3 Definitions and Elementary Algorithms. 1.4 Shortest path by BFS 1.5 shortest path in edge-weighted case (Dijkasra's) 1.6 Depth-first search and computation of strongly connected components. 1.7 Emphasis on correctness proof of the algorithm and time/space analysis 1.8 Example of amortized analysis	1. Analysis of Time and space complexity BFS and DFS 2. Study of different sorting algorithms

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SW-1 Suggested Sessional Work (SW):
a. Assignments:

1. Explain Different Sorting techniques with code.
2. Discuss DFS and BFS with time complexity Analysis.
3. Explain amortized analysis.

b. Other Activities (Specify):
   Seminar and Tutorial

20CSE211.2: Analyze different paradigms to solve graph problems.

Approximate Hours

Item	Appx. Hrs.
Cl	6
LI	0
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 Recall different Greedy concept of problem solving. **SO2.2** Develop algorithm to analysis maximumweight maximal independent set **SO2.3** Discuss different applications of Minimum spanning trees **SO2.4** Explain Maximum matching by augmenting paths **SO2.5** Analyze Edmond's Blossom algorithm to Compute augmenting Path	**LI01.**	**Unit-2 Matroids** 2.1 Introduction to greedy paradigm 2.2 Algorithm to compute a maximum weight maximal independent set 2.3 Application to MST 2.4 Graph Matching: Algorithm to compute maximum matching 2.5 Characterization of maximum matching by augmenting paths 2.6 Edmond's Blossom algorithm to Compute	1. Study of different greedy problems. 2. Study applications of Minimum spanning trees**.**

Path	augmenting path	

SW-2   Suggested Sessional Work (SW):

a.   Assignments:

    1. Write an Algorithm to compute maximum matching.

    2. Explain Edmond's Blossom algorithm to compute the augmenting path.

    3. Discuss applications of Minimum spanning trees.

b.   Other Activities(Specify):

    Seminar and Tutorial

20CSE211.3: Determine the appropriate data structure for solving a particular set of Problems.

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)
SO3.1. Recall Maxflow-mincut theoram **SO3.2.** Describe Ford – Fulkeson Method to compute maximum flow. . **SO3.3.** Explain Edmond-Karp Maximum flow algorithm. **SO3.4.** Discuss Strassen's algorithm for matrix multiplication **SO3.5.** Describe LUP - decomposition.		**Unit-3 : Flow Networks** 3.1 Maxflow-mincut theorem 3.2 Ford-Fulkerson Method to compute maximum flow 3.3 Edmond-Karp maximum-flow algorithm 3.4 Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm 3.5 inverse of a triangular matrix 3.6 Relation between the time complexities of basic matrix operations 3.7 LUP-decomposition	1. Study and test Edmord – Karp maximum flow algorithm. 2. Study of matrix multiplication.

SW-3   Suggested Sessional Work (SW):

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a. **Assignments:**
   1. Explain LUP-decomposition
   2. Discuss the relationship between time complexities of basic matrix operations.
   3. Explain the Edmond-Karp maximum-flow algorithm

b. **Other Activities(Specify):**
   Seminar and Tutorial

20CSE211.4: Categorize the different problems in various classes according to their complexity.

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)
.1. Explain Floyd – Warshall Algorithm **SO4.2.** Explore Different Real life examples on Dynamic programming **SO4.3.** Describe Chinese Remainder theorem with Example. **SO4.4.** Identify Difference between base-representation and modulo-Representation. **SO4.5.** Explore concepts of algorithm for different Mathematical		**Unit-4 : Shortest Path in Graph** 4.1 Floyd-Warshall algorithm 4.2 introduction to dynamic programming paradigm Examples on GNF 4.3 Examples of dynamic programming(LCS) 4.4 More examples of dynamic programming(MCM) 4.5 Modulo Representation of integers/polynomials: Chinese Remainder Theorem 4.6 Conversion	1. Study different Dynamic programming example 2. Study examples on Chinese Remainder Theorem

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Problems.		between base-representation and modulo-representation 4.7 Extension to polynomials 4.8 Application: Interpolation problem 4.9 Discrete Fourier Transform (DFT): In complex field 4.10 DFT in modulo ring 4.11 Fast Fourier Transform algorithm 4.12 Schönhage-Strassen Integer Multiplication algorithm	

SW-4 Suggested Sessional Work (SW):

a. **Assignments:**
   1. Discuss Fast Fourier Transform algorithm.
   2. Explain Schönhage-Strassen Integer Multiplication algorithm.
   3. Explain Schönhage-Strassen Integer Multiplication algorithm.
b. **Other Activities(Specify):**
   Seminar and Tutorial

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20CSE211.5: **Students will have an insight of recent activities in the field of the advanced data structure.**

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)
SO5.1. Describe Geometry of the feasibility region **SO5.2.** Explain simplex algorithm **SO5.3.** Identify and Proof of NP, NP completeness Problem **SO4.4.** Explain Randomized algorithm **SO5.5.** Discuss Approximation Algorithms		**Unit 5: Linear Programming** 5.1 Geometry of the Feasibility region 5.2 Simplex algorithm 5.3 NP-completeness: Examples 5.4 proof of NP-hardness 5.5 proof of NP completeness 5.6 Topics based on time and interest: Approximation Algorithms 5.7 Randomized Algorithms 5.8 Interior Point Method 5.9 Advanced Number Theoretic Algorithm 5.10 Recent Trends in problem solving paradigms using recent searching 5.11 Recent Trends in problem solving paradigms using recent Sorting techniques 5.12 Recent Trends in problem solving	1. Differentiate among NP,NP-hard and NP-completeness 2. Use knowledge of advanced algorithm and apply in real world problems.

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		paradigms using recent searching and sorting techniques by applying recently proposed data Structures.	

SW-5   Suggested Sessional Work (SW):

a.   Assignments:
1. Explain Randomized algorithm.
2. Differentiate NP and NP – completeness.
3. Take suitable example and explain approximation algorithm

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+LI+SW+Sl)
20CSE211.1: Analyze the complexity/performance of different algorithms.	08	0	2	1	11
20CSE211.2: Analyze different paradigms to solve graph problems.	06	0	2	1	9
20CSE211.3: Determine the appropriate data structure for solving a particular set of problems.	07	0	2	1	10
20CSE211.4: Categorize the different problems in various classes according to their complexity.	12	0	2	1	15
20CSE211.5: Students will have an insight of recent activities in the field of the advanced data structure.	12	0	2	1	15
Total Hours	45	0	10	5	60

Suggestion for End Semester Assessment

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Suggested Specification Table(ForESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
20CSE211.1	Sorting and Graphs	02	03	03	08
20CSE211.2	Matroids	02	03	05	10
20CSE211.3	Flow Networks	02	03	07	12
20CSE211.4	Shortest Path in Graph	-	03	07	10
20CSE211.5	Linear Programming	-	05	05	10
Total		06	17	27	50

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

The end of semester assessment for advanced algorithms will be held with written examination of 50 marks.

Suggested Learning Resources:

a. Books:

S. No.	Title	Author	Publisher	Edition &Year
1	"Introduction to Algorithms"	Cormen, Leiserson, Rivest, Stein	MIT Press	Third Edition
2	"The Design and Analysis of Computer Algorithms"	by Aho, Hopcroft, Ullman	Addison - Welsley	Paperback – 1 January 1974
3	"Algorithm Design"	by Kleinberg and Tardos	Pearson New International	1st Edition, Kindle Edition

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COs, POs and PSOs Mapping

Program: M. Tech (CSE)
Course Code: 20CSE211
Course Title: Advanced Algorithm

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	PSO 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 systems of various complexity	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 in multidisciplinary settings	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.
20CSE211.1: Analyze the complexity/performance of different algorithms.	1	3	2	2	2	2	3	1	2	1	3	2	2	3	1	2	2
20CSE211.2: Analyze different paradigms to solve graph problems.	2	3	2	2	1	2	3	1	1	1	2	2	2	2	2	2	2
20CSE211.3: Determine the appropriate data structure for solving a particular set of problems.	2	3	3	2	1	3	3	1	1	2	3	3	1	1	2	2	2
20CSE211.4: Categorize the different problems in various classes according to their complexity.	3	2	3	2	1	3	3	1	2	1	3	3	2	3	1	2	2
20CSE211.5: Students will have an insight of recent activities in the field of the advanced data structure	2	2	3	2	1	3	3	1	1	1	2	2	2	3	1	1	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Advanced Algorithm

POs & PSOs No.	COs No.& Titles	SOs No.	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: Analyze the complexity/performance of different algorithms.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	Unit-1 : Sorting and Graphs 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,	As mentioned in page number above
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO2: Analyze different paradigms to solve graph problems.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	Unit-2 : Matroids 2.1, 2.2, 2.3, 2.4, 2.5, 2.6,	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO3: Determine the appropriate data structure for solving a particular set of problems.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	Unit-3 **:** Flow Networks 3.1,3.2,3.3,3.4,3.5,3.6,3.7	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO4: Categorize the different problems in various classes according to their complexity.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	Unit-4: Shortest Path in Graph 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.1 1,4.12	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO5: Students will have an insight of recent activities in the field of the advanced data structure	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	Unit-5 : Linear Programming 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5. 11,5.12	

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Semester-II

Course Code: 20CSE212

Course Title: Soft Computing

Pre-requisite:

Student should have basic knowledge of AI

Rationale: To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario. To implement soft computing-based solutions for real-world problems. To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms. To provide student a hand-on experience on MATLAB to implement various strategies.

Course Outcomes:

20CSE212.1:Describe soft computing techniques and their roles in building intelligent machines.

20CSE212.2: Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems

20CSE212.3: Apply genetic algorithm to combine real optimization problems.

20CSE212.4: Evaluate and compare solutions by various soft computing approaches for a given problem

20CSE212.5:Practice MARLAB

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)	20CSE212	Soft Computing	3	2	2	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 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	Cous e Code	Course Title	Scheme of Assessment (Marks)						End Semester Assessment	Total Marks
			Progressive Assessment (PRA)							
			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	20CSE212	Soft Computing	15	20	5	5	5	50	50	100

Practical

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)					End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Progressive Assessment (PRA)						
			Class/Home Assignment 5 number 3 marks each (CA)	Viva1 (5)	Viva2 (5) (SA)	Class Attendance (AT)	Total Marks (CA+CT+SA+ CAT+AT)		
PCC	20CSE212	Soft Computing	35	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.

20CSE212.1: Identify and describe soft computing techniques and their roles in building intelligent machines

Approximate Hours

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

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Understand the Evaluation of Soft Computing **SO1.2** Explain Soft Computing Constituents **SO1.3** Understand the concept of From Conventional AI to Computational Intelligence **SO1.4** Understand the Basics of Machine Learning .	1. Research and present a case study on a real-world application of soft computing (e.g., fuzzy logic control in washing machines, neural networks in image recognition). Discuss the benefits and challenges faced in the implementation. 2. Implement a genetic algorithm to solve an optimization problem (e.g., traveling salesman problem). Evaluate its performance and compare it with other optimization techniques like simulated annealing. 3. Implement a supervised learning algorithm (e.g., linear regression, decision tree) on a real-world dataset. Evaluate its performance using metrics like	**Unit-1 INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS** 1.1 Evaluation of Soft Computing 1.2 Soft Computing Constituents 1.3 Conventional AI 1.4 Computational Intelligence 1.5 Machine Learning Basics. 1.6 Learn by example	1. Write the steps of machine learning

	accuracy, precision, recall, and F1-score.		

SW-1 Suggested Sessional Work (SW):

a. **Assignments:**
   (i)   **Write the evaluation of soft computing**
b. **Presentation**
c. Pictorial representation of different components of machine learning

20CSE212.2: Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems

Approximate Hours

Item	Appx Hrs
Cl	10
LI	6
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 To Understand Fuzzy Sets and Operations **SO2.2** To Understand Fuzzy Relations ,rules and reasoning **SO2.3** Explain Fuzzy Inference Systems, **SO2.4** Explain Fuzzy Expert Systems, **SO2.5** Apply Fuzzy Decision Making.	1. Implement and demonstrate fuzzy arithmetic operations (addition, subtraction, multiplication, division) using fuzzy numbers. Apply these operations to solve a simple problem, such as calculating fuzzy distances or costs. 2. Implement a fuzzy rule-based system for a simple application (e.g., weather prediction, traffic control). Define the fuzzy	**Unit2 FUZZYLOGIC** **2.1** Fuzzy Sets **2.2** Operations on Fuzzy Sets **2.3** Fuzzy Relations, **2.4** Membership **2.5** Fuzzy Rules and **2.6** Fuzzy Reasoning **2.7** Fuzzy Inference Systems, **2.8** Fuzzy Expert Systems, **2.9** Fuzzy Decision Making. 2.10 learn by example	1. Learn different operations on fuzzy sets.

	rules and apply fuzzy reasoning to derive conclusions from given inputs. 3. Implement aggregation operators (e.g., max, min, average) for fuzzy sets. Demonstrate their use in combining fuzzy information from multiple sources.		

SW-2   Suggested Seasonal Work (SW):

a. **Assignments:**
   (i)   **Write the different applications of fuzzy sets?**
b. **Presentation**

20CSE212.3: Apply genetic algorithm to combine real optimization problems.

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 To understand Machine Learning Using Neural Network SO3.2 know the different concepts of Supervised Learning SO3.3 know the different concepts of unsupervised Learning	1. Implement a simple neural network from scratch to solve a classification problem (e.g., binary classification of linearly separable data). Train the network and evaluate its	**Unit3 NEURALNETWORKS** **3.1** Machine Learning Using Neural Network 3.2 Adaptive Networks. 3.3 Feed forward Networks 3.4 Supervised Learning 3.5 Neural Networks Radial 3.6 Basis Function Networks 3.7 Reinforcement Learning,	**i. Classification diagram of neural network**

SO3.4 To understand the adaptive and advanced neural networks.	performance. 2. Implement a feedforward neural network to solve a regression problem (e.g., predicting house prices). Train the network and evaluate its performance using metrics such as Mean Squared Error (MSE). 3. mplement a supervised learning algorithm (e.g., neural network) for a classification task (e.g., image recognition). Train the model and evaluate its accuracy, precision, recall, and F1-score.	3.8 Unsupervised Learning Neural Networks 3.9 Adaptive Resonance architectures 3.10 Advances in Neural networks	

SW-2   Suggested Seasonal Work (SW):

a. **Assignments:**
   (i)   **Explain the architecture of adaptive resonance**
b. **Presentation**

20CSE212.3: Apply genetic algorithm to combine real optimization problems.

Approximate Hours

Item	App X Hrs
Cl	9
LI	6
SW	2
SL	1
Total	18

Session Out comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 To Understand the Genetic Algorithms. **SO4.2** Explain the Applications of GA in Machine Learning **SO4.3** To understand the different Approach to Knowledge Acquisition	1. Implement a simple genetic algorithm to solve a basic optimization problem (e.g., maximizing a mathematical function). Experiment with different genetic operators (selection, crossover, mutation) and analyze their effects on the algorithm's performance. 2. Investigate the impact of different parameters (population size, mutation rate, crossover rate) on the performance of a genetic algorithm. Conduct experiments to find the optimal parameter settings for a given problem. 3. Implement a genetic algorithm to perform feature selection for a machine learning model. Apply it to a dataset and compare the model's performance with and without feature selection.	**Unit-4: GENETIC ALGORITHMS** 4.1 Introduction to Genetic Algorithms. 4.2 Applications of GA in Machine Learning 4.3 Approach to Knowledge Acquisition 4.4 different techniques of knowledge acquisition 4.5 learn by example 4.6 case study-1 4.7 case study-2 4.8 case study-3 4.9 implementation of genetic algorithm in any language	I. Draw a diagram of different approaches of Knowledge Acquisition

SW-4 Suggested Seasonal Work (SW):

Assignments:

a. **(i) Write the Applications of GA in Machine Learning**

b. **Presentation**

20CSE212.5: Practice MARLAB

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)
SO5.1 To Understand MATLAB and Python **SO5.2** Discuss Arrays and array operations **SO5.3** Discuss neural network toolbox and fuzzy logic toolbox. **SO5.4** To implementation of Artificial Neural Network and Fuzzy Logic		**Unit5: Mat lab/Python Lib:** 5.1 Introduction to **MATLAB/** 5.2 Intro **to** Python 5.3 Arrays and 5.4 array operations 5.5 Functions and 5.6 Files 5.7 Study of neural network toolbox 5.8 fuzzy logic toolbox 5.9 Simple implementation of Artificial Neural Network 5.10 Simple implementation of Fuzzy Logic	i. Learn about neural network toolbox

SW-5 Suggested Seasonal Work (SW):

a. Assignments:

      (i)   Explain in detail about implementation of artificial neural network

b. Presentation:

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20CSE212.5: Evaluate and compare solutions by various soft computing approaches for a given problem

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)
SO6.1 To Understand Recent trends in deep learning. **SO6**.2 Explain Genetic algorithm **SO6.3** Discuss about various classifiers and Neural networks. **SO6.4** know the Implementation of recently proposed soft computing techniques .		**Unit6:** 6.1 Recent trends in deep learning, 6.2 various classifiers 6.3 Neural networks. 6.4 Genetic algorithm. 6.5 Implementation of recently proposed soft computing techniques 6.6 case study 6.7 learn by example	I. Learn implementation process of soft computing techniques

SW-5Suggested Seasonal Work (SW):

      Assignments:
                  Write short notes on various classifiers.
      Presentation:

      Other Activities (Specify): Group discussion

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)
20CSE212.1: Identify and describe soft computing techniques and their roles in building intelligent machines	6	6	2	1	**9**
20CSE212.2: Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems	10	6	2	1	**12**

20CSE212.3: Apply genetic algorithm to combine real optimization problems.	10	6	2	1	**13**
20CSE212.4: Evaluate and compare solutions by various soft computing approaches for a given problem	9	6	2	1	**10**
20CSE212.5: Understand recent trends in deep learning	**10**	6	**2**	**1**	**10**
Total Hours	45	30	12	6	64

Suggestion for End Semester Assessment

Suggested Specification Table (ForESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	**U**	**A**	
20CSE212.5:-1	Unit-1	03	02	03	08
20CSE212.5:-2	Unit-2	03	01	05	09
20CSE212.5:-3	Unit-3	03	07	02	12
20CSE212.5:-4	Unit-4	03	05	05	13
20CSE212.5:-5	Unit-5	03	02	03	08
	Total	15	17	18	50

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

The end of semester assessment for autonomous system for AI and DS 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. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, WhatsApp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

A. Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Fuzzy and Soft Computing,	Jyh: Shing RogerJang, Chuen: TsaiSun, EijiMizutani, Neuro	Prentice: Hall	2003
2	Fuzzy Sets and Fuzzy Logic: Theory and Applications	GeorgeJ. Klirand BoYuan	Prentice Hall.	1995

B. Alternative NPTEL/SWAYAM/MOOC Course (if any): NA

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COs, POs and PSOs Mapping

Course Title: M.TECH
Course Code: 20CSE212
Course Title: SOFT COMPUTING

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	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 systems of various complexity	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 in multidisciplinary settings	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.
20CSE212.1: Identify and describe soft computing techniques and their roles in building intelligent machines	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1	2

20CSE212.2: Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems	1	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1	3
20CSE212.3: Apply genetic algorithm to combine real optimization problems.	3	2	2	2	3	2	3	2	2	1	2	3	3	3	3	2	2
20CSE212..4: Evaluate and compare solutions by various soft computing approaches for a given problem	-	-	-	1	1	3	3	3	1	1	2	2	3	3	1	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)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	**20CSE212..1: Identify and describe soft computing techniques and their roles in building intelligent machines**	SO1.1 SO1.2 SO1.3 SO1.4		Unit-1 1.1,1.2,1.3,1.4,1.5,1.6,1.7	As mentioned in page number above
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	**20CSE212.2: Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems**	SO2.1 SO2.2 SO2.3 SO2.4		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	**20CSE212.3: Apply genetic algorithm to combine real optimization problems.**	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	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	**20CSE212.3: Apply genetic algorithm to combine real optimization problems.**	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	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	**20CSE212.4: Evaluate and compare solutions by various soft computing approaches for a given problem**	SO5.1 SO5.2 SO5.3 SO5.4		Unit-5 5.1,5.2,5.3,5.4,5.5,5.6,5.7	

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SEMESTER-II

Course Code:	20CSE214-A
Course Title:	Data Preparation and Analysis
Pre-requisite:	Data preparation and analysis require proficiency in programming languages like Python or R, knowledge of statistical methods, and familiarity with data manipulation techniques such as cleaning, transforming, and aggregating datasets. Additionally, a solid understanding of data structures and databases is crucial for efficient handling and querying of data during the analysis process.
Rationale:	To prepare the data for analysis and develop meaningful Data Visualizations.

Course Outcome:

Upon completion of the degree program, students will be able to:-

20CSE214-A .1.   Students will gain proficiency in handling various data formats, parsing techniques, and addressing scalability and real-time challenges in data processing.

20CSE214-A .2.   Learners will acquire skills in identifying and resolving inconsistencies, handling heterogeneous and missing data, and performing effective data transformations and segmentation.

20CSE214-A .3.   Participants will develop the ability to perform exploratory data analysis using descriptive and comparative statistics, clustering, association techniques, and hypothesis generation.

20CSE214-A .4.   Students will learn to create visually compelling representations of data, including time series and geo located data, while exploring correlations, hierarchies, networks, and interactive elements for effective communication and insight extraction.

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)	
PEC	20CSE214-A	Data Preparation and Analysis	3	2	1	1	7	4

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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 performance sin 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 perform denuder 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)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Progressive Assessment(PRA)							
			Class/Home Assignment 5number 3 marks each (CA)	Class Test2(2bestoutof3)10 markseach (CT)	Seminar one (SA)	Class Activityanyone (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
PEC	20CSE214-A	Data Preparation and Analysis	15	20	5	5	5	50	50	100

Practical

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)					End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Progressive Assessment (PRA)						
			Class/Home Assignment 5 number 3 marks each (CA)	Viva1 (5)	Viva2 (5) (SA)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		

PEC	20CSE214-A	Data Preparation and Analysis	35	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.

20CSE214-A .1.Introduction Data Gathering and Preparation

Approximate Hours

Item	Appx Hrs.
Cl	9
LI	6
SW	1
SL	1
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1.Understand the importance of data gathering and preparation in the data analysis process. SO1.2.Demonstrate the ability to work with different data formats using appropriate tools and libraries. SO1.3.Explain techniques for parsing different data formats using programming languages. SO1.4.Enhance knowledge of cryptographic principles, including symmetric and asymmetric cryptography, digital signatures, and hashing	1. Research and compare at least three different methods of data collection (e.g., surveys, web scraping, APIs). Discuss the advantages and disadvantages of each method. 2. Identify and describe at least five different public data sources. Collect a small dataset from	**Module-1.0** Introduction Data Gathering and Preparation : 1.1 Introduction to Data Gathering and Preparation 1.2 Data Formats 1.3 Data Parsing Techniques 1.4 Data Transformation 1.5 Scalability Challenges in Data	1. Explore a specific data format or parsing technique not covered in class. Prepare a short presentation or write-up summarizing your

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algorithms. Describe the process of transforming raw data into a format suitable for analysis. SO1.5.Identify scalability challenges when dealing with large volumes of data.	one of these sources and provide a summary of the collected data. 3. ollect datasets in different formats (e.g., CSV, JSON, XML). Compare and contrast these formats in terms of ease of use, readability, and compatibility with various data analysis tools.	Processing 1.6 Real-Time Data Processing 1.7 Data Integration and ETL (Extract, Transform, Load) 1.8 Data Quality and Governance 1.9 Data Privacy and Security I	findings and present it to the class.

SW-1 Suggested Sessional Work (SW):

a. **Assignments:**
- Design and implement a data parsing and transformation pipeline using a real-world dataset. Document the process, including data format selection, parsing techniques employed, and transformation steps applied. Submit both the code and a report detailing your approach and results.
- **Mini Project:**
  - Develop a scalable data processing solution for a given dataset, considering scalability challenges and real-time processing requirements. Implement data integration, transformation, and analysis components using appropriate tools and frameworks. Present your project to the class, highlighting key design decisions and outcomes.
b. **Other Activities (Specify):**
- Provide examples and case studies.

20CSE214-A .**2 Data Cleaning**.

Item	Appx Hrs.
Cl	11
LI	8
SW	1
SL	1
Total	21

Approximate Hours

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

| SO2.1. Understand the importance of data cleaning in the data analysis process.
SO2.2. Learn techniques for assessing data quality, including consistency checking and outlier detection.
SO2.3. Learn techniques for detecting and handling missing data, including imputation methods.
SO2.4. Gain familiarity with data transformation techniques such as standardization, normalization, and scaling.
SO2.5. Understand the challenges and best practices associated with each technique. | 1. Explain the importance of data cleaning in the data analysis process. Provide examples of common data quality issues and how they can impact analysis.
2. Outline a step-by-step data cleaning workflow for a given dataset. Describe the tools and techniques you would use at each step.
3. Identify and calculate key data quality metrics (e.g., completeness, consistency, accuracy) for a given dataset. Discuss any issues you find and their potential impact.
4. Generate a comprehensive data quality report for a sample dataset. Highlight areas of concern and propose strategies for improvement. | **Module 2.0** Data Cleaning
2.1 Introduction to Data Cleaning
2.2 Data Quality Assessment
2.3 Handling Heterogeneous Data
2.4 Dealing with Missing Data
2.5 Data Transformation Techniques
2.6 Data Segmentation Strategies
2.7 Data Deduplication
2.8 Text Data Cleaning
2.9 Handling Noisy Data
2.10 Temporal Data Cleaning
2.11 Spatial Data Cleaning | SL1. Explore a specific data cleaning technique or tool not covered in class (e.g., advanced outlier detection methods, deep learning-based data cleaning approaches). |

SW-2 Suggested Sessional Work (SW):

a) **Assignments:**
- Analyze a provided dataset with known data quality issues. Identify and document the data quality issues present in the dataset, propose and implement appropriate data cleaning techniques to address these issues, and evaluate the impact of the cleaning process on the dataset's quality and analysis outcomes.

b) **Mini Project:**
- Envelop a comprehensive data cleaning pipeline for a real-world dataset relevant to a specific industry or domain (e.g., healthcare, finance, marketing). The project should involve assessing data quality, handling heterogeneous and missing data, applying data transformation and segmentation techniques, and implementing advanced data cleaning methods as needed. Present your project findings and insights to the class.

c) **Other Activities (Specify):**
- Provide examples and case studies.

20CSE214-A .3 Exploratory Analysis

Approximate Hours

Item	Appx Hrs.
Cl	13
LI	8
SW	1
SL	1
Total	23

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1. Understand the importance of Exploratory Data Analysis (EDA) in the data analysis process. SO3.2. Learn various descriptive and comparative statistics techniques to summarize and analyze data. SO3.3. Gain proficiency in different data visualization techniques to effectively communicate insights from data. SO3.4. Develop skills in univariate, bivariate, and multivariate analysis for exploring relationships within datasets. SO3.5. Explore advanced techniques such as correlation analysis, clustering, association analysis, dimensionality reduction, and interactive data exploration to uncover patterns and trends in	1. Calculate and interpret summary statistics (e.g., mean, median, mode, standard deviation) for a given dataset. Discuss how these statistics describe the data. 2. Analyze the distribution of a dataset using measures of central tendency and dispersion. Create visualizations (e.g., histograms, box plots) to support your analysis. 3. Compare the means of two or more groups within a dataset using statistical tests (e.g., t-test, ANOVA). Interpret the results and discuss any significant differences. 4. Perform an analysis of	**Module-3.0 Exploratory Analysis** **3.1** Introduction to Exploratory Data Analysis (EDA), **3.2** Descriptive Statistics **3.3** Comparative Statistics **3.4** Data Visualization Techniques **3.5** Univariate Analysis **3.6** Multivariate Analy **3.7** Bivariate Analysis **3.8** Multivariate Analysis **3.7** Correlation Analysis **3.8** Clustering Techniques **3.9** Association Analysis **3.10** Dimensionality Reduction **3.11** Interactive Data Exploration	SL1. Explore additional data visualization libraries and tools beyond the ones covered in class, such as Plotly, Bokeh, or Seaborn, and create visualizations using these tools to deepen understanding and broaden skillset in data visualization

data.	variance (ANOVA) on a dataset to compare the variance between groups. Explain the results and their implications.		

SW-3 Suggested Sessional Work (SW):

a) **Assignments:**
  - Analyze a given dataset using descriptive statistics, comparative statistics, and various visualization techniques. Summarize key findings and insights obtained from the analysis in a report format.

b) **Mini Project:**
  - Perform exploratory data analysis on a real-world dataset, applying various statistical techniques and data visualization methods to uncover patterns and insights. Present findings and recommendations in a comprehensive report.

c) **Other Activities (Specify):**
  - Provide examples and case studies.

20CSE214-A .**4** After the completion of this module, students would be able to understand Visualization.

Approximate Hours

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

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

4.1. Understand the principles and techniques of designing effective visualizations for different types of data.	1. Research and summarize the key principles of effective data visualization. Provide examples of good and bad visualizations and explain why they are effective or ineffective.	Module 4.0 Introduction to Data Visualization	1. Explore advanced interactive visualization libraries such as D3.js and WebGL to create dynamic and engaging visualizations beyond the scope of the course content.
SO4.2. Gain proficiency in visualizing time series data to identify trends, patterns, and anomalies.		4.1. Introduction to Data Visualization: Principles and Importance	
SO4.3. Learn methods for visualizing geo located data and interpreting spatial relationships.	2. Create a presentation or report that highlights the importance of data visualization in decision-making processes. Use case studies to illustrate your points.	4.2. Time Series Visualization Techniques and Applications	
SO4.4. Explore techniques for visualizing correlations and connections between variables in datasets.		4.3. Visualizing Geo located Data: Maps and Spatial Analysis	
SO4.5. Understand hierarchical and network visualization methods for exploring complex data structures.	3. reate a line chart to visualize a time series dataset (e.g., stock prices, weather data). Add annotations to highlight significant events or trends.	4.4. Exploring Correlations and Connections through Visualization	
		4.5. Hierarchical Data Visualization: Trees, Treemaps, and Sunbursts	
		4.6. Network Visualization: Understanding Relationships in Complex Data	
		4.7. Interactive Visualization Tools and Techniques	
		4.8. Designing Effective Visualizations: Best Practices and Guidelines	
	4. Use techniques such as moving averages, seasonality plots, and time series decomposition to analyze and visualize a complex time series dataset.	4.9. Using Color and Shape Effectively in Visualizations	
		4.10. Visualizing Uncertainty and Variability in Data	
		4.11. Storytelling with Data: Narrative Visualization Techniques	
		4.12. Real-time Data Visualization: Challenges and Solutions	
		Ethical Considerations in Data Visualization: Avoiding Misleading Interpretations	

SW4 Suggested Sessional Work (SW):

a) **Assignments:**
   - Create a series of visualizations using a provided dataset, demonstrating proficiency in designing visualizations for different data types and effectively communicating insights derived from the data.

b) **Mini Project:**
   - Create a series of visualizations using a provided dataset, demonstrating proficiency in designing visualizations for different data types and effectively communicating insights derived from the data.

c) **Other Activities (Specify):**
   - Case Study: Provide hands-on examples of tool usage.

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)
20CSE214-A .**1** Introduction Data Gathering and Preparation	9	6	1	1	11
20CSE214-A .**2** Data Cleaning	11	8	1	1	13
20CSE214-A .**3** Introduction to Exploratory Data Analysis (EDA)	13	8	1	1	15
20CSE214-A .**4** Introduction to Data Visualization	12	8	1	1	15
Total Hours	45	30	4	4	54

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	**U**	**A**	
2 MTech (CSE) 1	Unit-1	05	05	02	12
2 MTech (CSE) 2	Unit-2	05	05	02	12
2 MTech (CSE) 3	Unit-3	05	05	03	13

2 MTech (CSE) 4	Unit-4	05	05	03	13
Total		20	20	10	50

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

The end of semester assessment for Introductory Cyber Security 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 canal so 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 IT Industry.
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, WhatsApp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition &Year
1	Making sense of Data : A practical Guide to Exploratory Data Analysis and Data Mining,	Glenn J. Myatt		
2	Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking.	Foster Provost and Tom Fawcett	O'Reilly Media	2013
3	Python for Data Analysis	Wes McKinney	O'Reilly Media	2017

4	Data Cleaning: Problems and Current Approaches	Peter Christen		2012
5	The Visual Display of Quantitative Information	Edward Tufte	Graphics Press	1983

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COs, POs and PSOs Mapping

Program Name: M.Tech. CSE
Course Code: 20CSE214-A
Course Title: Data Preparation and Analysis

Course Outcomes	PO1 Engineering knowledge	PO2 Problem analysis	PO3 Understand the cyber security threat landscape Design/development of solutions	PO4 Conduct studies of difficult problems	PO5 Utilization of modern tools	PO6 Engineers and society	PO7 Environment and sustainability	PO 8 Ethics	PO9 Individual and team work	PO10 Communication	PO11 Project management and finance	PO12 Life-long learning	PSO1 Proficiency in handling diverse data formats, parsing, and transforming data for analysis.	PSO2 Ability to address scalability and real-time issues in data gathering and preparation processes.	PSO3 Mastery in data cleaning techniques including consistency checking, handling heterogeneous and missing data, and performing data transformation and segmentation.	PSO4 Competence in conducting exploratory analysis through descriptive and comparative statistics, clustering, association analysis, and hypothesis generation.	PS0 5 Skill in designing and implementing visualizations for various data types including time series, geolocated data, correlations and connections, hierarchies, and networks with interactive features.
20CSE214-A .1 Students will gain proficiency in handling various data formats, parsing techniques, and addressing scalability and real-time challenges in data processing	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1	2
20CSE214-A .2 Learners will acquire skills in identifying and resolving inconsistencies, handling heterogeneous and missing data, and performing effective data transformations and segmentation.	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1	2
20CSE214-A .3 Participants will develop the ability to perform exploratory data analysis using descriptive and comparative statistics, clustering, association techniques, and hypothesis generation.	1	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1	3
20CSE214-A .4: Students will learn to create visually compelling representations of data, including time series and geolocated data, while exploring	3	2	2	2	3	2	3	2	2	1	2	3	3	3	3	2	2
correlations, hierarchies, networks, and interactive elements for effective communication and insight extraction.																	

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 PSO1,2,3,4,5,6,7	CO1 Students will gain proficiency in handling various data formats, parsing techniques, and addressing scalability and real-time challenges in data processing	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		UNIT – I: Introduction Data Gathering and Preparation 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	As mentioned in Page number above
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4,5	CO2 Learners will acquire skills in identifying and resolving inconsistencies, handling heterogeneous and missing data, and performing effective data transformations and segmentation.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		UNIT – II: **Data Cleaning** 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 Participants will develop the ability to perform exploratory data analysis using descriptive and comparative statistics, clustering, association techniques, and hypothesis generation.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		UNIT – III: Introduction to Exploratory Data Analysis (EDA) 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	
PO1,2,3,4,5,6,7, 8,9,10,11,12 PSO1,2,3,4,5	CO4: Students will learn to create visually compelling representations of data, including time series and geo located data, while exploring correlations, hierarchies, networks, and interactive elements for effective communication and insight extraction.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4: Introduction to Data Visualization 4.1,4.2,4.3,4.4,4.5,4.64.7,4.8,4.9,4.10,4.11,4.12,4.13	

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Semester-II

Course Code:	20CSE214-B
Course Title:	Data Storage Technologies and Networks
Pre-requisite:	Basic knowledge of Computer Architecture, Operating Systems, and Computer Networking is required.
Rationale:	To provide learners with a basic understanding of Enterprise Data Storage and Management Technologies.

Course Outcome:

At the end of this chapter the student will be able to-

20CSE214-B .1: Remember the fundamentals of magnetic, optical and semiconductor media.

20CSE214-B 2: Understand the principles of hardware and software design for access data.

20CSE214-B.3: Apply their knowledge for exploring large storages devices.

20CSE214-B.4: Analyze and evaluate storage architecture and functionality.

20CSE214-B.5: Create and develop hardware and software components and architecture.

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)**	
PEC	20CSE214-B	Data Storage Technologies and Networks	3	2	2	1	8	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, fiel doro the relocations 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.

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Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment(Marks)						End Semester Assessment	Total Marks
			Progressive Assessment(PRA)							
			Class/Home Assignment 5number 3 marks each (CA)	Class Test2 (2bestout of3) 10 marks each(CT)	Seminar one (SA)	Class Activity anyone (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	(ESA)	(PRA+ESA)
PEC	20CSE214-B	Data Storage Technologies and Networks	15	20	5	5	5	50	50	100

Practical

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)					End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Progressive Assessment (PRA)						
			Class/Home Assignment 5 number 3 marks each (CA)	Viva1 (5)	Viva2 (5) (SA)	Class Attendance (AT)	Total Marks (CA+CT+SA+ CAT+AT)		
PEC	20CSE214-B	Data Storage Technologies and Networks	35	5	5	5	50	50	100

Course-Curriculum Detailing:

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20CSE214-B 1: At the end of this chapter the student will explain the Magnetic, Optical and Semiconductor Media.

Item	AppX. Hrs.
CI	9
LI	6
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Understand the concept of storage media. **SO1.2** Understand about the Techniques for read Operations. **SO1.3** Understand about the Techniques for write Operations. **SO1.4** understand the performance of various storage. **SO1.5** understand the issues of various storage.	1. Collect data on capacity, speed, durability, and cost of different storage media. Present findings in a comparative chart. 2. Identify various storage media types and their use cases. Use a CD/DVD drive to read data from a disc. Record the process and analyze the read speed and error rate.	**Unit 1: Storage Media and Technologies** 1.1 Basics of storage media 1.2 Types of storage media 1.3 Magnetic media 1.4 Optical media 1.5 Semiconductor Media. 1.6 Techniques for read operations. 1.7 write Operations. 1.8 Issues Limitations.	1. Differentiate Magnetic, Optical and Semiconductor Memory. study of Issues and Limitations.

SW-1 Suggested Sessional Work (SW):

a.   Assignments:
i.   Storage Technologies.
ii.   explain applications of   various storage.

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20CSE214-B 2: At the end of this chapter the student will learn Hardware and Software Design for Access data.

Item	AppX Hrs
Cl	7
LI	6
SW	2
SL	1
Total	16

ession Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 Understand the Memory Hierarchy.	1. Examine different memory modules and identify their characteristics. Compare their speeds, capacities, and typical use cases.	**Unit 2:** **Usage and Access** 2.1 Introduction of Various types of memories	1. Performance issues of various storage mediums.
SO2.2 Data accessing techniques		2.2 Memory hierarchy	
SO2.3 study of performance issues of various storage.		2.3 Positioning in the Memory Hierarchy.	
SO2.4 Hardware Design for Access	2. Create a visual representation of the memory hierarchy. Include registers, cache, main memory, and secondary storage. Explain the purpose and speed of each level.	2.4 Hardware Design for Access. 2.5 Software Design for Access	
SO2.5 Software Design for Access		2.6 Performance issues. 2.7 Solutions.	

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	3. Study the role of each memory type in a computer system and how they interact. Demonstrate with examples how data moves between different levels of the hierarchy.		

SW-1 Suggested Sessional Work (SW):

a.   Assignments:
i.   Explain **Memory Hierarchy.**

20CSE214-B 3: At the end of this chapter the student will be able to describe about **Large Storages .**

Item	AppXHrs
CI	9
LI	6
SW	2
SL	1
Total	18

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

SO3.1 Understand about Large Storages.
 SO3.2 Study of Networked Attached Storage.
 SO3.3 Understand about Scalability issues.
	1. Research and compare the technologies in terms of speed, capacity,	**Unit 3:**
		 Large Storages
		  1.1 Storage introduction.
		  1.2 Storage
			.

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SO3.4 Understand about Networking issues. SO3.5 Learn about the solutions of various issues.	cost, and use cases. Conduct simple read/write tests if hardware is available. 2. Open a hard disk drive to identify its components. Conduct read/write performance tests and analyze factors affecting its speed. Compare NAS with other storage solutions in terms of accessibility, scalability, and ease of management. Document the benefits and potential drawbacks.	technologies. 1.3 Comparison of storage technologies 1.4 Hard Disks 1.5 Networked Attached Storage 1.6 Advantages of network attached storage. 1.7 Scalability issues. 1.8 Networking issues Solutions	

SW-1 Suggested Sessional Work (SW):

a.   Assignments:
   i.   **Networked Attached Storage**

20CSE214-B 4: At the end of this chapter the student will learn the Storage Architecture.

Item	AppX Hrs
CI	9
LI	6
SW	2
SL	1

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Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 Understand about Partitioning. SO4.2 Learn Storage System Design Techniques. SO4.3 Learn Caching. SO4.4 Learn Legacy Systems. SO4.5 Learn available solutions.	1. Compile a glossary of storage terms such as block, file, object storage, RAID, etc. Provide examples and context for each term. 2. Use disk management tools to create, modify, and delete partitions on a storage device. Analyze the impact of partitioning on storage efficiency and performance. 3. Format different types of storage media (e.g., HDD, SSD, USB drive) using various file systems (e.g., NTFS, FAT32, ext4). Document the steps and results.	**Unit 4: Storage Architecture** 4.1 Basics of storage architecture 4.2 Terminologies of storage 4.3 Storage formatting 4.4 Storage Partitioning 4.5 Storage System Design 4.6 Caching 4.7 Legacy Systems 4.8 Implementation 4.9 Issues and solutions.	1. study of Cache memory.

SW-1 Suggested Sessional Work (SW):

a.   Assignments:

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i.   Explain various Storage System Design Techniques.

20CSE214-B 5: At the end of this chapter the student will be able to describe about Hardware and Software Components.

Item	AppXHrs
CI	11
LI	6
SW	2
SL	1
Total	20

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1 Understand about Storage Area Networks. SO5.2 Learn Performance, Reliability, SO5.3 Security issues. SO5.4 Learn Recent Trends related to Copy data management. SO5.5 Learn various available solutions.	1. Identify and document the function of various SAN hardware components (e.g., switches, storage arrays, HBAs). Set up a basic SAN using these components. 2. Implement QoS policies in a SAN environment. Measure performance and reliability metrics under different workloads.	**Unit 5: Storage Area Networks** 5.1 Hardware Components 5.2 Software Components 5.3 Storage Clusters 5.4 Storage grid 5.5 Storage QoS–Performance Storage QoS-Reliability 5.6 Security issues 5.7 Recent trends of data management 5.8 Software defined storage appliances 5.9 Applications of software defined storage. 5.10 Limitations. 5.11 Solutions.	1. Performance, Reliability, and Security issues.

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	3. Research and present on recent trends such as big data, cloud storage, and AI-driven data management. Discuss their impact on SANs.		

SW-1 Suggested Sessional Work (SW):

a.   Assignments:
i.   Explain various   Security issues with storage.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
20CSE214-B.1: Remember the fundamentals of magnetic, optical and semiconductor media.	9	2	1	12
20CSE214-B.2: Understand the principles of hardware and software design for access data.	7	1	1	09
20CSE214-B.3: Apply their knowledge for exploring large storages devices.	9	1	1	11
20CSE214-B.4: Analyze and evaluate storage architecture and functionality.	9	1	1	11
20CSE214-B.5: Create and develop hardware and software components and architecture.				

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		11	1	1	13
Total Hours		45	6	5	56

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
20CSE214-B.1	Storage Media and Technologies	03	04	03	10
20CSE214-B.2	Usage and Access	05	03	02	10
20CSE214-B 3	Large Storages	05	02	03	10
20CSE214-B.4	Storage Architecture	04	04	02	10
20CSE214-B.5	Storage Area Networks	03	05	2	10
Total		20	15	15	50

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

The end of semester assessment for Problem Solving and Programming 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:

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

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition &Year
1	Network Storage	James O'Reilly	O'Reilly	2016
2	Data Storage Technology A Complete Guide	Gerardus Blokdyk	5STARCooks	2020

Curriculum Development Team

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COs, POs and PSOs Mapping

Program: M. Tech. Computer Science & Engineering

Course Code: 20CSE214-B

Course Title: Data Storage Technologies and Networks

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	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 systems of various complexity	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 in multidisciplinary settings	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.
20CSE214-B 1: At the end of this chapter the student will explain the Magnetic, Optical and Semiconductor Media .	2	3	3	2	1	2	1	1	1	1	1	2	2	3	1	2	2
20CSE214-B 2: At the end of this chapter the student will learn Hardware and Software Design for Access data.	2	2	3	3	1	2	1	1	1	1	1	3	2	2	2	2	2
20CSE214-B 3: At the end of this chapter the student will be able to describe about Large Storages.	2	3	3	2	1	1	1	1	1	1	1	3	1	1	2	2	2
20CSE214-B 4: At the end of this chapter the student will learn the Storage Architecture.	2	2	3	3	1	2	1	1	1	1	1	3	2	3	1	2	2
20CSE214-B 5: At the end of this chapter the student will be able to describe about Hardware and Software Components.	2	3	3	3	2	2	1	1	1	1	3	3	2	3	1	1	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map

POs & PSOs No.	COs No.& Titles	SOs No.	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: At the end of this chapter the student will explain the Magnetic, Optical and Semiconductor Media.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	Unit-1 Introduction to Computational Science 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	As mentioned in page number above
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 2: At the end of this chapter the student will learn Hardware and Software Design for Access data.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	Unit-2 Regular Expression 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: At the end of this chapter the student will be able to describe about Large Storages.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	Unit-3 : Context free Grammar 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 PSO 1,2, 3, 4, 5	CO 4: At the end of this chapter the student will learn the Storage Architecture.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	Unit-4: Linear Bounded Automata and Turing Machine 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 5: At the end of this chapter the student will be able to describe about Hardware and Software Components.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	Unit-5 Decidability 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11,5.12	

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Semester-II

Course Code:	20CSE214-C
Course Title:	Cloud Computing
Pre- requisite:	Strong background in Basic Programming Skills, Understanding of Databases, Security & Privacy Basics.
Rationale:	The student will also learn how to apply trust-based security model to real-world security problems. An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures. Students will learn the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.

Course Outcomes:

After completion of the course

20CSE214-C.1: Student will be able to demonstrate knowledge of Online Social Networks and Applications.

20CSE214-C.2: Student will be able to apply Security in Cloud computing environments, CPU Virtualization.

20CSE214-C.3: Student will be able to use Infrastructure Security and Cloud Authorization Management,

20CSE214-C.4: Student will be able to Security Management in the Cloud an SaaS, PaaS and IaaS

20CSE214-C.5: Student will be able to Internal Policy Compliance, Governance, Risk, and Compliance

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)**	
PEC	20CSE 214-C	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),
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.

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Scheme of Assessment:

Board of Study	Course title	Course Title	Scheme of Assessment (Marks)						End Semester Assessment	Total Marks (PRA+ ESA)
			Progressive Assessment (PRA)							
			Class/Home Assignment 5 number 3 marks each	Class Test 2 10 marks each (CT)	Seminar one	Class Activity any one	Class Attendance	Total Marks		
PEC	20CSE214-C	Cloud Computing	15	20	5	5	5	50	50	100

Practical

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)					End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Progressive Assessment (PRA)						
			Class/Home Assignment 5 number 3 marks each (CA)	Viva1 (5)	Viva2 (5) (SA)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
PEC	20CSE214-C	Cloud Computing	35	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.

20CSE214-C 1: Student will be able to demonstrate knowledge of Different clouds, Risks

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and novel applications of cloud computing.

Approximate Hours

Item	Appx. Hrs
CI	11
LI	6
SW	1
SL	1
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Student will be able to understand the Online Social Networks and Applications. **SO1.2** Student will be able to compare various clouds **SO1.3** Student will be able to apply novel applications of cloud computing	1. Compare and contrast the major cloud service providers (AWS, Azure, Google Cloud). 2. Develop a risk mitigation plan for a hypothetical organization moving to the cloud. 3. Explore cloud-native technologies such as containers (Docker, Kubernetes) and microservices.	**Unit-1 Introduction to Cloud Computing** 1.1 Introduction to Cloud Computing 1.2 Online Social Networks and Applications 1.3 Cloud introduction and overview 1.4 Different clouds, Risks 1.5 Novel applications of cloud computing	1. Practice on Online Social Networks and Applications 2. Utilizing various applications of cloud computing

20CSE214-C 2: Students will be able to exploring cloud computing architecture and cloud Deployment Models

Approximate Hours

Item	Appx. Hrs
Cl	12
LI	6
SW	1
SL	1
Total	20

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO2.1 Understand Cloud computing architecture **SO2.2** Use SPI Framework for Cloud Computing **SO2.3** Demonstrate Key Drivers to Adopting the Cloud **SO2.4** Understand barriers to Cloud Computing Adoption in the enterprise	1. Design a basic cloud computing architecture for a web application, including components such as servers, databases, and load balancers. 2. Set up virtual machines using a cloud service provider (e.g., AWS EC2, Azure Virtual Machines). 3. Explore CPU virtualization by creating and managing virtual CPUs in a cloud environment.	**Unit-2 Cloud Computing Architecture and Cloud Deployment Models** 1. Requirements, Introduction Cloud computing architecture 2. On Demand Computing Virtualization at the infrastructure level 3. Security in Cloud computing environments, CPU Virtualization 4. A discussion on Hypervisors Storage Virtualization Cloud Computing Defined 5. The SPI Framework for Cloud Computing, The Traditional Software Model 6. The Cloud Services Delivery Model 7. Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users 8. Governance in the Cloud, Barriers to Cloud Computing Adoption in the enterprise	1. How security is achieved in Cloud computing environments. 2. Exploring Impact of Cloud Computing on Users

20CSE214-C .3: Students will be able to explore Security Issues and Access Management in cloud sytem.

Approximate Hours

Item	Appx Hrs
Cl	11
LI	6
SW	1
SL	1
Total	19

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1 Understand the Infrastructure Security **SO3.2** Use Data Security and Storage **SO3.3** Apply IAM Practices in the Cloud	1. Set up a virtual private cloud (VPC) with subnets, route tables, and security groups. 2. Develop a web application with integrated security features such as input validation and secure authentication. 3. Implement data integrity checks using hashing algorithms.	**Unit-3 Security Issues in Cloud Computing and Identity & Access Management** 1. Infrastructure Security: The Network Level, The Host Level & The Application Level 2. Data Security and Storage 3. Aspects of Data Security 4. Data Security Mitigation Provider Data and Its Security 5. Trust Boundaries and IAM, IAM Challenges 6. Relevant IAM Standards and Protocols for Cloud Services 7. IAM Practices in the Cloud, Cloud Authorization	1. Analyze Data Security and Storage

20CSE214-C .4: Students will be able to familiarize with Security Management in the Cloud and Privacy Issues.

Approximate Hours

Item	Appx Hrs
Cl	6
LI	6
SW	1
SL	1
Total	14

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

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SO4.1 Understand the concept and purpose of Security Management in the Cloud. **SO4.2** Use of SaaS, PaaS, IaaS **SO4.3** Apply Risk Management and Compliance in Relation to Cloud Computing.	1. Compare different security management frameworks (e.g., NIST, ISO, CIS). 2. Set up monitoring for a cloud-based application using tools like AWS CloudWatch or Azure Monitor. 3. Document the data life cycle stages (creation, storage, usage, archiving, deletion) for a cloud-based application.	**Unit-4 Security Management in the Cloud and Privacy Issues** 1. Security Management Standards 2. Security Management in the Cloud 3. Availability Management: SaaS, PaaS, IaaS 4. Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud 5. Protecting Privacy 6. Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing 7. Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations	1. Compare and analyze Security Management Standards

20CSE214-C 5: Students will be able to comprehend the use of data visualization tools and techniques.

Approximate Hours

Item	Appx Hrs
Cl	5
LI	6
SW	1
SL	1
Total	13

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO5.1 Understand the Governance, Risk, and Compliance (GRC), Regulatory/External Compliance. **SO5.2** Demonstrate the Auditing the Cloud for Compliance, Security- as-a-Cloud. **SO5.3** Explore recent trends in cloud system and its security.	1. Develop internal compliance policies for a cloud-based organization 2. Set up a Governance, Risk, and Compliance (GRC) framework for a cloud environment 3. Explore different Security-as-a-Service offerings from cloud providers.	**Unit-5 Audit and Compliance** 1. Internal Policy Compliance, Governance, Risk, and Compliance (GRC) 2. Auditing the Cloud for Compliance, Security-as-a-Cloud 3. Advanced topics: Recent trends in hybrid cloud and cloud security.	1. Compare and analyze Internal Policy Compliance. 2. Explore recent cloud system and tools.

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)
20CSE214-C.1: Demonstrate knowledge of Different clouds, Risks and novel applications of cloud computing.	11	6	1	1	13
20CSE214-C.2: Exploring cloud computing architecture and cloud Deployment Models.	12	6	1	1	14
20CSE214-C.3: Exploring Security Issues and Access Management in cloiud sytem	11	6	1	1	13

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20CSE214-C.4: Familiarize with Security Management in the Cloud and Privacy Issues.	6	6	1	1	8
20CSE214-C.5: Comprehend the use of data visualization.	5	6	1	1	7
Total Hours	**45**	**30**	**5**	**5**	**85**

Suggested Specification Table (ForESA)
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	Cloud Computing Explained: Implementation Handbook for Enterprises	John Rhoton	O'Reilly Media	November 2, 2009
2	Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice)	Tim Mather	O'Reilly Media	September 2009

Curriculum Development Team

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COs, POs and PSOs Mapping

Program: M. Tech. (CSE)
Course Code: 20CSE214-C
Course Title: Cloud Computing

Course Outcomes	PO1 Engineering knowledge	PO2 Problem Analysis	PO3 Design/development of solutions	PO4 Conduct studies of difficult problems	PO5 Utilization of modern tools	PO6 Engineers and society	PO7 Environment and sustainability	PO8 Ethics	PO9 Individual and team work	PO10 Communication	PO11 Project management and finance	PO12 Life-long learning	PSO1	PSO2	PSO3	PSO4	PSO5
20CSE214-C 1	3	2	3	2	3	3	1	1	1	1	1	3	2	2	3	2	3
20CSE214-C 2	3	3	2	3	3	2	1	2	1	1	1	3	2	3	2	1	3
20CSE214-C 3	3	3	3	3	3	2	1	2	2	1	1	3	2	2	2	2	3
20CSE214-C 4	3	2	3	2	3	2	1	2	1	1	1	3	2	2	3	2	2
20CSE214-C 5	2	2	3	2	2	2	1	1	1	1	1	3	2	2	3	3	2

Program Specific Outcomes:

PSO1: 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 systems of various complexity

PSO2: 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 in multidisciplinary settings

PSO3: 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.

PSO4: Learn and use the most recent Artificial Intelligence and Data Science technologies in the fields of engineering and computer science

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: Core concepts and tecnologies of cloud computing	SO1.1 SO1.2 SO1.3		Unit-1 Introduction to Cloud Computing 1.1,1.2,1.3,1.4,1.5	As Mentioned in Page no. above
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 2: Cloud Computing Architecture and Deployment Models	SO2.1 SO2.2 SO2.3 SO2.4		Unit-2 Cloud Computing Architecture and Cloud Deployment Models 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 PSO:1,2,3,4	CO 3: Security Issues, Identity and Access Management	SO3.1 SO3.2 SO3.3		Unit-3 Security Issues in Cloud Computing, Identity and Access Management 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7	
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 4: Security Management and Privacy Issues in the Cloud	SO4.1 SO4.2 SO4.3		Unit-4 Security Management in the Cloud and Privacy Issues 4.1, 4.2, 4.3, 4.4,4.5, 4.6, 4.7	
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 5: Understanding Audit and Compliance	SO5.1 SO5.2 SO5.3		Unit-5 Audit and Compliance 5.1, 5.2, 5.3	

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SEMESTER-II

Course Code:	20CSE215-A
Course Title:	Data Warehousing and Data Mining
Pre- requisite:	Student should have a basic understanding of Databases, Probability.
Rationale:	The objective of this course is to introduce data warehousing and mining techniques. Application of data mining in web mining, pattern matching and cluster analysis is included to aware students of broad data mining areas.

Course Outcome:

20CSE215-A.1 Study of different sequential pattern algorithms
20CSE215-A.2 Study the technique to extract patterns from time series data and its application in real world.
20CSE215-A.3 Study of different techniques of web mining.
20CSE215-A.4 Can extend the Graph mining algorithms to Web mining
20CSE215-A.5 Help in identifying the computing framework for Big Data

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)**	
PEC	20CSE215-A	Data Warehousing and Data Mining	3	0	1	1	5	3

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.

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Scheme of Assessment:

Bo ard of St u d y	Co us e Co de	Course Title	\multicolumn{6}{c}{Scheme of Assessment (Marks)}	End Semest er Assess ment	Tot al Mar ks
			Progressive Assessment (PRA)		
			Class/ Home Assign ment 5 number 3 ma rks eac h (CA)	Cla ss Tes t2 (2 best out of 3) 10 ma rks ea ch (C T)	Sem ina r one (SA)	Clas s Acti vity any one (C AT)	Class Attend ance (AT)	Total Marks (CA+CT+SA+C AT+AT)	(E S A)	(PR A+ ES A)
PEC	20CSE 215-A	Data Wareho using and Data Mining	1 5	20	5	5	5	50	5 0	100

Theory

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.

20CSE215-A.1 . Study of different sequential pattern algorithms**.**

Item	AppX Hrs
Cl	7
LI	0

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SW	1
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Understand about Data warehousing **SO1.2** about Data Mining **SO1.3** Understand about patters of mining **SO1.4** Understand about association and correlations. **SO1.5** use of sequential pattern mining and learn about primitives, scalable methods		**Module-1.0 Introduction**: 1.1 Introduction to Data Warehousing 1.2 Data Mining. 1.3 Mining frequent patterns 1.4 association and correlations; 1.5 Sequential Pattern Mining concepts 1.6 Primitives' methods 1.7 scalable methods	1. Learn about DBMS and data Models.

SW-1 Suggested Sessional Work (SW):

a. Assignments:
i. Pre-Processes Techniques on Data Set
ii. Pre-process a given dataset based on Handling Missing Values
iii Perform data preprocessing tasks and demonstrate performing association rule mining on data sets.

b. Mini Project:
i. Build Data Warehouse and Explore WEKA

c. Other Activities (Specify):
Class Test

20CSE215-A.2. Study the technique to extract patterns from time series data and its application in real world.

Item	AppX Hrs
Cl	10

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LI	0
SW	1
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO2.1 Understand about cluster analysis. **SO2.2** Learn About partitioning and hierarchical method **SO2.3** Understand About Transactional pattern **SO2.4** Understand about temporal based frequent patterns **SO2.5** use of Mining Time series Data **SO2.6** Periodicity Analysis for time related sequence data **SO2.7** Learn about Trend analysis, Similarity search in Time-series analysis		Module 2.1 Classification and prediction 2.2 Cluster Analysis – Types of Data in Cluster Analysis 2.3 Partitioning methods 2.4 Hierarchical Methods 2.5 Transactional Patterns and other 2.6 temporal based frequent patterns 2.7 Mining Time series Data 2.8 Periodicity Analysis for time related sequence data 2.9 Trend analysis, 2.10 Similarity search in Time-series analysis	SL1. Learn about Data analysis techniques

SW-1 Suggested Sessional Work (SW):
a.   Assignments:
i.   Demonstrate performing classification on data sets.
ii   Demonstrate performing Regression on data sets.
b.   Mini Project:

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i. Demonstrate performing clustering on data sets.

c. Other Activities (Specify):

Quiz, Class Presentation

20CSE215-A.3 **Study of different techniques of web mining.**

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 about data mining. **SO3.2** Understand Methodologies for stream data processing and stream data systems. **SO3.3** Use of Frequent pattern mining in stream data **SO3.4** use of Sequential Pattern Mining in Data Streams **SO3.5** Classification of dynamic data streams. **SO3.6** understand about Class Imbalance Problem. **SO3.**7 Understand about Graph mining **SO3.8** Understand about social Network Analysis		**Module-3.0** 3.1 Mining Data Streams 3.2 Methodologies for stream data processing and stream data systems-1 3.3 Methodologies for stream data processing and stream data systems-2 3.4 Frequent pattern mining in stream data-1 3.5 Frequent pattern mining in stream data-2 3.6 Sequential Pattern Mining in Data Streams 3.7 Classification of dynamic data streams-1 3.8 Classification of dynamic data streams-**2** 3.9 Class Imbalance Problem 3.10 Graph Mining 3.11 Social Network	1. various types of miming techniques.

		Analysis	

SW-1 Suggested Sessional Work (SW):

a. **Assignments:**

i. One type of model that you can create is a Decision Tree -train a Decision Tree 14 using the complete dataset as the training data. Report the model obtained after training.

b. **Mini Project:**

i. One approach for solving the problem encountered in the previous question is using 21 cross-validation? Describe what is cross -validation briefly. Train a Decision Tree again using cross -validation and report your results. Does your accuracy increase/decrease? Why?

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

Case Study: Create Placement. Riff file to identify the students who are eligible for placements using KNN

20CSE215-A.4. **Can extend the Graph mining algorithms to Web mining**

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 about Web Mining **SO4.2** About Mining the web page layout structure **SO4.3** About mining web link structure **SO4.4** Understand about mining multimedia data on the web **SO4.5** Automatic classification of web documents and web usage mining **SO4.6** learn about Distributed Data Mining		**Module 4.0 : Web Mining** 4.1 Web Mining 4.2 Mining the web page layout Structure-1 4.3 Mining the web page layout Structure-2 4.4 mining web link structure 4.5 mining multimedia data on the web 4.6 Automatic classification of web documents 4.7 web usage mining-1 4.8 web usage mining-2 4.9 Distributed Data Mining-1 4.10 Distributed Data Mining-2	1. Learn about Source of data

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SW-1 Suggested Sessional Work (SW)

Assignments:

i.   All businesses have both structured and unstructured data Explain it.

b.   Mini Project:

i.   Why the rapid growth of unstructured data is putting greater pressure on businesses. Explain it.

c.   Other Activities (Specify):

Case Study: Create Student. ariff file to suggest better college using Decision tree.

20CSE215-A.5. **Help in identifying the computing framework for Big Data.**

Item	AppX Hrs
Cl	7
LI	0
SW	1
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO5.1 Understand about Recent trends in Distributed Warehousing and Data Mining **SO5.2** About Class Imbalance Problem **SO5.3** understand about Graph Mining **SO5.4** understand about Social Network Analysis		**Module 5.0** 5.1 Recent trends in Distributed Warehousing and Data Mining-1 5.2 Recent trends in Distributed Warehousing and Data Mining-2 5.3 Class Imbalance Problem 5.4 Graph Mining-1 5.5 Graph Mining-2 5.6 Social Network Analysis-1 5.7 Social Network Analysis-2	2. Learn about Source of data

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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)
20CSE215-A.1. Study of different sequential pattern algorithms.	7	0	1	1	9
20CSE215-A.2. Study the technique to extract patterns from time series data and it application in real world.	10	0	1	1	12
20CSE215-A.3. Can extend the Graph mining algorithms to Web mining.	10	0	1	1	12
20CSE215-A.4. Help in identifying the computing framework for Big Data	10	0	1	1	12
20CSE215-A.5. Help in identifying the computing framework for Big Data.	7	0	1	1	9
Total Hours	45	00	5	5	55

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	**U**	**A**	
20CSE215-A.1	Unit-1	03	04	03	10
20CSE215-A.2	Unit-2	05	03	02	10
20CSE215-A.3	Unit-3	05	03	02	10
20CSE215-A.4	Unit-4	04	05	01	10
20CSE215-A.5	Unit-5	03	05	2	10
	Total	20	17	13	50

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

The end of semester assessment for Data Warehousing and Data Mining 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 IT Industry.
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, WhatsApp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition & Year
1	Data Mining Concepts and Techniques	Jiawei Han and M Kamber	Elsevier Publication	2011
2	Introduction to Data Mining - Pang-Ning Tan	Vipin Kumar, Michael Steinbach	Addison Wesley	2006
3	Sequence Data Mining	G Dong and J Pei	Springer	2007

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7. Mr. Vinay Kumar Dwivedi, Assistant Professor, Department of Computer Science and Engineering.
8. Ms. Pinki Sharma, Assistant Professor, Department of Computer Science and Engineering..

COs, POs and PSOs Mapping

Course Title: M. Tech. (Computer Science & Engineering)
Course Code: 20CSE215-A
Course Title: Data Warehousing and Data Mining

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
	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	The ability to apply technical & engineering knowledge for production quality cement with the available raw material resource. Complexity.	Ability to understand the day to plant operational problems of cement manufacture and provide economical solution to enhance the production without compromising quality of cement.	Ability to understand the latest cement manufacturing technology and it application in conservation of electrical and thermal energy in Portland cement manufacture.	Ability to use the research based innovative knowledge for sustainable development in cement manufacture.
20CSE215-A.1: Study of different sequential pattern algorithms	1	1	2	2	3	2	3	1	2	1	3	2	2	3	3	1
20CSE215-A..2: Study the technique to extract patterns from time series data and its application in real world.	1	1	2	2	1	2	3	1	1	1	2	2	2	2	2	1
20CSE215-A.1 3: Study of different techniques of web mining.	2	2	3	3	1	2	2	1	1	2	1	2	1	1	2	2
20CSE215-A. 4: Can extend the Graph mining algorithms to Web mining.	3	3	2	3	3	2	3	1	2	1	2	3	3	3	3	2
20CSE215-A 5: Help in identifying the computing framework for Big Data.	2	2	3	2	2	3	3	1	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)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 1: Analyzing the graph of a function is a powerful way to understand its behavior, make predictions, and solve mathematical and real-world problems.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1 Equations, Functions and Graphs 1.1,1.2,1.3,1.4,1.5,1.6,1.7	As mentioned in page number _ above
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 2 : Discuss of Derivatives and optimization are closely related concepts in mathematics and have important applications in various fields, engineering, and machine learning.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5 SO2.6 SO2.7		Unit-2 Derivatives and Optimizations 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 PSO 1,2, 3, 4, 5	CO 3: Use of operations involving vectors and matrices depend on the specific operations being performed.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5 SO3.6 SO3.7 SO3.8		Unit-3 Vectors and Matrices 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 4: Use and apply hypothesis testing on different datasets.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5 SO4.6		Unit-4 Probability 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 PSO 1,2, 3, 4, 5	CO 5: Use statistical methods to analyze and collect data.	SO5.1 SO5.2 SO5.3 SO5.4		Unit-5 Statistics 5.1,5.2,5.3,5.4,5.5,5.6,5.7,	

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Semester-II

Course Code:	20CSE215-B
Course Title:	Microprocessor and Computer architecture
Pre-requisite:	Basic knowledge of Integrated circuits, processing logic, and control.
Rationale:	ALU, Instruction set, CPU design, Micro-operation and their RTL specification, CPU-memory interaction, I/O processing, Programmed controlled I/O transfer, Interrupt controlled I/O transfer, DMA controller, RISC and CISC paradigm, to pipelining and pipeline hazards, design issues of pipeline architecture, interconnection networks, Multiprocessors and its characteristics, models of memory consistency Architecture of Microprocessors, Overview of microprocessor, Signals and pins of microprocessor, Assembly language and interfacing with microprocessor.

Course Outcomes:

20CSE215-B 1: Students will Recall the concepts of Instructions and addressing modes.

20CSE215-B 2: Students will analyze the concepts of Memory.

20CSE215-B 3: Students will understand I/O transfer and DMA Controller.

20CSE215-B 4: Students will Evaluate various design alternative of computer architecture based on CPU Performance, memory, I/O.

20CSE215-B 5: Students will have an insight into parallel processing, Microprocessors and Multiprocessing Systems.

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)	
PEC	20CSE215-B	Microprocessor and Computer architecture	3	0	2	1	6	3

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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 teachers 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)		
PEC	20CSE215-B	Microprocessor and Computer architecture	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.

20CSE215-B 1: Students will recall the concepts of Instructions and addressing modes.

	Approximate Hours
Item	Appx. Hrs.
Cl	9

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LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Recall concepts of ALU **SO1.2** Identify different addressing mode **SO1.3** Explain subroutine and subroutine call. **SO1.4** Discuss Instruction set and cycle. **SO1.5** Develop an understanding to CPU design		**Unit-1. Basics of Computer architecture** 1.1 Arithmetic and Logic Unit. 1.2 Introduction to memory Unit 1.3 control units 1.4 Instruction Set 1.5 working with an ALU 1.6 Various addressing modes 1.7 designing of an Instruction set 1.8 Concepts of subroutine and subroutine call 1.9 Introduction to CPU design	1. Study different addressing mode 2. Study of instruction set

SW-1 Suggested Sessional Work (SW):

a. Assignments:
1. Explain Subroutines and subroutine call.
2. Discuss Different addressing modes.
3. Discuss Instruction cycle.

b. Other Activities (Specify):
   Seminar and Tutorial

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20CSE215-B 2: Students will analyze the concepts of Memory.

Approximate Hours

Item	Appx. Hrs.
Cl	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 Recall concepts Of semiconductor **SO2.2** Explain cache memory **SO2.3** Explain virtual memory **SO2.4** Discuss different micro operations **SO2.5** Identify different Instructions		**Unit-2 Memory and semiconductor memory** 2.1 Instruction interpretation and execution 2.2 Micro-operation and their RTL specification 2.3 Concepts of semiconductor memory 2.4 CPU- memory interaction 2.5 organization of memory modules 2.6 Cache memory 2.7 Mapping in cache memory 2.8 replacement policies in cache memory 2.9 Virtual memory Introduction to input/output processing	1. Study of different semiconductor memory. 2. Study cache memory mapping.

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SW-2 Suggested Sessional Work (SW):
a. Assignments:
   1. Explain virtual memory.
   2. Discuss different memory modules.
   3. Explain Micro operations.
b. Other Activities(Specify):
   Seminar and Tutorial

20CSE215-B 3: Students will understand I/O transfer and DMA Controller.

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Approximate Hours

Item	Appx. Hrs.
Cl	9
LI	0
SW	2
SL	1
Total	12

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1. Recall programmed controlled I/O transfer **SO3.2.** Describe Interrupt controlled I/O transfer **SO3.3.** Identify Secondary storage and type of storage devices **SO3.4.** Discuss RISC and CISC paradigm **SO3.5.** Discuss DMA controller		**Unit-3: Programmed controlled I/O and DMA Controller** 3.1 working with video display unit and keyboard and routine to control them 3.2 programmed controlled I/O transfer 3.3 Interrupt controlled I/O transfer 3.4 DMA controller 3.5 Secondary storage and type of storage devices 3.6 Introduction to buses and connecting I/O devices to CPU and memory 3.7 Introduction to RISC and	1. Study types of storage 2. Study RISC and CISC

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		CISC paradigm	
		3.8 Design issues of a RISC processor	
		3.9 Example of an existing RISC processor	

SW-3   Suggested Sessional Work (SW):
a.   Assignments:
   1. Explain DMA controller.
   2. Discuss RISC and CICS.
   3. Explain programmed controlled I/O.

b.   Other Activities(Specify):

   Seminar and Tutorial

20CSE215-B 4: Students will Evaluate various design alternative of computer architecture based on CPU performance, memory, I/O.

Approximate Hours

Item	Appx. Hrs.
Cl	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1. Recall Pipeline Concepts and design issues **SO4.2.** Explore Instruction level Parallelism and advanced issue **SO4.3.** Discuss Multiprocessor system **SO4.4.** Discuss issues of deadlocks and		**Unit-4: Pipelining and Introduction to Microprocessor** 4.1 Introduction to pipelining and pipeline hazards. Design issues of pipeline architecture 4.2 Instruction-level parallelism and advanced issues 4.3 Introduction to interconnection	1. Study Instruction level parallelism and advanced issues 2. Study the interconnection of networks

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		network and practical issues	
scheduling in multiprocessor **SO4.5.** Explain modulo representation of integers		4.5 Modulo Representation of integers/polynomials 4.6 Examples of interconnection networks 4.7 Multiprocessors and its characteristics 4.8 Memory organization for multiprocessors systems 4.9 synchronization and models of memory consistency 4.10 Issues of deadlock and scheduling in multiprocessor systems.	

SW-4 Suggested Sessional Work (SW):

a. **Assignments:**
1. Discuss Memory organization for multiprocessor systems.
2. Explain deadlock and scheduling in a multiprocessor system
3. Explain different pipeline hazards.

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

Seminar and Tutorial

20CSE215-B 5: **Students will have an insight of parallel processing, Microprocessor and Multiprocessing systems.**

Approximate Hours

Item	Appx. Hrs.
Cl	9
LI	0
SW	2
SL	1

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Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1. Describe Cache in multiprocessor system **SO5.2.** Recall cache coherence protocols **SO5.3.** Discuss parallelism algorithm for multiprocessor system **SO5.4.** Explain basic concepts of microprocessor **SO5.5.** Identify digital signal and microcontrollers		**Unit 5: Parallel Processing And multiprocessor System** 5.1 Cache in multiprocessor systems and related problems 5.2 Cache coherence protocols 5.3 Parallel processing concepts 5.4 Parallelism algorithm for multiprocessor systems 5.5 General definitions of mini computers, microprocessors 5.6 micro controllers and digital signal processors 5.7 Overview of microprocessor, Signals and pins of microprocessor 5.8 Overview of	1. Study micro controllers 2. Study of microprocessors
		microprocessor 5.9 Signals and pins of microprocessor	

SW-5 Suggested Sessional Work (SW):
a. Assignments:
   1. Explain Parallel processing concepts.
   2. Differentiate signals and pins in microprocessor.
   3. Discuss cache coherence protocol.
b. Other Activities (Specify):

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Seminar and Tutorial

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
20CSE215-B 1: Recall the concepts of Instructions and addressing modes.	09	2	1	12
20CSE215-B 2: Students will analyze the concepts of Memory.	09	2	1	12
20CSE215-B 3: Students will understand I/O transfer and DMA Controller.	09	2	1	12
20CSE215-B 4: Students will Evaluate various design alternative of computer architecture based on CPU performance, memory, I/O	09	2	1	12
20CSE215-B 5: Students will have an insight of parallel processing, Microprocessors and Multiprocessing systems.	09	2	1	12
Total Hours	45	10	5	60

Suggestion for End Semester Assessment

Suggested Specification Table(ForESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
20CSE215-B 1	Basics of Computer architecture	02	03	03	08
20CSE215-B 2	Memory and semiconductor memory	02	03	05	10

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20CSE215-B 3	Programmed controlled I/O and DMA Controller	02	03	07	12
20CSE215-B 4	Pipelining and Introduction to Microprocessor	-	03	07	10
20CSE215-B 5	Parallel Processing And multi-processor System	-	05	05	10
	Total	06	17	27	50

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

The end-of-semester assessment for Problem Solving and Programming will be held with the written examination of 50 marks.

Suggested Learning Resources:

a.   Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Computer Architecture: A Quantitative Approach	J. L. Hennessy and D. A. Patterson	Morgan Kaufmann	5th Edition, 2012
2	Computer Organization and Architecture	William Stallings	Pearson	9th Edition, 2012
3	Digital Design and Computer Architecture	D. M. Harris and S. L. Harris	Morgan Kaufmann	2nd Edition, 2012

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COs, POs and PSOs Mapping

Program: M. Tech. Computer Science & Engineering
Course Code: 20CSE215-B
Course Title: Microprocessor and Computer architecture

Course Outcomes	PO 1 Engineering knowledge	PO 2 Problem analysis	PO 3 Design/development of solutions	PO 4 Conduct studies of difficult problems	PO 5 Utilization of modern tools	PO 6 Engineers and society	PO 7 Environment and sustainability	PO 8 Ethics	PO 9 Individual and team work	PO 10 Communication	PO 11 Project management and finance	PO 12 Life-longlearning	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
20CSE215-B .1: Recall the concepts of Instructions and addressing modes.	1	3	2	2	2	2	3	1	2	1	3	2	3	3	1	2	2
20CSE215-B .2: Students will analyze the concepts of Memory.	2	3	2	2	1	2	3	1	1	1	2	2	3	2	2	2	2
20CSE215-B .3: Students will understand I/O transfer and DMA Controller.	2	3	3	2	1	3	3	1	1	2	3	3	3	1	2	2	2
20CSE215-B .4: Students will Evaluate various design alternative of computer architecture based on CPU performance, memory, I/O	3	2	3	2	1	3	3	1	2	1	3	3	3	3	3	2	2
20CSE215-B .5: Students will have an insight of parallel processing, Microprocessor and Multiprocessing systems.	2	2	3	2	1	3	3	1	1	1	2	2	3	3	1	1	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map

POs & PSOs No.	COs No.& Titles	SOs No.	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: Recall the concepts of Instructions and addressing modes.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	Unit-1: Basics of Computer Architecture 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	As mentioned in page number _ above
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO2: Students will analyze the concepts of Memory.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	Unit-2: Memory and semiconductor memory 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 PSO 1,2, 3, 4, 5	CO3: Students will understand I/O transfer and DMA Controller.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	Unit-3: Programmed controlled I/O and DMA Controller 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 PSO 1,2, 3, 4, 5	CO4: Students will Evaluate various design alternative of computer architecture based on CPU performance, memory, I/O.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	Unit-4: Pipelining and Introduction to Microprocessor 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 PSO 1,2, 3, 4, 5	CO5: Students will have an insight of parallel processing, Microprocessor and Multiprocessing systems.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	Unit-5: Parallel Processing And multiprocessor System5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9	

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Semester-II

Course Code: 20CSE215-C

Course Title: Security in IoT Devices

Pre-requisite: Network Security

Rationale: The students should get familiar with the Internet of Things (IoT) technology it's future needs and security challenges.

Course Outcomes:

After completion of the course, students would be able to:

20CSE215-C 1. Remember the foundational concepts of Internet of Things (IoT) technology.
20CSE215-C 2. Understand the principles of security concerns in IoT architecture.
20CSE215-C 3. Apply their knowledge for encrypting and decrypting information and commands in IoT.
20CSE215-C 4. Analyze and evaluate various authorization and authentication schemes.
20CSE215-C 5. Create and develop security for IoT based cloud services.

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)	
PEC	20CSE215-C	Security in IoT Devices	3	0	1	1	5	3

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.

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Scheme of Assessment:

Theory

Board of Study	Course Code	Course Title	Scheme of Assessment (Marks)						End Semester Assessment	Total Marks
			Progressive Assessment (PRA)							
			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)
PEC	20CSE 215-C	Operation Research	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.

20CSE215-C 1: Remember the foundational concepts of Internet of Things (IoT) technology.

Approximate Hours

Item	Appx. Hrs.
Cl	9
LI	0
SW	1
SL	1
Total	11

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Understanding the basics of Internet of Things (IoT) **SO1.2** Understanding applications and architecture of IoT. **SO1.3** Understanding security issues and prevention with IoT. .	.	**Unit-1.0 Brief review of the Internet of Things (IoT)** 1.1 Introduction 1.2 IoT in business world, 1.3 Benefits & Applications of IoT, 1.4 Security Issues with IoT, 1.5 Basic Architecture of IoT, 1.6 IoT Attack Surface, 1.7 OWASP Top 10 for IoT. 1.8 Concept of Vulnerability management, 1.9 Quarantine and Prevention.	Learning fundamentals of Internet of Things (IoT).

SW-1 Suggested Sessional Work (SW):

a. **Assignments**:
   1. IoT Attack Surface
   2. IoT in business world
b. **Mini Project:**
   1. OWASP Top 10

20CSE215-C 2: Understand the principles of security concerns in IoT architecture.

Approximate Hours

Item	Appx. Hrs.
Cl	9
LI	0
SW	1
SL	1
Total	11

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 Understanding security concerns in IoT applications. **SO2.2** Understanding authentication and authorization in smart devices. **SO2.3** Understanding transport encryption and fault tree.	.	**Unit-2.0 Security Requirements in IoT Architecture** 2.1 Introduction 2.2 Security in Enabling Technologies 2.3 Security Concerns in IoT Applications. 2.4 Security Architecture in the Internet of Things 2.5 Security Requirements in IoT 2.6 Insufficient Authentication/Authorization 2.7 Insecure Access Control - Threats to Access Control, Privacy, and Availability 2.8 Attacks Specific to IoT. Vulnerabilities – Secrecy and Secret-Key Capacity 2.9 Authentication/Authorization for Smart Devices - Transport Encryption – Attack & Fault trees.	Learning security requirements in IoT architecture.

SW-2   Suggested Sessional Work (SW):

    a. **Assignments**:
         1. Insufficient Authentication
         2. Insecure Access Control
    b. **Mini Project:**
         1. Authorization for Smart Devices

20CSE215-C 3: Apply their knowledge for encrypting and decrypting information and commands in IoT.

Approximate Hours

Item	Appx. Hrs.
Cl	9
LI	0

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SW	1
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 Understanding the basics of cryptography along with encryption and description. **SO3.2** Understanding cipher suits and key management fundamentals. **SO3.3** Understanding digital signature node authentication in IoT.	.	**Unit-3: Cryptographic primitives and its role in IoT** 3.1. Introduction 3.2. Encryption and Decryption 3.3. Hashes 3.4. Digital Signatures 3.5. Random number generation 3.6. Cipher suites 3.7. Key management fundamentals 3.8. Cryptographic controls built into IoT messaging and communication protocols 3.9. IoT Node Authentication.	Learning cryptographic primitive and its role in IoT.

SW-3 Suggested Sessional Work (SW):

a. **Assignments**:
1. Cipher Suites
2. Digital Signatures

b. **Mini Project:**
1. Encryption and Decryption

20CSE215-C 4: Analyze and evaluate various authorization and authentication schemes.

Approximate Hours

Item	AppXHrs
Cl	9
LI	0
SW	1
SL	1
Total	11

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
O4.1 Understanding the basics of subscribe schemes and access control. **SO4.2** Understanding lightweight and robust schemes for privacy protection. **SO4.3** Understanding trust and trust models in IoT.		**Unit-4: Identity lifecycle** 4.1 Introduction 4.2 Authentication credentials 4.3 IoT IAM infrastructure 4.4 Authorization with Publish 4.5 Subscribe schemes – access control. 4.6 Concerns in data dissemination 4.7 Lightweight and robust schemes for Privacy protection 4.8 Trust and Trust models for IoT 4.9 Self-organizing Things Preventing unauthorized access.	Learning identifying life cycle for IoT.

SW-4Suggested Sessional Work (SW):

a. **Assignments**:
   1. Trust Models for IoT
   2. Subscribe Schemes for IoT

b. **Mini Project:**
   1. Self-Organizing Things for IoT

20CSE215-C 5: Create and develop security for IoT based cloud services.

Approximate Hours

Item	Appx. Hrs.
Cl	9
LI	0
SW	1
SL	1
Total	11

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1 Understanding the basics of cloud security for IoT. **SO5.2** Understanding cloud services and IoT. **SO5.3** Understanding cloud IoT security controls.		**Unit-5: Cloud security for IoT** 5.1 Introduction 5.2 Cloud Computing Security 5.3 Cloud security for IoT, 5.4 IoT Cloud Platforms 5.5 Cloud Internet Services 5.6 Cloud services and IoT 5.7 Protocols for IoT 5.8 Offerings related to IoT from Cloud Service Providers 5.9 Cloud IoT Security Controls.	Learning Cloud security for Internet of Things (IoT).

SW-5 Suggested Sessional Work (SW):

a. **Assignments**:
1. Cloud services for IoT
2. Cloud security for IoT
b. **Mini Project:**
1. Cloud Platforms for IoT

Brief of Hours Suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour(Cl+SW+Sl)
20CSE215-C 1. Remember the foundational concepts of Internet of Things (IoT) technology.	11	1	1	13
20CSE215-C 2. Understand the principles of security concerns in IoT architecture.	12	1	1	14
20CSE215-C 3. Apply their knowledge for encrypting and decrypting information and commands in IoT.	11	1	1	13
20CSE215-C 4. Analyze and evaluate various authorization and authentication schemes.	6	1	1	8
20CSE215-C 5. Create and develop security for IoT based cloud services.	5	1	1	7
Total Hours	**45**	**5**	**5**	**55**

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Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
20CSE215-C -1	Brief review of the Internet of Things (IoT)	03	01	01	05
20CSE215-C -2	Security Requirements in IoT Architecture	02	06	02	10
20CSE215-C -3	Cryptographic primitives and its role in IoT	03	07	05	15
20CSE215-C -4	Identity lifecycle	-	10	05	15
20CSE215-C -5	Cloud security for IoT	01	02	02	05
Total		11	26	13	50

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

The end of semester assessment for security in IoT devices 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.
    Teacher scan 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 IT industry
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	IoT and OT Security	Smita Jain Vasantha Lakshmi	Packt Publishing Ltd	2023
2	Security in IoT-Enabled Spaces	Fadi Al-Turjman	Taylor & Francis Books India Pvt. Ltd	2019

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3	Lecture notes provided by Dept. of Computer Science and Engineering, AKS University, Satna.

Curriculum Development Team

1. Mr. Brijesh Soni, Assistant Professor, Computer Science, AKS University.
2. Dr. Pinki Sharma, Assistant Professor, Computer Science, AKS University.
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Cos, POs and PSOs Mapping Course

Program: M.Tech. (Computer Science and Engineering)

Course Code: 20CSE215-C

Course Title: Security in IoT Devices

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	PSO 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 systems of various complexity	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 in multidisciplinary settings	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.
20CSE215-C 1. Remember the foundational concepts of Internet of Things (IoT) technology.	1	3	2	2	2	2	3	1	2	1	3	2	3	3	1	2	2
20CSE215-C 2. Understand the principles of security concerns in IoT architecture.	2	3	2	2	1	2	3	1	1	1	2	2	3	2	2	2	2
20CSE215-C 3. Apply their knowledge for encrypting and decrypting information and commands in IoT.	2	3	3	2	1	3	3	1	1	2	3	3	3	1	2	2	2
20CSE215-C 4. Analyze and evaluate various authorization and authentication schemes.	3	2	3	2	1	3	3	1	2	1	3	3	3	3	3	2	2
20CSE215-C 5. Create and develop security for IoT based cloud services.	2	2	3	2	1	3	3	1	1	1	2	2	3	3	1	1	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map

POs & PSOs No.	COs No.& Titles	SOs No.	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	20CSE215-C 1. Remember the foundational concepts of Internet of Things (IoT) technology.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	Unit-1: Basics of Computer Architecture 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	As mentioned in page number above
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	20CSE215-C 2. Understand the principles of security concerns in IoT architecture.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	Unit-2: Memory and semiconductor memory 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 PSO 1,2, 3, 4, 5	20CSE215-C 3. Apply their knowledge for encrypting and decrypting information and commands in IoT.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	Unit-3: Programmed controlled I/O and DMA Controller 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 PSO 1,2, 3, 4, 5	20CSE215-C 4. Analyze and evaluate various authorization and authentication schemes.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	Unit-4: Pipelining and Introduction to Microprocessor 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 PSO 1,2, 3, 4, 5	20CSE215-C 5. Create and develop security for IoT based cloud services	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	Unit-5: Parallel Processing And multiprocessor System5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9	

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Semester II

Course Code:	**20AU213**
Course Title:	**Indian Constitution**
Pre-requisite:	N/A
Rationale:	Understanding of the constitutional framework, rights, duties, and institutions that define India's democracy. It provides the necessary knowledge to become informed citizens and professionals in fields related to law, politics, public administration, and more.

Course Outcomes:

20AU213.1: Demonstrate a comprehensive understanding of the nature and characteristics of the Indian Constitution, including its historical background, key principles, evaluate the concepts of federalism and unitary form of government in the Indian context, assessing their advantages, disadvantages, and implications for governance and power distribution.

20AU213.2: Examine the provisions and significance of citizenship and fundamental rights in the Indian Constitution, and critically analyze their role in safeguarding individual liberties, promoting equality, and ensuring social justice.

20AU213.3: Recognize the role that the Directive Principles of State Policy play in providing a framework for government action; examine the complex interactions that shape the constitutional ethos between fundamental rights and directive principles; and recognize the role that fundamental duties play in promoting civic engagement and fortifying the basis of a just and inclusive society.

20AU213.4: Understand the structure and functioning of the Union Executive, Legislature, and Judiciary, including the roles and powers of the President, Vice President, Council of Ministers, and the Supreme Court, and assess their significance in the Indian system of governance.

20AU213.5: Analyze the structure and functioning of the State Executive, Legislature, and Judiciary, including the roles and functions of the Governor, State Legislature (Vidhan Sabha and Vidhan Parishad), and High Court, and assess their significance in the state-level governance and legal system.

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	PI	SA	SL	Total Study Hours (CI+PI+SW+SL)	
AUC	20AU213	Indian Constitution	2	0	1	1	4	2

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

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PI: Practical Instruction
SA: Sessional assignment.
SL: Self Learning,
C: Credits.

Note: SA & SL have 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)						End Semester Assessment	Total Marks
			Progressive Assessment (PRA)							
			Class/ Home Assignment 1 5 marks (CA)	Class Test 1 10 marks (CT)	Present ation (P)	Class Activity any one (CAT)	Class Attend ance (AT)	Total Marks (CA+CT+P+C AT+AT)	(ESA)	(PR A+ ES A)
AUC	20AU2 13	Indian Constit ution	15	20	5	5	5	50	5 0	1 0 0

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), Practical Instruction (PI), Sessional Assignment (SA), 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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20AU213.1: **Demonstrate a comprehensive understanding of the nature and characteristics of the Indian Constitution, including its historical background, key principles, evaluate the concepts of federalism and unitary form of government in the Indian context, assessing their advantages, disadvantages, and implications for governance and power distribution.**

Approximate Hours

Item	AppXHrs
Cl	06
PI	00
SW	01
SL	01
Total	**08**

Session Outcomes (SOs)	Practical Instruction (PI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Understand background, meaning, definition, nature and fundamental features of constitution. **SO1.2** Understand Types of Constitution. **SO1.3** Understand Types of Government. **SO1.4** Understand Characteristics of federalism. **SO1.5** Understand the concepts of federalism. .	.	**Unit-1. Introduction of Constitution (10 Lectures)** 1.1 Historical Evolution of Constitutions Concept and Meaning of Constitution 1.2 Definition and Nature of Constitution Fundamental Features of a Constitution 1.3 Preamble and its Significance Written and unwritten Constitution 1.4 Rigid Constitution vs. Flexible Constitution Codified Constitution vs. Uncodified Constitution 1.5 Characteristics of a Good Constitution, Democracy: Types and Principles 1.6 Monarchy: Absolute vs.	1. Remembering the Preamble of the Constitution.

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		Constitutional	

SW-1 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Importance of Preamble.
   ii. Is Indian Constitution federal or unitary?

20AU213.2: Examine the provisions and significance of citizenship and fundamental rights in the Indian Constitution, and critically analyze their role in safeguarding individual liberties, promoting equality, and ensuring social justice.

Approximate Hours

Item	AppXHrs
Cl	06
PI	00
SW	01
SL	01
Total	**08**

Session Outcomes (SOs)	Practical Instruction (PI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 To understand the citizenship. **SO2.2** To understand the essential elements of state.	.	**Unit-2. Citizenship Fundamental Rights** **(9 Lectures)** 1.1 Definition and Concept of Citizenship Different Types of Citizenship Dual Citizenship: Advantages and Disadvantages 1.2 Definition and Concept	

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SO2.3 To learn about fundamental rights.		of a State 1.3 Sovereignty: Meaning and Significance Government: Structure and Functions 1.4 Definition and Significance of Fundamental Rights Historical Evolution of Fundamental Rights 1.5 Constitutional Safeguards for Fundamental Rights 1.6 Limitations on Fundamental Rights for Public Interest.	

SW-2 Suggested Sessional Work (SW):

a. Assignments:
  i. How to acquire citizenship?
  ii. Constitutional remedies available for violation of fundamental rights.

20AU213.3:   **Recognize the role that the Directive Principles of State Policy play in providing a framework for government action; examine the complex interactions that shape the constitutional ethos between fundamental rights and directive principles; and recognize the role that fundamental duties play in promoting civic engagement and fortifying the basis of a just and inclusive society.**

Approximate Hours

Item	AppX Hrs
Cl	06
PI	00
SW	01
SL	01
Total	**08**

Session Outcomes (SOs)	Practical Instruction (PI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 Comprehend the significance of Directive Principles of State Policy in shaping government actions, enabling them to recognize their role as a	.	**Unit-3: Fundamental duties and directive principles of state policy.** **(9 Lectures)** 1.1 Definition and Purpose of Directive	

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framework for achieving a just and welfare state. **SO3.** Analyze the intricate interactions between fundamental rights and directive principles to appreciate how these constitutional elements work in tandem to establish a harmonious constitutional ethos that balances individual liberties with the welfare of society. **SO3.3** Recognize the importance of fundamental duties as a means of promoting civic engagement and social responsibility, strengthening the foundational principles of a just and inclusive society in the context of Indian democracy. **SO3.4** Develop the capacity to critically assess how the interplay between directive principles, fundamental rights, and fundamental duties influences government policies, legal decisions, and social outcomes in India, and how these factors collectively contribute to the nation's progress and well-being.		Principles, Categories of Directive Principles (e.g., social, economic, political) 1.2 Relationship between Directive Principles and Fundamental Rights Legal and Judicial Perspectives on the Interplay 1.3 Objectives and Significance of Fundamental Duties Correlation between Fundamental Duties and Rights 1.4 Enforcement Mechanisms and Legal Implications 1.5 Civic Education and Awareness of Fundamental Duties 1.6 Fundamental Duties as the Foundation of a Just Society Ensuring Inclusivity through the Fulfillment of Fundamental Duties	

SW-3 Suggested Sessional Work (SW):

a. Assignments:
  i. Directive Principles and Policy Implementation.
  ii. Balancing Fundamental Rights and Directive Principles

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20AU213.4: Understand the structure and functioning of the Union Executive, Legislature, and Judiciary, including the roles and powers of the President, Vice President, Council of Ministers, and the Supreme Court, and assess their significance in the Indian system of governance.

Approximate Hours

Item	App. Hrs
Cl	06
PI	00
SW	01
SL	01
Total	**10**

Session Outcomes (SOs)	Practical Instruction (PI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 Describe the roles, powers, and functions of the President and Vice President of India in the Union Executive. **SO4.2** Distinguish between the Lok Sabha and Rajya Sabha as the two houses of the Indian Parliament. **SO4.3** Explain the jurisdiction and powers of the Supreme Court of India in interpreting and upholding the Constitution. **SO4.4** Recognize how the Union Executive, Legislature, and Judiciary are interconnected and provide checks and balances on one another.	.	**Unit-4: Union executive, legislature and judiciary** **(8 Lectures)** 4.1 Constitutional, emergency and executive powers of the President Role of the Vice President in the Union Executive 4.2 Composition and Membership of Lok Sabha and Rajya Sabha 4.3 Composition and Membership of Legislative Powers of Lok Sabha Legislative Powers of Rajya Sabha 4.4 Representation of States in Rajya Sabha Original Jurisdiction of the Supreme Court 4.5 Appellate Jurisdiction of the Supreme Court.	

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SW-4 Suggested Sessional Work (SW):

a. Assignments:
i. The roles, powers, and functions of the President and Vice President of India in the Union Executive.
ii. Supreme Court of India in interpreting and upholding the Constitution.

20AU213.5: Analyze the structure and functioning of the State Executive, Legislature, and Judiciary, including the roles and functions of the Governor, State Legislature (Vidhan Sabha and Vidhan Parishad), and High Court, and assess their significance in the state-level governance and legal system.

Approximate Hours

Item	App. Hrs
Cl	09
PI	00
SW	02
SL	01
Total	**12**

Session Outcomes (SOs)	Practical Instruction (PI)	Classroom Instruction (CI)	Self-Learning (SL)
O5.1 Describe the role and powers of the Governor in the state executive and assess the relationship between the Governor and the Chief Minister. **SO5.2** Differentiate between the Vidhan Sabha and Vidhan Parishad as the two houses of the state legislature. **SO5.3** Examine the jurisdiction and functions of the High Court in the state judiciary, including its role as a guardian of the state's legal system. **SO5.4** Recognize how the State Executive, Legislature, and Judiciary in each state		**Unit 5: State Executive, Legislature and judiciary (9 Lectures)** 1.1 Constitutional Powers of the Governor Executive Functions of the Governor 1.2 Discretionary Powers vs. Constitutional Duties Composition and Membership of Vidhan Sabha 1.3 Power of Judicial Review in State Matters 1.4 Composition and Membership of Vidhan Parishad 1.5 Legislative Powers of Vidhan Sabha and Vidhan Parishad. Representation of Local Authorities in Vidhan Parishad 1.6 State Executive Oversight by the	**1.** High Court in the state judiciary.

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interact and provide checks and balances on one another.		Legislature	

SW-5 Suggested Sessional Work (SW):
a. Assignments:
i. Role and powers of the Governor in the state executive.
ii. Vidhan Sabha and Vidhan Parishad.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CL)	Sessional Assignment (SA)	Self Learning (SL)	Total hour (CL+SA+SL)
20AU213.1: Demonstrate a comprehensive understanding of the nature and characteristics of the Indian Constitution, including its historical background, key principles, evaluate the concepts of federalism and unitary form of government in the Indian context, assessing their advantages, disadvantages, and implications for governance and power distribution.	6	01	01	8
20AU213.2: Examine the provisions and significance of citizenship and fundamental rights in the Indian Constitution, and critically analyze their role in safeguarding individual liberties, promoting equality, and ensuring social justice.	6	01	01	8
20AU213.3: Recognize the role that the Directive Principles of State Policy play in providing a framework for government action; examine the complex interactions that shape the constitutional ethos between fundamental rights and directive principles; and recognise the role that fundamental duties play in promoting civic engagement and fortifying the basis of a just and inclusive society.	6	01	01	8

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20AU213.4: Understand the structure and functioning of the Union Executive, Legislature, and Judiciary, including the roles and powers of the President, Vice President, Council of Ministers, and the Supreme Court, and assess their significance in the Indian system of governance.	6	01	01	8
20AU213.5: Analyze the structure and functioning of the State Executive, Legislature, and Judiciary, including the roles and functions of the Governor, State Legislature (Vidhan Sabha and Vidhan Parishad), and High Court, and assess their significance in the state-level governance and legal system.	6	01	01	8
Total Hours	**30**	**05**	**05**	**40**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
20AU213-1	Demonstrate a comprehensive understanding of the nature and characteristics of the Indian Constitution, including its historical background, key principles, evaluate the concepts of federalism and unitary form of government in the Indian context, assessing their advantages, disadvantages, and implications for governance and power distribution.	03	04	03	10
20AU213-2	Examine the provisions and significance of citizenship and fundamental rights in the Indian Constitution, and critically analyze their role in safeguarding individual liberties, promoting equality, and ensuring social justice.	05	03	02	10
20AU213-3	Recognize the role that the Directive Principles of State Policy play in providing a framework for government action; examine the complex				

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	interactions that shape the constitutional ethos between fundamental rights and directive principles; and recognise the role that fundamental duties play in promoting civic engagement and fortifying the basis of a just and inclusive society.	05	03	02	10
20AU213-4	Understand the structure and functioning of the Union Executive, Legislature, and Judiciary, including the roles and powers of the President, Vice President, Council of Ministers, and the Supreme Court, and assess their significance in the Indian system of governance.	04	05	01	10
20AU213-5	Analyze the structure and functioning of the State Executive, Legislature, and Judiciary, including the roles and functions of the Governor, State Legislature (Vidhan Sabha and Vidhan Parishad), and High Court, and assess their significance in the state-level governance and legal system.	03	05	02	10
Total		20	17	13	50

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

The end of semester assessment will be held with written examination of 50 marks.

Suggested Instructional/ Implementation Strategies:
1. Improved Lecture.
2. Tutorial.
3. Case Method.
4. Group Discussion.
5. Moot court.
6. Visit to court.
7. Demonstration
8. Online sources.
9. Brainstorming.

Suggested Learning Resources:

A. Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Constitution of India	V.N. Shukla	Wdhawa and company.	Revised edition 21 edition 2020

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2	Constitutional law of India	J.N. Pandey	Central law agency	2022
3	Constitutional law of India	D.D. Basu	Central law agency	2020
4	Constitution of India	M.P. Jain	Wdhawa and company.	2018
5	Constitution of India (Vols. 3)	H.M. Seervai	Wdhawa and company.	2018
6	Constitutional law of India	Kailash Ra	Central law publication	2023
9	Lecture notes provided by Dept. of Law, AKS University, Satna.			

Curriculum Development Team

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CO, PO and PSO Mapping

Program: M.Tech(CSE)
Course Code: 20AU213
Course Title: Indian Constitution

Course Outcomes	Program Outcomes												Program Specific Outcomes				
	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 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	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 systems of various complexity	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 in multidisciplinary settings	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
20AU213.1	1	2	1	2	1	1	1	3	2	2	1	3	2	2	2	2	2
20AU213.2	1	1	2	2	1	1	1	3	2	2	1	3	2	2	2	1	2
20AU213.3	1	1	1	2	1	1	1	3	1	1	1	3	2	1	2	2	2
20AU213.4	1	2	1	2	1	2	1	3	1	1	1	3	2	2	1	2	2
20AU213.5	1	1	1	2	2	2	1	3	1	1	1	3	2	2	1	2	2

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	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: Demonstrate a comprehensive understanding of the nature and characteristics of the Indian Constitution, including its historical background, key principles, evaluate the concepts of federalism and unitary form of government in the Indian context, assessing their advantages, disadvantages, and implications for governance and power distribution	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	Unit-1.0 **Introduction of Constitution** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10	As Mentioned in Page no. above
PO: 1,2,3,4,5,6,7,8, 9,10,11,12 PSO:1,2,3,4	CO2: Examine the provisions and significance of citizenship and fundamental rights in the Indian Constitution, and critically analyze their role in safeguarding individual liberties, promoting equality, and ensuring social justice.	SO2.1 SO2.2 SO2.3	Unit-2 **Citizenship Fundamental Rights** 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 PSO: 1,2,3,4	CO3: Recognize the role that the Directive Principles of State Policy play in providing a framework for government action; examine the complex interactions that shape the constitutional ethos between fundamental rights and directive principles; and recognise the role that fundamental duties play in promoting civic engagement and fortifying the basis of a just and inclusive society.	SO3.1 SO3.2 SO3.3 SO3.4	Unit-3: **Fundamental duties and directive principles of state policy.** 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 PSO: 1,2,3,4	CO4: Understand the structure and functioning of the Union Executive, Legislature, and Judiciary, including the roles and powers of the President, Vice President, Council of Ministers, and the Supreme Court, and assess them significance in the Indian system of governance.	SO4.1 SO4.2 SO4.3 SO4.4	Unit-4: **Union executive, legislature and judiciary** 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 PSO: 1,2,3,4	CO 5: Analyze the structure and functioning of the State Executive, Legislature, and Judiciary, including the roles and functions of the Governor, State Legislature (Vidhan Sabha and Vidhan Parishad), and High Court, and assess their significance in the state-level governance and legal system.	SO5.1 SO5.2 SO5.3 SO5.4	Unit5: **State Executive, Legislature and judiciary** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,2.9	

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Semester-II

Course Code:	20CSE273
Course Title:	Mini Project with Seminar
Pre- requisite:	Student should have knowledge of programming languages, Software Engineering, and Many more tools and framework.

Rationale:	• To apply the knowledge and skills learnt in previous semesters, to solve real life industrial / engineering / professional problems.
	• To modify/ improve the existing engineering / professional systems.
	• To develop systems / components / methods / processes / resources to cater the needs of the nearby small scale / medium industry.
	• To learn to solve real life engineering / professional problems which often have many aspects to be considered and addressed.

Course Outcomes:
20CSE273.1: - The student will be able to prepare a detailed project plan for solving any real-life related engineering / technical / professional / industrial problem.
20CSE273.2: - The student will be able to implement the project plan and manage the project.
20CSE273.3: - The student will be able to present the completed project work.

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)	
PRC	20CSE273	Mini Project with Seminar	0	4	0	0	4	2

General Guidelines for Project/Dissertation Work
o The project topics should be related to concerned branch of engineering / profession, but should not be the exact content of the curriculum taughtin the discipline.
o Student's project topics should be preferably 'real life' topics. It means the project topics should have substantial element of uncertainty, complexity and multi-disciplinary-ness which can be coped up by the students. These elements offer opportunities to students to apply engineering/ professional knowledge in real life settings, solve real life problems and to take real life decisions. As a project guide, concerned teacher should ensure these by suitably altering / framing / reframing the statement of topic / title.
o The project topics should be such that students can get opportunity to refer IS codes, Manuals, Handbooks, norms and standards, opportunity to conduct standard tests, and

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opportunity to operate modern laboratory equipment's following SOPs.

o For student's interest, active participation and ownership in the project work, their self-motivation is necessary. Therefore, students should be actively involved in finalizing the topic of project.

o Students should be asked to conduct a brief review of literature for problems and issues in their engineering / professional areas of interest,where they think they can contribute effectively. The project guide should facilitate them in this regard, through his/her expertise and experience.

o Every student group should be asked to propose at least three topics oftheir interest. The topics proposed by student project groups should be assessed bythe facilitator-teacher on following three criteria: -

- **The work on the topic should be theoretically and practically feasible.**
- **The project work on the topic should be completed within approx. Three and half months.**
- **Availability of required resources should be certain. Cost of project work should also be bearable.**

o Normally, students' project works should be carried out in small groups and thesis by one only.

o All faculty members of department should be engaged as project guides. Every faculty member should be project guide of at least one student project group.

- Normally, project guides should be assigned to the students through lottery system and students under each faculty should be asked to formtheir small groups.

COs, POs and PSOs Mapping

Course Title: M.Tech CSE
Course Code: 20CSE273
Course Title: Dissertation-II

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	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 systems of various complexity	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 in multidisciplinary settings	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.
20CSE273 1: The student will be able to prepare a detailed project plan for solving any real-life related engineering / technical / professional / industrial problem.	2	3	3	2	3	2	3	1	3	1	3	3	2	3	3	1	2
20CSE273 2: The student will be able to implement the project plan and manage the project.	2	3	3	2	3	2	3	1	3	1	3	3	2	2	2	2	3
20CSE273 3: The student will be able to present the completed project work.	2	2	3	1	3	2	2	1	3	1	3	3	2	3	2	2	2

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	20CSE273 1: The student will be able to prepare a detailed project plan for solving any real-life related engineering / technical / professional / industrial problem.				As mentioned in page number above
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	20CSE273 2: The student will be able to implement the project plan and manage the project.				
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	20CSE273 3: The student will be able to present the completed project work.				

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SEMESTER-III

Course Code:	20CSE301-A
Course Title:	Mobile Applications and Services
Pre-requisite:	Student should have basic knowledge of Applications and Mobile Applications
Rationale	Screen, communication interfaces, and the user interface, context and profile

COURSE OUTCOMES

On completion of the course the student should

20CSE301-A 1 identify the target platform and users and be able to define and sketch a mobile application

20CSE301-A 2 understand the fundamentals, frameworks, and development lifecycle of mobile application platforms including iOS, Android, and Phone Gap

20CSE301-A 3 Design and develop a mobile application prototype in one of the platforms (challenge project)
20CSE301-A 4: The student will describe the putting it all together
20CSE301-A 5: The student will describe the platforms and additional issues

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	PI	SA	SL	Total Study Hours (CI+PI+SW+SL)	
PEC	20CSE301-A	Mobile Applications and Services	3	0	2	1	11	3

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

 PI: Practical Instruction **SA:** Sessional assignment. **SL:** Self Learning,
 C: Credits.

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

Scheme of Assessment: Theory

			Scheme of Assessment (Marks)		
			Progressive Assessment (PRA)	**End Semest**	**Tot al Ma rks**

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Board of Study	Course Code	Course Title	Class/ Home Assignment 15 marks (CA)	Class Test 1 10 marks (CT)	Presentation (P)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+P+CAT+AT)	er Assessment (ESA)	(PR A+ ES A)
PEC	20CSE301-A	Mobile Applications and Services	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) up on the course's conclusion.

20CSE301-A 1: **The student will know Introduction to Mobile Computing**

Approximate Hours

Item	AppX Hrs.
Cl	8
LI	0
SW	2
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Define Android OS **SO1.2** Factors in Developing android **SO1.3** Mobile Software Engineering **SO1.4** Frameworks	.	**Unit-1. Introduction: Introduction to Mobile Computing** 1.1. Introduction to Android 1.2. Factors in Developing Mobile Applications 1.3. Mobile Software Engineering 1.4. Frameworks and Tools 1.5. Generic UI Development	1. Properties of Android

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SO1.5 Generic UI Development		1.6. Android User 1.7 Development Environment. 1.8 Tools	

SW-1 Suggested Sessional Work (SW):
   a. Assignments:
   I.   Define what Android is and its significance in the mobile app development landscape.
   II.   Explain the history of Android OS and its evolution over the years.

   b. Mini Project:
   c. Other Activities:

20CSE301-A.2: the student will describe the More on UIs

Approximate Hours

Item	AppX Hrs
Cl	07
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 Uis **SO2.2** To learn Mobile Apps **SO2.3** Designing the Right UI. **SO2.4** To Replication of Mobile Data **SO2.5** To understand Content Provider	.	Unit-2 More on Uis 2.1 VUIs and Mobile Apps 2.2 Text-to-Speech Techniques. 2.3 Storing and Retrieving Data. Synchronization and Replication of Mobile Data 2.4 Storing and Retrieving Data 2.5 Working with a Content Provider 2.6 Designing the Right UI. 2.7 Multichannel and Multimodal Uis.	1. Properties of VUI

   SW-2   Suggested Sessional Work (SW):

   a.   Assignments:
         I.   Discuss the benefits and challenges of integrating VUIs into mobile apps.
         II.   Explore use cases and examples of successful VUI implementations in mobile apps.
   b. Mini Project:
   c. Other Activities.

20CSE301-A 3: The student will describe the Communications via Network and the Web

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Approximate Hours

Item	AppX Hrs
Cl	09
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
O3.1 To Understand Communications via Network **SO3.2** To learn Android Networking **SO3.3** Notifications and Alarms **SO3.4** Android Graphics	.	Unit-3 Communications via Network and the Web 3.1 Communications via Network and the Web: Correct Communications Model 3.2 Android Networking and Web, Telephony 3.3 Notifications and Alarms: Performance, Performance and Memory Management 3.4 Android Notifications 3.5 Alarms, Graphics 3.6 Graphics and UI Performance. 3.7 Android Graphics 3.8 Deciding Scope of an App 3.9 State Machine.	1. Communications media

SW-1 Suggested Sessional Work (SW):

a. **Assignments:**
   I. Explain the concepts of network communication and state machines in the context of Android app development.
   II. Describe the correct communication models and protocols used for networking in Android applications.
b. Mini Project:

20CSE301-A 4: the student will describe the Putting It All Together

Approximate Hours

Item	AppX Hrs.
Cl	9
LI	0
SW	2
SL	1
Total	12

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 To Understand Packaging and Deploying **SO4.2** To learn Mobility **SO4.3** Android Multimedia . **SO4.4** Mobile Agents	.	Unit-4 Putting It All Together 4.1 Packaging and Deploying, 4.2 Android Field Service App 4.3 Location Mobility 4.4 Android Multimedia 4.5 Mobile Agents 4.6 Peer-to-Peer Architecture 4.7 Android Multimedia 4.8 Location Based Services 4.9 Performance Best Practices	1. Familiarize yourself with the basic concepts of Packaging

SW-1 Suggested Sessional Work (SW):

a. **Assignments:**
   I. Explain the process of packaging an Android application for deployment.
   II. Discuss best practices for app signing, versioning, and preparing an app for release on the Google Play Store.
b. Mini Project:

20CSE301-A .5: The student will describe the Platforms and Additional Issues

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)
O5.1 To Understand Development Process **SO5.2** To learn Mobile App Development Hurdles **SO5.3** Aim to know Testing . **SO5.4** Hacking Android	.	Unit-5 Platforms and Additional Issues 5.1 Development Process, 5.2 Technology Selection. 5.3 Testing 5.4 Security and Hacking 5.5 Active Transactions. 5.6 Hacking Android 5.7 Architecture Design 5.8 App Development Hurdles	1. Software development process

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		5.9 More on Security 5.10 Mobile security 5.11 protocols for IOT nodes 5.12 Mobile computing techniques in IOT agents-based communications in IOT	

SW-1 Suggested Sessional Work (SW)

a. **Assignments**
    I.   Describe the typical development process for Android applications.
    II.   Explain the stages involved, from ideation and design to deployment and maintenance.
b. Mini Project
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)
20CSE301-A 1 identify the target platform and users and be able to define and sketch a mobile application	8	2	1	11
20CSE301-A 2 understand the fundamentals, frameworks, and development lifecycle of mobile application platforms including iOS, Android, and Phone Gap	7	2	1	10
20CSE301-A 3 Design and develop a mobile application prototype in one of the platforms (challenge project)	9	2	1	12
20CSE301-A 4: The student will describe the putting it all together	9	2	1	12
20CSE301-A 5: The student will describe the platforms and additional issues	12	2	1	15
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	
20CSE301-A 1	Understanding abstract specification of android and their implementation	02	01	01	04
20CSE301-A 2	Understanding of Uis	02	04	02	08
20CSE301-A 3	Knowledge of basic Packaging	03	05	04	12
20CSE301-A 4	Understand the Platforms	02	08	05	15
20CSE301-A 5	Understand the Communication protocols for IOT	03	05	03	11

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Total	12	23	15	50

References:

1.   Online Courses:
•   Udacity - Android Developer Nanodegree
•   Coursera - iOS App Development with Swift
•   edX - Introduction to Mobile Application Development using Android
•   LinkedIn Learning - Building a Mobile App with React Native Books:
•   "The Complete Guide to Android App Development" by Nick Congleton
•   "iOS 14 Programming for Beginners" by Ahmad Sahar
•   "React Native in Action" by Nader Dabit
•   "Flutter in Action" by Eric Windmill
.   Wei-Meng Lee, Beginning Android™ 4 Application Development, 2012 by John Wiley & Sons

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COs, POs and PSOs Mapping

Program: M. Tech. Computer Science & Engineering
Course Code: 20CSE301-A
Course Title: Mobile Applications and Services

Course Outcomes	Program Outcomes												Program Specific Outcome				
	PO 1 Engineering knowledge	PO 2 Problem analysis	PO 3 Design/development of solutions	PO 4 Conduct studies of difficult problems	PO 5 Utilization of modern tools	PO 6 Engineers and	PO 7 Environment and sustainability	PO 8 Ethics	PO 9 Individual and team work	PO 10 Communication	PO 11 Project management and	PO 12 Life-longlearning	PSO 1 — 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 systems of various complexity	PSO 2 — 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 in multidisciplinary settings	PSO 3 — 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.	PSO 4 — Learn and use the most recent Artificial Intelligence and Data Science technologies in the fields of engineering and computer science	PS0 5 — Recognize and examine issues in real life, then offer creative software solutions with the help of AI and Data Science Technologies.
CO 1: Understanding abstract specification of data-structures and their implementation	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1	2
CO 2 : Understanding time and space complexity of programs and data-structures	1	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1	3
CO3. Knowledge of basic data-structures, their applications and relative merits	2	2	1	1	1	2	2	2	1	2	1	2	1	1	2	2	2
CO 4: Ability to convert an algorithmic solution to a program using suitable data-structures and analyze the trade-offs involved in terms of time and space complexity	3	2	2	2	3	2	3	2	2	1	2	3	3	3	3	2	2
CO 5: Acquire basic knowledge on hashing	-	-	-	1	1	3	3	3	1	1	2	2	3	3	1	3	3

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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	• Identify the target platform and users and be able to define and sketch a mobile application	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5 SO1.6 SO1.7 SO1.8		**Unit-I** **Introduction to Mobile Computing** 1.1,1.2,1.3, 1.4,1.5,1.6,1.7,1.8	As mentioned in page number _ above
PO:1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	• Understand the fundamentals, frameworks, and development lifecycle of mobile application platforms including iOS, Android, and PhoneGap	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5 SO2.6 SO2.7		**Unit-2** More on Uis 2.1, 2.2, 2.3, 2.4, 2.5,2.6	
PO:1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	• Design and develop a mobile application prototype in one of the platform (challenge project)	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5 SO3.6 SO3.7		**Unit-3** Communications via Network and the Web 3.1,3.2,3.3,3.4,3.5	

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		SO3.8 SO3.9		
PO:1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	• Users and be able to define and sketch a mobile application	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5 SO4.6 SO4.7 SO4.8 SO4.9		**Unit-4:** Putting It All Together 4.1,4.2,4.3,4.4
PO:1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	• Understand the fundamentals, frameworks, and development iOS, Android	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5 SO5.6 SO5.7 SO5.8 SO5.9 SO5.10		**Unit 5-** Platforms and Additional Issues 5.1,5.2,5.3,5.4,5.5,5.6,5. 7,5.8,5.9,5.10

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SEMESTER-III

Course Code:	**20CSE301-B**
Course Title:	**Cryptography And Network Security**
Pre-requisite:	**Computer Networking**

Rationale: 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) up on the course's conclusion.

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Course Outcome:

20CSE301-B 1**.** To understand basics of Cryptography and Network Security.

20CSE301-B 2. To be able to secure a message over insecure channel by various means.

20CSE301-B 3. To learn about how to maintain the Confidentiality, Integrity and Availability of a data

20CSE301-B 4. To understand various protocols for network security to protect against the threats in the networks.

Scheme of Studies:

Board of Study	Course Code	Course Title	Cl	LI	SW	SL	Scheme of studies(Hours/Week) Total Study Hours(CI+LI+SW +SL)	Total Credits(C)
PEC	20CSE301-B	**CRYPTOGRAPHY AND NETWORK SECURITY**	3	0	2	1	6	3

Scheme of Studies:

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,

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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)							End Semester Assessment	(PRA+ ESA)
			Progressive Assessment (PRA)								
			Assignment 5 number 3 marks each (CA)	(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+C AT+AT)			
PEC	20CSE301-B	**CRYPTOGRAPHY AND NETWORK 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) up on the course's conclusion.

20CSE301-B 1: To understand basics of Cryptography and Network Security.

Approximate Hours

Item	AppX Hrs
CI	7
LI	0
SW	2
SL	1
Total	10

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Define Cryptography **SO1.2 Explain** Key Management and Key Distribution **SO1.3 Explain** Security Attacks **SO1.4** Discuss Conventional Encryption, Classical encryption techniques **SO1.5 Explain** substitution ciphers and transposition ciphers, steganography.	.	**Unit-1. Introduction-** 1.1 Security Attacks, Security Services, Security Mechanisms and Principles, Malicious software, Worms, Viruses, Trojans, Spyware, Botnets, Security Vulnerabilities 1.2 Basic of Cryptography: A model for network Security, Symmetric ciphers (Difference between symmetric and asymmetric), 1.3 Monoalphabetic ciphers (Ceaser cipher, Affine cipher, Additive cipher) Polyalphabetic cipher (Playfair cipher, Vigenere cipher) hash functions Functional Units. 1.4 Authentication and key establishment Conventional Encryption, 1.5 Message Authentication Codes (MACs), digital signatures, PKI substitution ciphers 1.6 Block Ciphers (Fiestal Ciphers), 1.7 Numerical of Fiestal Ciphers, Data Encryption standards.	1. Draw Key distribution diagram

SW-1Suggested Sessional Work(SW):

a. **Assignments:**

    (i) **Discuss about different types of Security Attacks, Security Services.**

b. **Presentation**

20CSE301-B 2: To be able to secure a message over insecure channel by various means

Approximate Hours

Item	AppX Hrs
CI	9
LI	0
SW	2
SL	1
Total	12

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

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SO2.1 To Understand the stream and block ciphers **SO2.2**To learn Modern Block Ciphers **SO2.3**To understands Shannon's theory of confusion and diffusion. **SO2.4** apply Data Encryption Standard (DES) **SO2.**5 apply AES	.	Unit-2 **Block Ciphers** **2.1 Data encryption standards 64 bits, Advanced encryption standards** **2.2** Diffie Hellman Key Exchange Algorithm **2.3 Euclid Algorithm, Extended Euclid Algorithm** **2.4** RSA Algorithm. Message Authentication and Hash Functions **2.5** Hash Algorithm-SHA, **2.6** MD5. Digital Signature Algorithm and Authentication, **2.7** Authentication Applications **2.8** KDC . **2.9** Kerberos	1. Solve problems.

SW-2 **Suggested Seasonal Work (SW):**

a. **Assignments:**
   (i) **Draw the diagram of RSA algorithm**
b. **Presentation**
c. Pictorial representation of different steps of RSA and SHA Algorithm

20CSE301-B 3: To learn about how to maintain the Confidentiality, Integrity and Availability of a data.

Approximate Hours

Item	AppXHrs
CI	7
LI	0
SW	2
SL	1
Total	10

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1 To understand Intrusion Detection System. SO3.2 Apply Wireless Network Security SO3.3 Will learn Wireless Application Protocol SO3.4 know about Wireless Transport Layer Security, SO3.5 Apply End-to-End Security		3.1 Intruders, Intrusion Detection System 3.2 Anomaly and misuse detection 3.3 Wireless Network Security, 3.4 IEEE 802.11i Wireless LAN Security, 3.5 Wireless Application Protocol Overview 3.6 Wireless Transport Layer Security 3.7 WAP End-to-End Security.	i. Draw the steps of deffie hellman algorithm

SW-2   Suggested Seasonal Work (SW):

a. **Assignments:**
b. **WAP End-to-End Security Presentation**

20CSE301-B 4: To understand various protocols for network security to protect against the threats in the networks

Approximate Hours

Item	AppX Hrs
Cl	12
LI	0
SW	2
SL	1
Total	14

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO4.1 Explain MD5 message-digest algorithm **SO4.2 To u**nderstand Digital Signatures Certificate **SO4.3 Explain** Digital signature standards (DSS), **SO4.4 Apply** electronic mail security **SO4.**5 Explain Authentication protocols	.	**Unit-4: Integrity Checks and Authentication Algorithms**: 4.1 MD5 message-digest algorithm 4.2 Secure hash algorithm (SHA 4.3 Digital Signatures 4.4 Digital Signatures Certificate, 4.5 Authentication protocols 4.6 Digital signature standards (DSS), 4.7 Authentication Applications 4.8 Kerberos, X.509, 4.9 Directory authentication service 4.10 Electronic mail security 4.11 Secondary, pretty good privacy (PGP) 4.12 S/MIME.	i. Preparation of authentication application

SW-4Suggested Sessional Work (SW):

a. **Assignments:**
   (i) Explain Kerberos
   (ii) Discuss Authentication protocols
b. **Presentation**

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Brief of Hours suggested for the Course Outcome

Course Outcomes	ClassL lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour(Cl+SW+Sl)
20CSE301-B 1: The Student will understand basics of Cryptography and Network Security.	7	2	1	10
20CSE301-B 2: The Student will be able to understand secure a message over insecure channel by various means.	9	2	1	12
20CSE301-B 3: The Student will learn about how to maintain the Confidentiality, Integrity and Availability of a data.	07	2	1	10
20CSE301-B 4: The Student will understand various protocols for network security to protect against the threats in the networks	12	2	1	15
Total Hours	35	8	4	47

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	R	U	A	Total Marks
20CSE301-B 1	To understand basics of Cryptography and Network Security.	05	04	03	12
20CSE301-B 2	To be able to secure a message over insecure channel by various means	05	03	04	12
20CSE301-B 3	To learn about how to maintain the Confidentiality, Integrity and Availability of a data.	05	04	04	13
20CSE301-B 4	To understand various protocols for network security to protect against the threats in the networks.	05	04	04	13
Total		20	15	15	50

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

The end of semester assessment 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:

a. Improved Lecture
b. Tutorial
c. Case Method
d. Group Discussion
e. Role Play
f. Visit to cement plant
g. Demonstration
h. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, WhatsApp, Mobile, Online sources)
i. Brainstorming

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition &Year
1	"Cryptography and Network security Principles and Practices",	William Stallings	Pearson/PHI.	0
2	"Modern Cryptography –Theory and Practice",	W. Mao	Pearson Education.	2007
3	"Introduction to Cryptography with coding theory",	Wade Trappe, Lawrence C Washington,	Pearson.	2010

Curriculum Development Team

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COs, POs and PSOs Mapping

Program: M.Tech(CSE)
Course Code : 20CSE301-B
Course Title: Cryptography And Network Security

Course Outcomes	PO 1 Engineering knowledge	PO 2 Problem analysis	PO 3 Design/development of solutions	PO 4 Conduct studies of difficult problems	PO 5 Utilization of modern tools	PO 6 Engineers and society	PO 7 Environment and sustainability	PO 8 Ethics	PO 9 Individual and team work	PO 10 Communication	PO 11 Project management and finance	PO 12 Life-longlearning	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
20CSE301-B 1 To understand basics of Cryptography and Network Security.	2	3	3	2	1	2	1		1	1	1	2	2	3	1	2	2
20CSE301-B 2 To be able to secure a message over insecure channel by various means	2	2	3	3	1	2	1	1	1	1	3	2	2	2	2	2	
20CSE301-B 3 To learn about how to maintain the Confidentiality, Integrity and Availability of a data.	2	3	3	2	1	1	1		1	1	1	3	1	1	2	2	2
20CSE301-B 4 To understand various protocols for network security to protect against the threats in the networks.	2	2	3	3	1	2	1		1	1	1	3	2	3	1	2	2

PSO 1: 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 systems of various complexity

PSO 2: 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 in multidisciplinary settings

PSO 3: 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.

PSO 4: Learn and use the most recent Artificial Intelligence and Data Science technologies in the fields of engineering and computer science

PS0 5: Recognize and examine issues in real life, then offer creative software solutions with the help of AI and Data Science Technologies.

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map

POs & PSOs No.	COs No.& Titles	SOs No.	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	20CSE301-B 1 To understand basics of Cryptography and Network Security.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	Unit-1 Understand the basics of Cryptography and Network Security.1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11	As mentioned in page number above
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	20CSE301-B 2 To be able to secure a message over insecure channel by various means.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	Unit-2 To be able to secure a message over insecure channel by various means. 2.1, 2.2, 2.3, 2.4, 2.5, 2.6	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	20CSE301-B 3 To learn about how to maintain the Confidentiality, Integrity and Availability of a data.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	Unit-3 : To learn about how to maintain the Confidentiality, Integrity and Availability of a data. 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 PSO 1,2, 3, 4, 5	20CSE301-B 4 To understand various protocols for network security to protect against the threats in the networks.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	Unit-4: To understand various protocols for network security to protect against the threats in the networks.4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	

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Semester-III

Course Code:	20OE302-A
Course Title:	Optimization Techniques
Pre-requisite	Student should have basic knowledge of Linear Algebra and Numerical Methods
Rationale:	The objective of this course is to provide insight to the mathematical formulation of real-world problems. To optimize these mathematical problems using nature-based algorithms and the solution is useful specially for NP-Hard problems

Course Outcomes:

After completion of course, students would be able to:

20OE302-A 1: Formulate optimization problems.

20OE302-A 2: Understand and apply the concept of Optimization Algorithms.

20OE302-A 3: Understand and apply the concept of optimality criteria for various types of optimization problems.

20OE302-A 4: Apply the methods of optimization in real life situation.

20OE302-A 5: Solve various constrained and unconstrained problems in Single variable as well as multivariable.

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)	
OEC	20OE302-A	Optimization Techniques	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.

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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	Couse Code	Course Title	Scheme of Assessment (Marks)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Progressive Assessment (PRA)							
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activityany one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
OEC	20OE302-A	Optimization Techniques	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 show case the in mastery of Session Outcomes (SOs), culminating in the o ver all achievement of Course Outcomes (COs) outercourse's conclusion.

20OE302-A 1: Formulate optimization problems.

Approximate Hours

Item	Appx. Hrs.
Cl	6
LI	0
SW	2
SL	1
Total	9

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Understanding Engineering application of Optimization **SO1.2** Explain Formulation of design problems		**Unit-1. Optimization (06-Lectures)** **1.1** Engineering application of Optimization(i) **1.2** Engineering application of Optimization(ii) **1.3** Engineering application of Optimization(iii) **1.4** Formulation of design problems as mathematical programming problems(i). **1.5** Formulation of design problems as mathematical programming problems(ii). **1.6** Formulation of design problems as mathematical programming problems(iii).	1. Formulation of design problems as mathematical programming problems.

SW-1: Suggested Sessional Work (SW):

    a. Assignments:
       i.   Formulation of design problems as mathematical programming problems.
       ii.   Engineering application of Optimization
    b. Mini Project: None
    c. Other Activities (Specify): Seminar

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20OE302-A 2: Understand and apply the concept of Optimization Algorithms.

Approximate Hours

Item	Appx. Hrs.
Cl	6
LI	0
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 Define General Structure of Optimization Algorithms. **SO2.2** Discuss Constraints. . **SO2.3** To learn about The Feasible Region.		**Unit-2** : **Optimization Algorithms**: **(06-Lectures)** **2.1** General Structure of Optimization Algorithms **2.2** Definition of Optimization Algorithms **2.3** Constraints of Optimization Algorithms **2.4** Example of Optimization Algorithms **2.5** The Feasible Region(i). **2.6** The Feasible Region(ii)	1. General Structure of Optimization Algorithms.

SW-2 Suggested Seasonal Work (SW):

    a. Assignments:
      i. General Structure of Optimization Algorithms.
      ii. The Feasible Region.

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20OE302-A 3:- Understand and apply the concept of optimality criteria for various types of optimization problems.

Approximate Hours

Item	Appx. Hrs.
Cl	17
LI	0
SW	2
SL	1
Total	20

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 To Understand Mathematical Programming **SO3.2** To learn Graphical Optimization **SO3.3** Explain Linear Programming. **SO3.4** To Understand Semi Definite Programming.		**Unit-3: Mathematical Programming: (17-Lectures)** **3.1** Branches of Mathematical Programming: Optimization using calculus(i) **3.2** Branches of Mathematical Programming: Optimization using calculus(ii) **3.3** Graphical Optimization, **3.4** Example of Graphical Optimization(i) **3.5** Example of Graphical Optimization(ii) **3.6** Linear Programming, **3.7** Example of Linear Programming(i) **3.8** Example of Linear Programming(ii) **3.9** Quadratic Programming, **3.10** Example of Quadratic Programming (i). **3.11** Example of Quadratic Programming(ii). **3.12** Integer Programming **3.13** Example of Integer Programming(i)	1. Branches of Mathematical Programming: Optimization using calculus,

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| | | **3.14** Example of Integer Programming(ii)
3.15 Semi Definite Programming.
3.16 Example of Semi Definite Programming(i).
3.17 Example of Semi Definite Programming(i). | |

SW-3 Suggested Sessional Work (SW):
 a. **Assignments:**
- i.   Branches of Mathematical Programming, Graphical Optimization.
- ii. Linear Programming and Quadratic Programming,
- iii. Integer Programming and Semi Definite Programming.

20OE302-A 4: Apply the methods of optimization in real life situation.
.

Approximate Hours

Item	Appx. Hrs.
Cl	5
LI	0
SW	2
SL	1
Total	8

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 To Understand Optimization algorithms. **SO4.2** To learn genetic Optimization.		**Unit-4: Optimization Algorithms : (05-Lectures)** **4.1** Optimization Algorithms like Genetic Optimization **4.2** Particle Swarm Optimization, **4.3** Example of Particle Swarm Optimization **4.4** Ant Colony Optimization(i)	1. To Learn Optimization algorithms
		4.5 Ant Colony Optimization(ii)	

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SW-4 Suggested Sessional Work (SW):

a. Assignments:
  i.   Optimization algorithms like genetic optimizations.

20OE302-A 5: Solve various constrained and unconstrained problems in Single variable as
<div align="right">well</div>

as multivariable.

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)
SO5.1 To understand Real life Problem in mathematics **SO5.2** To learn about Recent trends. **SO5.3** To understand programming in real world applications		**Unit 5 programming problems** **(11-Lectures)** **5.I** Real life Problems(i) **5.2** Real life Problems (ii) **5.3** mathematical formulation as standard programming problems (i). **5.4** mathematical formulation as standard programming problems (ii). **5.5** Recent trends: Applications of ant colony optimization, **5.6** genetics programming in real world applications(i) **5.7** genetics programming in real world applications(ii) **5.8** linear programming in real world applications(i). **5.9** linear programming in real world applications(ii). **5.10** Quadratic programming in real world applications (i).	1. Programming in real world applications.
		5.11 Quadratic programming in real world applications (ii).	

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SW-5 Suggested Sessional Work (SW):

    a. Assignments:

        i.   genetics and linear and quadratic programming in real world applications.

        ii.   Applications of ant colony optimization.

        iii.   Real life Problems and their mathematical formulation as standard programming problems.

Brief of Hours suggested for the Course Outcome

Course Out comes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
20OE302-A.1:-Formulate optimization problems.	06	02	01	09
20OE302-A.2:- Understand and apply the concept of Optimization Algorithms.	06	02	01	09
20OE302-A.3: Understand and apply the concept of optimality criteria for various types of Optimization problems.	17	02	01	20
20OE302-A.4:- Apply the methods of optimization in real life situation.	05	02	01	08
20OE302-A.5:-Solve various constrained and unconstrained problems in Single variable as well as multivariable.	11	02	01	14
Total Hours	45	10	05	60

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
20OE302-A-1	Optimization	03	02	03	08
20OE302-A-2	Optimization Algorithms	03	01	05	09
20OE302-A-3	Mathematical Programming	03	07	02	12
20OE302-A-4	Optimization algorithms	03	05	05	13

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20OE302-A-5	Programming problems	03	02	03	08
	Total	15	17	18	50

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

The end of semester assessment 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 software industry
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	Applied Integer Programming: Modeling and Solution.	Der-San Chen; Robert G. Batson; Yu Dang	John Wiley and Sons,	2010
2	Introduction to Operations Research,	F.S. Hillier and G.J. Lieberman	Tata McGraw Hill, Singapore	9th Ed 2009

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7. Ms. Pinki Sharma, Assistant Professor, Department of Computer Science and Engineering.
8. Ms. Pushpa Kushwaha, Assistant Professor, Department of Computer Science and Engineering.

CO, PO and PSO Mapping

Program: M.Tech(CSE)

Course Code: 20OE302-A

Course Title: Optimization Techniques

Course Outcomes	Program Outcomes												Program Specific Outcomes				
	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 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	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 systems of various complexity	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 in multidisciplinary settings	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	
20OE302-A 1	2	2	3	3	2	1	1	1	1	1	1	3	2	2	3	2	3
20OE302-A 2	2	3	2	3	2	2	1	1	1	1	1	3	2	3	2	3	3
20OE302-A 3	2	2	2	3	2	2	1	1	1	1	1	3	2	2	2	2	3
20OE302-A 4	2	2	3	2	2	2	1	1	1	1	1	3	2	2	3	2	2
20OE302-A 5	2	2	3	2	2	2	1	1	1	1	1	3	2	2	3	2	2

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	20OE302-A 1: :-Formulate optimization	SO1.1 SO1.2		Unit-1 Optimization 1.1,1.2,1.3,1.4,1.5,1.6	As mentioned above
PO 1,2,3,4,5,6,7,8,9,10,11,12 PSO 1,2, 3, 4, 5	20OE302-A2: Understand and apply the concept of Optimization	SO2.1 SO2.2 SO2.3		Unit-2 Optimization Algorithms 2.1, 2.2, 2.3, 2.4, 2.5, 2.6	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	20OE302-A3: Understand and concept of optimality criteria for various types of optimization problems.	SO3.1 SO3.2 SO3.3 SO3.4		Unit-3: Mathematical Programming 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	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	20OE302-A4: Apply the methods of optimization in real life situation.	SO4.1 SO4.2		Unit-4: Optimization algorithms 4.1, 4.2,4.3,4.4,4.5	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	20OE302-A5: Solve various unconstrained problems in Single variable as well as multivariable.	SO5.1 SO5.2 SO5.3		Unit-5: Programming problems 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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Semester-III

Course Code: 20OE302-B

Course Title: Operation Research

Pre-requisite: Theory of Computation and Networking

Rationale: The students should get familiar with the core theory of mathematical modeling for computer science future needs and challenges. To get familiar with key concepts of computational modelling, standards, technologies and their basic operations. To learn how to design and analyze various model implementation.

Course Outcomes:

After completion of the course, students would be able to:

20OE302-B1. Remember the foundational concepts of optimization processes and modeling of tools.
20OE302-B2. Understand the principles of duality theorem and simplex methods.
20OE302-B3. Apply their knowledge for solving non-linear programming problems.
20OE302-B4. Analyze and evaluate the deterministic models for sequencing and scheduling problems.
20OE302-B5.Create and develop competitive models single and multi-channel 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)	
OEC	20OE302-B	Operation Research	3	0	1	1	5	3

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.

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Scheme of Assessment:

Theory

Board of Study	Couse Code	Course Title	Scheme of Assessment (Marks)						End Semester Assessment	Total Marks
			Progressive Assessment (PRA)							
			Class/HomeAssignment5 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)
OEC	20OE302-B	Operation Research	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.

20OE302-B 1: Remember the foundational concepts of optimization processes and modeling of tools.

Approximate Hours

Item	Appx. Hrs.
Cl	9
LI	0
SW	1
SL	1
Total	11

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Understanding the basics of optimization techniques **SO1.2** Understanding Simplex Techniques. **SO1.3** Understanding Sensitivity Analysis. .	.	**Unit-1.0 Optimization Techniques** 1.1 Introduction 1.2 Model Formulation 1.3 Various Models 1.4 Logistic Regression 1.5 Linear Programming 1.6 General L.R Formulation 1.7 Simplex Techniques 1.8 Sensitivity Analysis 1.9 Inventory Control Models	Learning optimization modeling.

SW-1 Suggested Sessional Work (SW):

a. **Assignments**:
   1. Logistic Regression
   2. Linear Programming
b. **Mini Project:**
   1. Simplex Techniques

20OE302-B 2: Understand the principles of duality theorem and simplex methods.

Approximate Hours

Item	Appx. Hrs.
Cl	9
LI	0
SW	1
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
O2.1 Understanding the basics of Linear Programming Problem Formulation. **SO2.2** Understanding Revised Simplex Method. **SO2.3** Understanding Parametric Programming.	.	**Unit-2.0 Formulation of a LPP** 2.1 Introduction 2.2 Linear Programing Problem 2.3 Graphical Solution 2.4 Revised Simplex Method 2.5 Duality Theory 2.6 Dual Simplex	Learning Linear Programming Problems.

		Method	
		2.7 Sensitivity Analysis	
		2.8 Parametric Programming	
		2.9 Multiparametric Programming	

SW-2 Suggested Sessional Work (SW):

  a. Assignments:
  1. Duality Theory
  2. Sensitivity Analysis
  b. Mini Project:
  1. Parametric Programming

20OE302-B 3: Apply their knowledge for solving non-linear programming problems.

Approximate Hours

Item	Appx. Hrs.
Cl	9
LI	0
SW	1
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 Understanding the basics of Non-Linear Programming Problem. **SO3.2** Understanding Max-Flow Min-Cut Problem. **SO3.3** Understanding CPM/PERT Algorithm.	.	**Unit-3: Nonlinear programming problem** 3.1. Introduction 3.2. Nonlinear programming 3.3. Kuhn-Tucker Conditions 3.4. Network Flow 3.5. Max-Flow Min-Cut Problem 3.6. Max-Flow Min-Cut Graph 3.7. Dual Problem of Max Flow 3.8. CPM Algorithm 3.9. PERT Algorithm	Learning Nonlinear programming problems.

SW-3 Suggested Sessional Work (SW):
a. Assignments:
  1. CPM Algorithm
  2. PERT Algorithm

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b. **Mini Project:**
   1. Max-Flow Min-Cut Problem

20OE302-B 4: Analyze and evaluate the deterministic models for sequencing and scheduling problems.

Approximate Hours

Item	AppXHrs
Cl	9
LI	0
SW	1
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 Understanding the basics of Scheduling and Sequencing Techniques. **SO4.2** Understanding Single Server Model. **SO4.3** Understanding Geometric Programming.		**Unit-4: Scheduling and Sequencing** 4.1 Introduction 4.2 Server Model Optimization 4.3 Single Server Model 4.4 Multiple Server Model 4.5 Inventory Control Models 4.6 Deterministic Inventory Models 4.7 Probabilistic Inventory Control Models 4.8 Convex Optimization 4.9 Geometric Programming.	Learning Scheduling and Sequencing Techniques.

SW-4Suggested Sessional Work (SW):

a. **Assignments**:
   1. Deterministic Inventory Control Models
   2. Probabilistic Inventory Control Models

b. **Mini Project:**
   1. Geometric Programming

20OE302-B 5: Create and develop competitive models single and multi-channel problems.

Approximate Hours

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

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Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1 Understanding the basics of Single Channel Problems. **SO5.2** Understanding Elementary Graph Theory. **SO5.3** Understanding Game Theory Simulation.		**Unit-5: Competitive Models** 5.1 Introduction, 5.2 Single Channel Problems, 5.3 Multi-Channel Problems, 5.4 Sequencing Models, 5.5 Dynamic Programming, 5.6 Flow in Networks, 5.7 Discrete Structures 5.8 Elementary Graph Theory, 5.9 Game Theory Simulation	Learning Competitive Models for Optimization.

SW-5 Suggested Sessional Work (SW):

a. **Assignments**:
    1. Elementary Graph Theory
    2. Game Theory Simulation
b. **Mini Project:**
    1. Single Channel Problems

Brief of Hours Suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour(Cl+SW+Sl)
20OE302-B 1. Remember the foundational concepts of optimization processes and modeling of tools.	11	1	1	13
20OE302-B 2. Understand the principles of duality theorem and simplex methods.	12	1	1	14
20OE302-B 3. Apply their knowledge for solving non-linear programming problems.	11	1	1	13
20OE302-B 4. Analyze and evaluate the deterministic models for sequencing and scheduling problems.	6	1	1	8
20OE302-B 5. Create and develop competitive models single and multi-channel problems.	5	1	1	7
Total Hours	**45**	**5**	**5**	**55**

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Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	**U**	**A**	
20OE302-B -1	Optimization Techniques	03	01	01	05
20OE302-B -2	Formulation of a LPP	02	06	02	10
20OE302-B -3	Nonlinear programming problem	03	07	05	15
20OE302-B -4	Scheduling and sequencing	-	10	05	15
20OE302-B -5	Competitive Models	01	02	02	05
	Total	11	26	13	50

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

The end of semester assessment for Operation Research 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 IT industry
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	Operations Research	S.R. Yadav A.K. Malik	Oxford University Press	2014
2	Operations Research	Bronson	TMH Publication	2015
3	Lecture notes provided by Dept. of Computer Science and Engineering, AKS University, Satna.			

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Curriculum Development Team

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7. Ms. Pinki Sharma, Assistant Professor, Department of Computer Science and Engineering.
8. Ms. Pushpa Kushwaha, Assistant Professor, Department of Computer Science and Engineering.

CO, PO and PSO Mapping

Program: M.Tech. (CSE)
Course Code: 20OE302-B
Course Title: Operation Research

Course Outcomes	Program Outcomes												Program Specific Outcomes				
	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 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	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 systems of various complexity	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 in multidisciplinary settings	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	
20OE302-B 1	2	2	3	3	2	1	1	1	1	1	1	3	2	2	3	2	3
20OE302-B 2	2	3	2	3	2	2	1	1	1	1	1	3	2	3	2	3	3
20OE302-B 3	2	2	2	3	2	2	1	1	1	1	1	3	2	2	2	2	3
20OE302-B 4	2	2	3	2	2	2	1	1	1	1	1	3	2	2	3	2	2
20OE302-B 5	2	2	3	2	2	2	1	1	1	1	1	3	2	2	3	2	2

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. Remember the foundational concepts of optimization processes and modeling of tools.	SO1.1 SO1.2		Unit-1 Optimization 1.1,1.2,1.3,1.4,1.5,1.6	As mentioned above
PO 1,2,3,4,5,6,7,8,9,10,11,12 PSO 1,2, 3, 4, 5	20OE302-B 2. Understand the principles of duality theorem and simplex methods.	SO2.1 SO2.2 SO2.3		Unit-2 Optimization Algorithms 2.1, 2.2, 2.3, 2.4, 2.5, 2.6	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	20OE302-B 3. Apply their knowledge for solving non-linear programming problems.	SO3.1 SO3.2 SO3.3 SO3.4		Unit-3: Mathematical Programming 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	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	20OE302-B 4. Analyze and evaluate the deterministic models for sequencing and scheduling problems.	SO4.1 SO4.2		Unit-4: Optimization algorithms 4.1, 4.2,4.3,4.4,4.5	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	20OE302-B 5.Create and develop competitive models single and multi-channel problems.	SO5.1 SO5.2 SO5.3		Unit-5: Programming problems 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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Semester-III

Course Code:	20CSE371
Course Title:	Dissertation-I /Industrial Project
Pre- requisite:	Student should have knowledge of programming languages, Software Engineering, and Many more tools and framework.

Rationale:
- To apply the knowledge and skills learnt in previous semesters, to solve real life industrial / engineering / professional problems.
- To modify/ improve the existing engineering / professional systems.
- To develop systems / components / methods / processes / resources to cater the needs of the nearby small scale / medium industry.
- To learn to solve real life engineering / professional problems which often have many aspects to be considered and addressed.

Course Outcomes:

20CSE371.1: - The student will be able to prepare a detailed project plan for solving any real-life related engineering / technical / professional / industrial problem.
20CSE371.2: - The student will be able to implement the project plan and manage the project.
20CSE371.3: - The student will be able to present the completed project work.

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)	
PRC	20CSE371	Dissertation-I /Industrial Project	0	6	0	0	6	3

General Guidelines for Project/Dissertation Work
- o The project topics should be related to concerned branch of engineering / profession, but should not be the exact content of the curriculum taughtin the discipline.
- o Student's project topics should be preferably 'real life' topics. It means the project topics should have substantial element of uncertainty, complexity and multi-disciplinary-ness which can be coped up by the students. These elements offer opportunities to students to apply engineering/ professional knowledge in real life settings, solve real life problems and to take real life decisions. As a project guide, concerned teacher should ensure these by suitably altering / framing / reframing the statement of topic / title.
- o The project topics should be such that students can get opportunity to refer IS codes, Manuals, Handbooks, norms and standards, opportunity to conduct standard tests, and

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opportunity to operate modern laboratory equipment's following SOPs.

o For student's interest, active participation and ownership in the project work, their self-motivation is necessary. Therefore, students should be actively involved in finalizing the topic of project.

o Students should be asked to conduct a brief review of literature for problems and issues in their engineering / professional areas of interest,where they think they can contribute effectively. The project guide should facilitate them in this regard, through his/her expertise and experience.

o Every student group should be asked to propose at least three topics oftheir interest. The topics proposed by student project groups should be assessed bythe facilitator-teacher on following three criteria: -

- **The work on the topic should be theoretically and practically feasible.**
- **The project work on the topic should be completed within approx. Three and half months.**
- **Availability of required resources should be certain. Cost of project work should also be bearable.**

o Normally, students' project works should be carried out in small groups and thesis by one only.

o All faculty members of department should be engaged as project guides. Every faculty member should be project guide of at least one student project group.

- Normally, project guides should be assigned to the students through lottery system and students under each faculty should be asked to formtheir small groups.

COs, POs and PSOs Mapping

Course Title: M.Tech CSE
Course Code: 20CSE371
Course Title: Dissertation-I /Industrial Project

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	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 systems of various complexity	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 in multidisciplinary settings	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.
20CSE371 1: The student will be able to prepare a detailed project plan for solving any real-life related engineering / technical / professional / industrial problem.	2	3	3	2	3	2	3	1	3	1	3	3	2	3	3	1	2
20CSE371 2: The student will be able to implement the project plan and manage the project.	2	3	3	2	3	2	3	1	3	1	3	3	2	2	2	2	3
20CSE371 3: The student will be able to present the completed project work.	2	2	3	1	3	2	2	1	3	1	3	3	2	3	2	2	2

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	20CSE371 1: The student will be able to prepare a detailed project plan for solving any real-life related engineering / technical / professional / industrial problem.				
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	20CSE371 2: The student will be able to implement the project plan and manage the project.				As mentioned in page number above
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	20CSE371 3: The student will be able to present the completed project work.				

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Semester-IV

Course Code:	20CSE471
Course Title:	Dissertation-II
Pre- requisite:	Student should have knowledge of programming languages, Software Engineering, and Many more tools and framework.

Rationale:
- To apply the knowledge and skills learnt in previous semesters, to solve real life industrial / engineering / professional problems.
- To modify/ improve the existing engineering / professional systems.
- To develop systems / components / methods / processes / resources to cater the needs of the nearby small scale / medium industry.
- To learn to solve real life engineering / professional problems which often have many aspects to be considered and addressed.

Course Outcomes:
20CSE471.1: - The student will be able to prepare a detailed project plan for solving any real-life related engineering / technical / professional / industrial problem.
20CSE471.2: - The student will be able to implement the project plan and manage the project.
20CSE471.3: - The student will be able to present the completed project work.

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)	
PRC	20CSE471	Dissertation-II	0	32	0	0	32	16

General Guidelines for Project/Dissertation Work
- The project topics should be related to concerned branch of engineering / profession, but should not be the exact content of the curriculum taughtin the discipline.
- Student's project topics should be preferably 'real life' topics. It means the project topics should have substantial element of uncertainty, complexity and multi-disciplinary-ness which can be coped up by the students. These elements offer opportunities to students to apply engineering/ professional knowledge in real life settings, solve real life problems and to take real life decisions. As a project guide, concerned teacher should ensure these by suitably altering / framing / reframing the statement of topic / title.
- The project topics should be such that students can get opportunity to refer IS codes, Manuals, Handbooks, norms and standards, opportunity to conduct standard tests, and

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opportunity to operate modern laboratory equipment's following SOPs.

o For student's interest, active participation and ownership in the project work, their self-motivation is necessary. Therefore, students should be actively involved in finalizing the topic of project.

o Students should be asked to conduct a brief review of literature for problems and issues in their engineering / professional areas of interest,where they think they can contribute effectively. The project guide should facilitate them in this regard, through his/her expertise and experience.

o Every student group should be asked to propose at least three topics oftheir interest. The topics proposed by student project groups should be assessed bythe facilitator-teacher on following three criteria: -

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- **Availability of required resources should be certain. Cost of project work should also be bearable.**

o Normally, students' project works should be carried out in small groups and thesis by one only.

o All faculty members of department should be engaged as project guides. Every faculty member should be project guide of at least one student project group.

- Normally, project guides should be assigned to the students through lottery system and students under each faculty should be asked to formtheir small groups.

COs, POs and PSOs Mapping

Course Title: M.Tech CSE
Course Code: 20CSE471
Course Title: Dissertation-II

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	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 systems of various complexity	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 in multidisciplinary settings	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.
20CSE471 1: The student will be able to prepare a detailed project plan for solving any real-life related engineering / technical / professional / industrial problem.	2	3	3	2	3	2	3	1	3	1	3	3	2	3	3	1	2
20CSE471 2: The student will be able to implement the project plan and manage the project.	2	3	3	2	3	2	3	1	3	1	3	3	2	2	2	2	3
20CSE471 3: The student will be able to present the completed project work.	2	2	3	1	3	2	2	1	3	1	3	3	2	3	2	2	2

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	20CSE471 1: The student will be able to prepare a detailed project plan for solving any real-life related engineering / technical / professional / industrial problem.				
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	20CSE471 2: The student will be able to implement the project plan and manage the project.				As mentioned in page number above
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	20CSE471 3: The student will be able to present the completed project work.				