Curriculum Book

and

Assessment and Evaluation Scheme

Based on

Outcome Based Education (OBE)

and

Choice – Based Credit System (CBCS)

in

Bachelor of Technology

Mining Engineering

4 Years Degree Program

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

AKS University

Satna - 485001, Madhya Pradesh, India

Department of Mining Engineering,

Faculty of Engineering and Technology

Department of Mining Engineering,
Faculty of Engineering and Technology,

AKS University, Satna, M.P.

Curriculum of B.Tech. Mining Engineering
(Revised as on 01st August 2025)

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Vice-chancellor

Professor B.A. Chopade
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Forwarding

I am thrilled to observe the updated curriculum of the Mining Engineering Department for B.Tech. Mining Engineering 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 ofNEP-2020and the Sustainable Development Goals.

The alignment of course outcomes (COs), Programme Outcome (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 B. Tech. in Mining Engineering program for implementation in the upcoming session.

Er. Anant Soni
Pro-Chancellor & Chairman
AKS University, Satna
01August2023

Department of Mining Engineering,
Faculty of Engineering and Technology,
AKS University, Satna, M.P.
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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, with the aim of enhancing 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 the guidelines out lined in the National Education Policy (NEP) of 2020, and sustainable goals. Collaboration with academia and industry experts. This curriculum design should be informed by the latest technological advancements, market demands.
I'm delighted to learn that the revised curriculum has been meticulously crafted by the Mining Department, in consultation with an array of experts from the mining 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 mining engineering.
The curriculum goes beyond theoretical learning and embraces practical applications by incorporating the utilization of industrial and domestic waste in cement production. To enhance students' skills, the curriculum integrates Hands-On Training, industrial visits, and On-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 cement and Mining industry.
I am confident that the updated curriculum for Mining 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 Mining engineering department has diligently adhered to the guidelines provided by the AICTE. Additionally, they have maintained a total credit requirement of 190 for the B. Tech. Mining 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 experts and 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.

Professor B. A. Chopade
Vice-Chancellor
AKS University, Satna
01st August2023

Department of Mining Engineering,
Faculty of Engineering and Technology,
AKS University, Satna, M.P.
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Preface

AKS University, Satna, has been imparting B.Tech. in Mining Engineering since 2012. With over 20 qualified and experienced faculty members the department of Mining Engineering draws inspiration from Vice Chancellor of AKSU, Prof. B. A. Chopade. The Department also enjoys full support from the management and Pro Chancellor Er. Anant K. Soni and Prof. G.K. Pradhan, Dean, Faculty of Engineering & Technology.

As part of our commitment to ongoing enhancement, the Department of Mining Engineering consistently reviews and updates its B.Tech. Mining Engineering program curriculum every three year. 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 B.Tech. Mining Engineering 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. In order 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-Job Training, have been incorporated. Furthermore, in alignment with AICTE's directives, the total credit allocation for the B. Tech. Mining Engineering program is capped at 190 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: 36 credits, Humanities and Social Sciences: 14 credits, Core Program Courses: 79 credits, Elective Program Courses: 13 credits, Open Electives: 9 credits, Project, Seminar and Practical Training: 11 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 being 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 independent thinking, skills, and overall employability of the students.

We are pleased to present the revised and updated edition of the approved Syllabus of the B.Tech. (Mining Engineering). This will be implemented wef 2023-24 batch. Since 2012, we have constantly updated the syllabus.

Attempts have been made to incorporate the new Syllabus circulated by DGMS (*) which extends exemption Certificate of Second Class Mine Managers' Certificate of Competency to B.Tech. Mining students after having one year experience and other necessary certificates (like Gas Testing to work in UG mines, First Aid, Experience & Medical certificate).

We acknowledge the efforts of our colleagues. Our thanks are due to the approving authorities of the University and for their guidance.

(*) Ref: The Gazette of India Part II, Section-3 sub-section (i) No. 672 dated 14 Sept 2018 under Regulation 12(1) & 12(4) of CMR 2017 & relevant Notification as under MMR 1961.

Professor B. K. Mishra
Associate Professor and HOD
AKS University
01st August2023

INTRODUCTION

AKS University proudly stands as a pioneer for preparing the Mining Engineers to serve the Industry with their Best academic knowledge and great field training during the vacation period while studying. Mining engineering in B. Tech. in Mining engineering started in 2012.

This innovative curriculum has been meticulously crafted to align with the dynamic needs of the present Mining industry and the most current technological advancements. Currently about 200 students are actively engaged in pursuing their B. Tech in Mining Engineering in this department. We have very good laboratories that serve as hubs for immersive hands-on training, enabling students to delve into practical applications of their learning. Every year during summer vacation we are sending our students to mine to have vocational training. To have better experience on field we have planned to send students in different type of mines such as open cast Mines, Underground Coal Mines and Underground Metal Mines. We prepare our students that after completion of their course they can accept any challenge. We also provide first aid training followed by first aid certificates to our students which is the integral part of Mining Engineering.

VISION

To provide best quality education in Mining Engineering at par with National Level Institutions through pertaining need based theoretical and practical learning with specific focus on world acclaimed mining technologies, sustainability framework for mining industry and advancing research orientation.

MISSION

M01: Accomplish academic excellence in Mining Engineering through an innovative teaching-learning process.

M 02: Carry out research and create human resource for developing and adopting appropriate technology towards sustainable development of mineral resources.

M 03: Designing and continual review of the mining engineering programme curriculum in commensuration with the articulated needs of the mining industry, academic institutions and research organizations.

M 04: More focus on individual assignments and project works based on analysis of the learning ability of the students to make all the students employable.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO -01: Develop technical and managerial skills among the students with practical knowledge to work in Mining Industry and be able to handle day to day problems in the mining units.

PEO-02: Develop short term planning abilities at production district/mine unit level in alignment with the broader perspective of the mining industry

PEO-03: Inculcate in students a mindset for adopting modern state of the art technologies and to implement them into practice.

POE 04: Develop ethical principles among the students and commitment to fulfilling international, national and local needs and social responsibilities with his/her professional excellence.

PEO 05: Ability to understand the impact of professional engineering solutions in societal, economic and environmental contexts and demonstrate knowledge and need for sustainable development

PROGRAM OUTCOME (PO)

The program outcomes are of generic nature that describe what the graduates of any engineering program should perform.

PO1: **Engineering Knowledge**- Apply the knowledge based on mathematics, science and fundamental and specific engineering courses to the solution of engineering problems.

PO2: Problem Analysis- Develop analytical skill to identify and solve engineering problems. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions- Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO-4: Conduct investigations of complex problems- Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-5: **Modern tool usage**- Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO-6: The engineer and society- Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO-7: Environment and sustainability- Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-8: **Ethics-** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO-9: Individual and team work- Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10: Communication- Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12: Life-long learning- Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOME (PSO)

PSOs are statements that describe what the graduates of a specific educational program should be able to do on completion of the program.

PSO 1- Develop analytical skills in identifying and accordingly take actions for solution of mining problems.

PSO 2- Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.

PSO 3- Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.

PSO 4- Development of the base for innovation & research in the field of mining engineering.

Consistency/Mapping of PEOs with Mission of the Department

PEO	M1	M2	M3	M4
PEO1	2	2	3	3
PEO2	3	2	2	2
PEO3	2	3	2	1
PEO4	3	2	3	3
PEO5	2	2	1	3

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

GENERAL COURSE STRUCTURE & THEME

1. Definition of Credit

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

2. Range of Credits

In the light of the fact that a typical Model Four-year Under Graduate degree program in Engineering has about 160 credits, the total number of credits proposed for the four-year. B.Tech. in Mining Engineering is kept as190 considering NEP-2020 and NAAC guidelines.

3. Structure of UG Program in Mining Engineering

The structure of UG program in Mining Engineering shall have essentially the following categories of courses with the breakup of credits as given:

Components of the Curriculum
(Program curriculum grouping based on course components)

Sl. No	Course Component	% of total number of credits of the Program	Total number of Credits
1	Basic Sciences (BSC)	12.63	24
2	Engineering Sciences (ESC)	18.95	36
3	Humanities and Social Sciences (HMSC)	7.37	14
4	Program Core (PCC)	41.58	79
5	Program Electives (PEC)	6.84	13
6	Open Electives (OEC)	4.74	09
7	Project (s)(PRC)/On job industries Training (OJT), Seminar (PSC)	5.79	11
8	Indian Knowledge System	1.05	02
9	Sustainable Development Goal	1.05	02
	Total	100.0	190

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General Course Structure and Credit Distribution

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Semester -I		**Semester-II**	
Course Title	Credit	Course Title	Credit
1.Chemistry -1	3:0:2 = 4	1.Physics-1	3:1:2 = 5
2.Engineering Mathematics-1	3:1:0 = 4	2.Engineering Mathematics-II	3:1:0 = 4
3. Programming for Problem Solving	3:0:4 = 5	3. Basic Mining Engineering	3:0:0 = 3
4.Manufacturing Practice Workshop	1:0:4 = 3	4.Biology for Engineers	3:0:0 = 3
5. Communication Skills (English)	3:0:0 = 3	5.Basic Electrical Engineering	2:1:2 = 4
6. Sports and Yoga	2:0:0 = 0	6.Engineering Graphics & Design	1:0:4 = 3
7. Sustainable Development Goals	2:0:0 =2	7. Indian Knowledge System	2:0:0 = 2
		8. Design Thinking & Idea-lab	0:0:2 = 1
Total Credit	**21**	**Total Credit**	**25**
Semester-III		**Semester-IV**	
Course Title	Credit	Course Title	Credit
1.Mining Geology-I	3:1:2 =5	1. Mining Geology-II	3:1:2 =5
2.Engineering Mathematics-III	3:1:0 =4	2. Professional Elective-I	3:1:2 =5
3.Environment Science (Audit)	2:0:0=0	3.Advanced Under Ground Coal Mining	3:1:0 = 4
4. Universal Human Values	2:1:0=3	4.Surface Mining	3:1:2 =5
5.Mine Development Drilling & Blasting	3:1:0 =4	5. Basic Electronics Engineering	3:1:2 =5
6.Under Ground Coal Mining	3:1:2 =5	6.Strength of Materials	3:1:2 =5
7. Engineering Mechanics	3:1:2=5		
Total Credit	**26**	**Total Credit**	**29**
Semester-V		**Semester-VI**	
Course Title	Credit	Course Title	Credit
1.Mining Machinery-I	3:1:2 =5	1. Professional Elective-III	3:0:0 =3
2.Mine Ventilation Environment - I	3:1:2 =5	2. Mine Ventilation Environment-II	3:1:2 = 5

3.Fluid Mechanics	3:1:2 =5	3. Advanced Rock Mechanics & Ground Control	3:0:2 =4
4.Rock Mechanics & Strata Control	3:1:2 =5	4.Mining Machinery-II	3:0:2 =4
5.Semester Break Training Seminar	0:0:2 = 1	5. Coal & Non-coal Mineral Processing	3:0:2 =4
6. Professional Elective-II	3:1:2 = 5	6. Mini Project Work on innovative &Sustainable Mining	0:0:2 = 1
7.Open Elective-I	3:0:0 = 3	7.Underground Metalliferous Mining	3:0:2 =4
Total Credit	**29**	**Total Credit**	**25**
Semester-VII		**Semester-VIII**	
Course Title	Credit	Course Title	Credit
1.Mine Planning & Design & Mineral Economics	3:0:2 =4	1. Mine Management General Safety & Mine Legislation	3:1:0 =4
2.Quantitative Decision Making	3:1:0 =4	2. Computer Application in Mining	3:1:0 =4
3.Mining Machinery-III	3:0:2 =4	3. Research Project	0:0:12 =6
4.OpenElective-II	3:0:0 =3	4. Seminar & Viva	0:0:2 =1
5. Open Elective-III	3:0:0 =3		
6.Mini Research Project	0:0:2 =1		
7.Mine Practical Training during Semester	0:0:2 =1		
Total Credit	**20**	**Total Credit**	**15**

i. **Humanities & Social Sciences & Mgt. Electives (HSM):** Any 2 courses from the list of those offered.

ii. **Open Electives (OEL)**: Any 3 courses (from any department), based on individual interest and project.

iii. **Industry internship**: Internship in industry, start-up or R&D lab in 2nd/3rd year summer is compulsory (audit). Longer internship for 2-monthy (6 credits) can be taken in VIIIth semester, in lieu of Engineering Project. The internship must be properly evaluated.

Course code and definition:

L	=	Lecture
T	=	Tutorial
P	=	Practical
C	=	Credit
BSC	=	Basic Science Courses
ESC	=	Engineering Science Courses
HSMC	=	Humanities and Social Sciences including Management courses
PCC	=	Professional core courses
PEC	=	Professional Elective courses
OEC	=	Open Elective courses
LC	=	Laboratory course
MC	=	Mandatory courses
IKS	**=**	Indian Knowledge System
SDGs	**=**	Sustainable Development Goals

Course level coding scheme:

Three-digit number (odd numbers are for the odd semester courses and even numbers are for even semester courses) used as suffix with the Course Code for identifying the level of the course. Digit at hundred’s place signifies the year in which course is offered. e.g.

101, 102 … etc. for first year.

201,202….etc. for second year.

301, 302… for third year.

401.402---for fourth year

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Category-wise Courses

HUMANITIES & SOCIAL SCIENCES COURSES [HS] & MANAGEMENT COURSES (2compulsory+2others)

(i) Number of Humanities & Social Science Courses:4, Credits:14

Sl.	Code No.	Subject	Semester	Credits
1	HSMC01	Communication Skills/English (Compulsory	1	2:0:2=3
2	HSMC301	Universal Human Values-2(Compulsory course)	3	2:1:0=3
3	HSMC03	Industrial Psychology	5 / 6	3:0:0=3
4	BSC401	Quantitative Decision Making	5 / 7	3:1:0=4
5	MIN403	Mine Management General Safety	5 / 8	3:1:0=4
6	HSMC06	Finance & Accounting	5 / 6	3:0:0=3
Total Credits				**14**

BASIC SCIENCE COURSE [BSC] (TOTAL7)

Sl.	Code No.	Subject	Semester	Credits
1	BSC101/BSC101-L	Physics-1(Electromagnetism)	2	3:1:2=5
2	BSC102	Mathematics-1(Calculus & Linear Algebra)	1	3:1:0=4
3	BSC103/BSC103-L	Chemistry-1	1	3:0:2=4
4	BSC104	Mathematics-2 (ODE, Complex variables)	2	3:1:0=4
5	BSC201	Mathematics-III	3	3:1:0=4
6	BSC105	Biology for Engineers	2	3:0:0=3
7	BSC106-AU	Environment Science (Audit)	3	2:0:0=0
Total Credits				**24**

ENGINEERING SCIENCE COURSE [ESC] (Total 8)

Sl.	Code No.	Subject	Semester	Credits
1	ESC101/ESC101-L	Basic Electrical Engineering	2	2:1:2=4
2	ESC102/ESC102-L	Engineering Graphics & Design	2	1:0:4=3
3	ESC103-L	Design Thinking+ Idea Lab	2	0:0:2=1
4	ESC104/ESC104-L	Programming for Problem Solving	1	3:0:4=5
5	ESC105/ESC105-L	Manufacturing Practice Workshop	1	1:0:4=3
6	ESC202/ESC202-L	Engineering Mechanics	3	3:1:2=5

7	ESC204/ESC204-L	Strength of Material	4	3:1:2=5
8	ESC303/ESC303-L	Fluid Mechanics	5	3:1:2=5
9	ESC201/ ESC201-L	Basic Electronics Engineering	4	3:1:2=5
Total Credits				**36**

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PROFESSIONAL CORE COURSES [PCC] (Total 18)

Sl.	Code No.	Subject	Semester	Credits
1	MIN101	Basic Mining Engineering	2	3:0:0 =3
2	MIN201/MIN201L	Mining Geology-I	3	3:1:2 =5
3	MIN202	Mine Development Drilling & Blasting	3	3:1:0=4
4	MIN203/MIN203-L	Under Ground Coal Mining	3	3:1:2=5
5	MIN204/MIN204-L	Mining Geology-II	4	3:1:2 =5
6	MIN205	Advanced Under Ground Coal Mining	4	3:1:0=4
7	MIN206/MIN206-L	Surface Mining	4	3:1:2 =5
8	MIN301/MIN301-L	Mining Machinery-I	5	3:1:2=5
9	MIN302/MIN302-L	Mine Ventilation Environment-I	5	3:1:2=5
10	MIN303/MIN303-L	Rock Mechanics & Strata Control	5	3:1:2=5
11	MIN304/MIN304-L	Underground Metalliferous Mining	6	3:0:2=4
12	MIN305/MIN305L	Mine Ventilation Environment-II	6	3:1:2=5
13	MIN306/MIN306-L	Advanced Rock Mechanics & Ground Control	6	3:0:2=4
14	MIN307/MIN307-L	Mining Machinery-II	6	3:0:2=4
15	MIN308/MIN308-L	Coal and Non coal mineral processing	6	3:0:2=4
16	MIN401/MIN401-L	Mine Planning & Design & Mineral Economics	7	3:0:2=4
17	MIN402/MIN402-L	Mining Machinery-III	7	3:0:2=4
18	MIN404	Computer Application in Mining	8	3:1:0=4
Total Credits				**79**

PROFESSIONAL ELECTIVE[PEC]

Total 3to be taken, at least one from each group Technology and Industry Sector, based on Project topic and individual interest. Illustrative courses are listed here.

Sl.	Code No.	Subj	Seme	Credits
TECHNOLOGY GROUP				
1	PEC-MIN01/ PEC-MIN01-L	Mine Surveying	4	3:1:2 =5
2	PEC-MIN02/ PEC-MIN02-L	Rock Fragmentation & Reliability Engineering	4	3:1:2 =5
3	PEC-MIN03	Innovative & Sustainable Mining	6	3:0:0=3

INDUSTRY SECTOR GROUP				
1	PEC-MIN04	Bulk Material Handling	6	3:0:0=3
2	PEC-MIN05/ PEC-MIN05-L	Mine Electrical Engineering	5	3:1:2 =5
3	PEC-MIN06/ PEC-MIN06-L	Remote Sensing & GIS	5	3:1:2 =5
Total Credit				**13**

OPENELECTIVE
(Total 3 from the Open elective subjects)

Sl.	Code No.	Subject	Semester	Credits
1	OEC-MIN01	Introduction to Mining Engineering	5	3:0:0=3
2	OEC-MIN02	Eco Friendly Mining	5	3:0:0=3
3	OEC-MIN03	EIA & EMP of Mining Industry	7	3:0:0=3
4	OEC-MIN04	Disaster Management	7	3:0:0=3
5	OEC-MIN05	Mineral Resources of India	7	3:0:0=3
6	OEC-MIN06	Remote Sensing &Geo-Spatial Technology	7	3:0:0=3
Total Credit				**9**

RESEARCH PROJECT (3Stages)

Sl.	Code No.	Subject	Semester	Credits
1	PROJ-MIN01	Industrial internship/ semester break training	5	0:0:2=1
2	PROJ-MIN02	Mini Project on Innovative & sustainable mining	6	0:0:2=1
3	PROJ-MIN03	Mini Research Project	7	0:0:2=1
4	PROJ-MIN04	Mine Practical Training	7	0:0:2=1
5	PROJ-MIN05	Research Project	8	0:0:12=6
6	PROJ-MIN06	Seminar and Viva	8	0:0:2=1
Total Credit				**11**

OTHER COURSES

Sl.	Code No.	Subject	Semester	Credits
1	HSMC08	Sustainable Development Goals	1	2:0:0=2
2	HSMC07	Indian Knowledge System	2	2:0:0=2
3	HSMC09	Sports and Yoga	1	2:0:0 = 0
Total Credit				**04**

Induction Program

Induction program for students to be offered right at the start of the first year. It is mandatory. AKS University has designed aninductionprogramfor1st yearstudent, details are below:

i. Physical activity
ii. Creative arts
iii. Universal Human Values
iv. Literary
v. Proficiency Modules
vi. Lectures by Eminent People
vii. Visits to local areas
viii. Familiarization to Dept./Branch &Innovations

Mandatory Visits/Workshop/Expert Lectures:

i. It is mandatory to arrange one industrial visit every semester for the students.
ii. It is mandatory to conduct a One-week workshop during the winter break after fifth semester on professional/industry/entrepreneurial orientation.
iii. It is mandatory to organize at least one expert lecture per semester for each branch by inviting resource persons from industry.

Evaluation Scheme:

1. For Theory Courses:

i. The weightage of Internal assessment is 50%and
ii. End Semester Exam is50%

The student has to obtain at least 40% marks individually both in internal assessment and end semester exams to pass.

2. For Practical Courses:

i. The weightage of Internal assessment is 50%and
ii. End Semester Exam is50%

The student has to obtain at least 40% marks individually both in internal assessment and end semester exams to pass.

3. For Summer Internship/Projects/Seminar etc.

Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.

4. Mapping of Marks to Grades

Each course (Theory/Practical) is to be assigned 100 marks, irrespective of the number of credits, and the mapping of marks to grades may be done as per the following table:

Range of Marks	Assigned Grade
91-100	AA/A^+
81-90	AB/A
71-80	BB/B^+
61-70	BC/B
51-60	CC/C^+
46-50	CD/C
40-45	DD/D
<40	FF/F(Fail due to less marks)
-	F^R(Fail due to shortage of attendance and therefore, to repeat the course)

Semester wise Course Structure

Semester wise Brief of total Credits and Teaching Hours

Semester	L	T	P	Total Hour	Total Credit
Semester-I	17	01	10	28	21
Semester-II	17	03	10	30	25
Semester-III	19	06	06	31	26
Semester-IV	18	06	10	34	29
Semester-V	18	05	12	35	29
Semester-VI	18	01	12	31	25
Semester-VII	15	01	08	24	20
Semester-VIII	06	02	14	22	15
Total	128	25	83	235	190

Details of Semester Wise Course Structure

Semester–I

SN	Category	Code	Course Title	L	T	P	Total Hour	Credit
1	BSC	BSC103/ BSC103-L	Chemistry -1	3	0	2	5	4
2	BSC	BSC102	Mathematics-1	3	1	0	4	4
3	ESC	ESC104/ ESC104-L	Programming for Problem Solving	3	0	4	7	5
4	ESC	ESC105/ ESC105-L	Manufacturing Practice Workshop	1	0	4	5	3
5	HSMC	HSMC01	Communication Skills (English)	3	0	0	3	3
6	HSMC	HSMC09	Sports and Yoga	2	0	0	2	0
7	HSMC	HSMC08	Sustainable Development Goals	2	0	0	2	2
Total				17	01	10	28	21

Semester–II

SN	Category	Code	Course Title	L	T	P	Total Hour	Credit
1	BSC	BSC101/ BSC101-L	Physics-1	3	1	2	6	5
2	BSC	BSC104	Mathematics-II	3	1	0	4	4
3	PCC	MIN101	Basic Mining Engineering	3	0	0	3	3
4	BSC	BSC105	Biology for Engineers	3	0	0	3	3
5	ESC	ESC101/ ESC101-L	Basic Electrical Engineering	2	1	2	5	4
6	ESC	ESC102/ ESC102-L	Engineering Graphics & Design	1	0	4	5	3
7	HSMC	HSMC07	Indian Knowledge System	2	0	0	2	2
8	ESC	ESC103-L	Design Thinking & Idea-lab	0	0	2	2	1
Total				17	3	10	30	25

Semester–III

SN	Category	Code	Course Title	L	T	P	Total Hour	Credit
1	PCC	MIN201/ MIN201-L	Mining Geology-I	3	1	2	6	5
2	BSC	BSC201	Mathematics-III	3	1	0	4	4
3	BSC	BSC106-AU	Environment Science (Audit)	2	0	0	2	0
4	PCC	MIN202	Mine Development & Drilling Blasting	3	1	0	4	4
5	PCC	MIN203/ MIN203-L	Under Ground Coal Mining	3	1	2	6	5
6	ESC	ESC202/ ESC202-L	Engineering Mechanics	3	1	2	6	5
7	HSMC	HSMC-301	Universal Human Values	2	1	0	3	3
Total				19	6	6	31	26

Semester–IV

SN	Category	Code	Course Title	L	T	P	Total Hour	Credit
1	PCC	MIN204/ MIN204-L	Mining Geology-II	3	1	2	6	5
2	PE-I	PEC-MIN01/ PEC-MIN01-L	Mine Surveying	3	1	2	6	5
		PEC-MIN02/ PEC-MIN02-L	Rock Fragmentation & Reliability Engineering					
3	PCC	MIN205	Advanced Under Ground Coal Mining	3	1	0	4	4
4	PCC	MIN206/ MIN206-L	Surface Mining	3	1	2	6	5
5	ESC	ESC201/ ESC201-L	Basic Electronics Engineering	3	1	2	6	5
6	ESC	ESC204/ ESC204-L	Strength of Material	3	1	2	6	5
Total				18	6	10	34	29

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Semester–V

SN	Category	Code	Course Title	L	T	P	Total Hour	Credit
1	PCC	MIN301/ MIN301-L	Mining Machinery-I	3	1	2	6	5
2	PCC	MIN302/ MIN302-L	Mine Ventilation Environment-I	3	1	2	6	5
3	ESC	ESC303/ESC303-L	Fluid Mechanics	3	1	2	6	5
4	PCC	MIN304/ MIN304-L	Rock Mechanics & Strata Control	3	1	2	6	5
5	PE-II	PEC-MIN05/ PEC-MIN05-L	Mine Electrical Engineering	3	1	2	6	5
		PEC-MIN06/ PEC-MIN06-L	Remote Sensing & GIS					
6	SEM	PROJ-MIN01	Semester Break Training Seminar	0	0	2	2	1
7	OEC-I	OEC-MIN01	Introduction to Mining Engineering	3	0	0	3	3
		OEC-MIN02	Eco-friendly Mining					
Total				18	5	12	35	29

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Semester–VI

SN	Category	Code	Course Title	L	T	P	Total Hour	Credit
1	PE-III	PEC-MIN04	Bulk Material Handling	3	0	0	3	3
		PEC-MIN03	Innovative and Sustainable Mining					
2	PCC	MIN305/ MIN305-L	Mine Ventilation Environment-II	3	1	2	6	5
3	PCC	MIN306/ MIN306-L	Advanced Rock Mechanics & Ground Control	3	0	2	5	4
4	PCC	MIN307/ MIN307-L	Mining Machinery-II	3	0	2	5	4
5	PCC	MIN304/ MIN304 -L	Underground Metalliferous Mining	3	0	2	5	4
6	PCC	MIN308/ MIN308 -L	Coal & Non-coal Mineral Processing	3	0	2	5	4
7	PROJ	PROJ-MIN02	Mini Project Work on Innovative and Sustainable mining	0	0	2	2	1
Total				18	1	12	31	25

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Semester VII

SN	Category	Code	Course Title	L	T	P	Total Hour	Credit
1	PCC	MIN401/ MIN401-L	Mine Planning & Design & Mineral Economics	3	0	2	5	4
2	BSC	BSC401	Quantitative Decision Making	3	1	0	4	4
	PCC	MIN402/ MIN402-L	Mining Machinery-III	3	0	2	5	4
3	OEC-II	OEC-MIN03	EIA & EMP of Mining Industry	3	0	0	3	3
		OEC-MIN04	Disaster Management					
	OEC-III	OEC-MIN05	Mineral Resources of India	3	0	0	3	3
4		OEC-MIN06	Remote Sensing &Geo-Spatial Technology					
5	PROJ	PROJ-MIN03	Mini Research Project	0	0	2	2	1
6	PROJ	PROJ-MIN04	Mine Practical Training during Semester	0	0	2	2	1
Total				15	1	8	24	20

Semester VIII

SN	Category	Code	Course Title	L	T	P	Total Hour	Credit
1	PCC	MIN403	Mine Management General Safety & Mine Legislation	3	1	0	4	4
2	PCC	MIN404	Computer Application in Mining	3	1	0	4	4
3	PROJ	PROJ-MIN05	Research Project	0	0	12	12	6
4	PROJ	PROJ-MIN06	Seminar & Viva	0	0	2	2	1
Total				6	2	14	22	15

Semester-I

Course Code: **BSC103, BSC103-L**

Course Title : **Chemistry-I**

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

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

Course Outcomes:

BSC103, BSC103-L .1 Apply VSEPR theory to predict three dimensional shape of molecules.

BSC103, BSC103-L.2 Describe the concept of symmetry chilarity and activity synthesize drug molecule.

BSC103, BSC103-L.3 Explain the concept of intermolecular force, hydrogen bond and transitional metal complex.

BSC103, BSC103-L.4 Predict the concept of thermodynamics free energy and entropy and apply Nernst equation, water chemistry as well as explain concept of acid-base, metallurgy, EMF cell and corrosion.

BSC103, BSC103-L 3.5: Collectively aim to equip students with a comprehensive understanding of the theoretical principles, practical methodologies, and diverse applications of various spectroscopic techniques.

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours(CI+LI+SW+SL)	
BSC	BSC103, BSC103-L	Chemistry-I	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, 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

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
BSC	**BSC103, BSC103-L**	Chemistry-I	15	20	5	5	5	50	50	100

Practical

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)					Total Marks (PRA+ESA)
			Progressive Assessment (PRA)				End Semester Assessment(ESA)	
			Class/Home Assignment 5 number 7 marks each (LA)	VIVA(VV)	Class Attendance (TA)	Total Marks (LA+VV+ TA)		
BSC	**BSC103, BSC103-L**	Chemistry-I	35	10	5	50	50	100

Course-Curriculum Detailing:

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

BSC103, BSC103-L .1 Apply VSEPR theory to predict three dimensional shape of molecules.

Approximate Hours

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. Describethe classification of different types of orbit orbitals **SO1.2**Discussthe fundamental concept of wave function and probability of distribution curve **SO1.3**Explainandapply Atomic Spectroscopy: Energiesofatomic orbital's **SO1.4** Apply concept of VSEPR ithe determination of geometry of different molecules. **SO1.5**Restatemolecularenergy level diagram of N2,F2 andO2 molecules.	**LI.1.1.** Determination of specific density Of given liquid **LI.1.2.** Determination of viscosity of given liquid **LI.1.3** Paperchromatography, Thin layer Chromatography.	**Unit-1: Atomic and Molecular Structure & Periodic Properties** **1.1** Introduction of orbit, orbital sand electronic configuration **1.2** Schrodinger wave equation and its derivation. **1.3** Hybridization and types, Intermixing of orbital **1.4** VSEPR theory, bond pair and lonepairrepulsion, **1.5** Determination of geometry of the molecules **1.6** Molecular orbital theory, **1.7** Molecularenergyleveldiagramandbondorderforhomoandheteroatomicmolecules **1.8** Periodicity of atomic size and ionization energy **1.9** Electron gain enthalpy and types of electron gain enthalpy	1. History of development of of development of Periodic table

SW-1 Suggested Sessional Work (SW):

a. Assignments:

1. Applications of molecular orbital theory for the determination of bond order and magnetic behavior.

b. Mini Project:

1. Hybridization and its application.

BSC103, BSC103-L2: Describe the concept of symmetry, chilarity and optical activity and synthesize hiraldrug molecule.

Approximate Hours

Item	**AppxHrs**
CI	9
LI	6
SW	2
SL	1
Total	18

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1 Understand the concept of representations of 3 dimensional structures. **SO2.2** explain structural isomers and stereo isomers **SO2.3** describe symmetry, chirality and optical activity **SO2.4** explain and identify different types of reactions with mechanisms **SO2.5** apply the concept of mechanisms to synthesize drug molecules	**LI.2.1.** To synthesize drug molecules and determine its percentage yield **LI.2.2.** To determine the acid value or saponification value of oil/fat L**I2.3.** To determine partition coefficient of a organic substance between two immiscible liquids.	**UNIT 2: Stereochemistry, Organic reactions and synthesis of a drug molecule** **2.1** Representations of 3dimensionalstructures **2.2** Structural isomers and stereoisomers **2.3** Symmetry and chirality ,optical activity and absolute configurations **2.4** Enantiomers, diastereomers **2.5** Isomerism in transitional metal compounds **2.6** Introduction to reactions involving substitution reaction **2.7** Addition, elimination, oxidation ,reduction reaction **2.8** Cyclizationandring openings **2.9** Synthesis of a commonly used drug molecule	1. Plane of Polarized light

SW-2 Suggested Sessional Work(SW):

a. Assignments: Conformational Isomerism andc on formational analysis

b.Mini Project:

Symmetry chilarity

BSC103,BSC103-L.3: Understand the concept of Intermolecular forces, Hydrogen bond, Transition metal complexes by applying this concept.

Approximate Hours

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 Describe Ionic, dipolar, London dispersion force, vander Waals interac **SO3.2** Explain Hydrogen bond and types of hydrogen bond **SO3.3** Coordination compounds **SO3.4** Describe Metallig and bonding by VBT **SO3.5** Explain Metallig and bondin gby CFT	**LI3.1.** Synthesisain organic metal complex **LI3.2.** Determine the two acid and two basics radical **LI.2.3.** Determination of chloride content of water	**Unit-3:**IntermolecularforcesandTransitionmetal complexes **3.1.** Ionic, dipolar, London dispersion force **3.2.** Vander Waalsinte ractions **3.3.** Hydrogen bond, types of hydrogen bond. **3.4.** Coordination compounds **3.5.** Metallig and bonding by VBT **3.6.** Metallig and bonding by CFT **3.7.** The energy level diagrams for transition metal ions and their magnetic properties. **3.8.** The energy level diagrams for transition metal ions and their magnetic properties **3.9.** Numerical	**1.**Coordinationcompounds IUPAC name and Werner theory

SW-3 Suggested Sessional Work(SW):

a. **Assignments:**
   VBT theory, CFT theory
b. **Mini Project:** applications of transition metal complexes

BSC103, BSC103 L4- Predict the concept of thermodynamics, free energy and entropy and apply Nerns equation, water chemistry as well as explain concept of acid-base metalurgy EMF cell and corrosion.

Approximate Hours

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)
SO4.1Restate concept of free energy, Free energy, Enthalpy Entropy and types of different thermodynamic system SO4.2Discuss the fundamental concept of cell representationstandard EMF of cell SO4.3 Explain and apply different types of concepts used in softening of water and purification of water SO4.4 Understand and apply concept of corrosion for the development of green corrosion inhibitors SO4.5 Understand different acid-base concepts, ionic and solubility product of salts	LI.4.1. Determination of hardness of water LI.4.2. Determination of alkalinity of water LI.4.3. Chemical analysis of a salt.	Unit4:Useoffreeenergyinchemical equilibrium 4.1Introduction energy, Enthalpy Entropy, system and surroundings 4.2Cellnotation of cell, Nernstequation and its application 4.3 Water chemistry, Hardness of water, Temporary and permanent hardness 4.4 Water softening methods 4.5 Introduction of Corrosion, Mechanism of corrosion 4.6 Factors affecting rate of corrosion 4.7 Various acid-base concepts, Arrhenius concept, 4.8 Lewisacid-base concept, Bronsted Lowry concept 4.9 Brief idea about ionic and solubility equilibria	1-derivation of Nernstequation.

SW-4 **Suggested Sessional Work(SW):**

a. Assignments:

Applications of green corrosion inhibitors

b. Mini Project:

Analysis of water quality parameters.

BSC103, BSC103-L.5: Collectively aim to equip students with a comprehensive understanding of the theoretical principles, practical methodologies, and diverse applications of various spectroscopic techniques.

Approximate Hours

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

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO5.1 Understand Identification and classification of different types of EMR and vibrational modes in molecules. **SO5.2** Understand the fundamental principles of vibrational and rotational spectroscopy, including the interaction of lightwith molecular vibrations, the concept of infrared(IR) **SO5.3** Explain and apply Atomic Spectroscopy: -Energies of atomic orbital's **SO5.4** Understand and apply concept of NMR, Nuclear spin, nuclear resonance. **SO5.5** Understand introduction of X-ray Diffraction determination crystallographic structure of materials.	**LI.5.1.** Verification of Beer- Lambert law **LI5.2.** Determination of absorption maximum of a given organic compound. **LI.5.3.** Determination of cell constan tand conductance of solutions.	**Unit 5: Spectroscopic techniques and applications** **5.1** Introduction of spectroscopy, discovery, properties and types of electromagnetic radiation. **5.2** Classification of different types of vibrational modes in molecules (stretching, bending, torsional, etc.).IR activity. **5.3** Energies of atomic orbitals and electronic transition, frank Condon principle. **5.4** Introduction of NMR, **5.5.** Nuclear spin, nuclear resonance **5.6** Principle and instrumentation of NMR **5.7.** Shielding and deshielding of magnetic nuclei. **5.8.** Surface characterization techniques **5.9.** Diffraction and scattering	**1.** Applications Nuclear magnetic resonance and magnetic resonance imaging

SW-5 Suggested Sessional Work(SW):

a. Assignments:

Applications Nuclear magnetic resonance and magnetic resonance imaging

b.Mini Project:

Fluorescence and its applications in medicine

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)
BSC103, BSC103-L .1 Apply VSEPR theory to predict three dimensional shape of molecules.	9	6	2	1	18
BSC103, BSC103-L2: Describe the concept of symmetry, chilarity and optical activity and synthesize hiraldrug molecule.	9	6	2	1	18
BSC103,BSC103-L.3: Understand the concept of Intermolecular forces, Hydrogen bond, Transition metal complexes by applying this concept.	9	6	2	1	18
BSC103, BSC103 L4- Predict the concept of thermodynamics, free energy and entropy and apply Nerns equation, water chemistry as well as explain concept of acid-base metalurgy EMF cell and corrosion.	9	6	2	1	18
BSC103, BSC103-L.5: Collectively aim to equip students with a comprehensive understanding of the theoretical principles, practical methodologies, and diverse applications of various spectroscopic techniques.	9	6	2	1	18
Total Hours	45	30	10	5	90

Suggestion for End Semester Assessment

Suggested Specification Table(ForESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Atomic and Molecular Structure &Periodic properties	03	01	01	05
CO-2	Stereochemistry, Organic reactions and synthesis of a drug molecule	02	06	02	10
CO-3	Intermolecular forces and Transition metal complexes	03	07	05	15
CO-4	Use of free energy in chemical equilibrium	-	10	05	15
CO-5	Spectroscopic techniques and applications	03	02	-	05
Total		11	26	13	50

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

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

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

Suggested Instructional/Implementation Strategies:

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

Suggested Learning Resources

(a) Books:

S. No.	Title	Author	Publisher	Edition &Year
1	A textbook of engineering chemistry	Shyamala Sundara	S. Chand	Edition2008

2	ATextbook of En gineering Chemistry	Shashi Chawla|	Dhanpat RaiPrakashan	Edition2020
3	A Textbook of Engineering Chemistry	PC Jain and MonikaJain	Dhanpat Rai Prakashan	Edition2018

Curriculum Development Team

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Cos, POs and PSOs Mapping

Program Title: B. Tech Mining Engineering **Course Code: BSC103 / BSC103-L** **Course Title: Chemistry-I**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Apply VSEPR theory to predict three dimensional shape of molecules.	3	1	2	2	3	2	3	2	2	1	3	2	2	3	2	2
CO-2: Describe the concept of symmetry, chilarity and optical activity and synthesize hiraldrug molecule.	2	1	2	2	1	2	3	2	1	1	2	2	2	2	2	2
CO-3: Explain and apply theconceptofIntermolecularforces,Hydrogenbond,andtransitionmetalcomplexes	2	2	1	1	1	2	2	2	1	2	1	2	1	2	2	2
CO-4: Predict the concept of thermodynamics, free energy and entropy and apply Nerns equation, water chemistry as well as explain concept of acid-base metalurgy EMF cell and corrosion.	2	2	2	2	3	2	3	2	2	1	2	3	3	2	3	2
CO-5: Collectively aim to equip students with a comprehensive understanding of the theoretical principles, practical methodologies, and diverse applications of various spectroscopic techniques.	2	1	1	1	1	3	3	3	1	1	2	2	3	3	2	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map: Chemistry-I

POs & PSOs No.	Cos No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO-1:** Apply VSEPR theory to predict three dimensional shape of molecules.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1,1.2,1.3	Unit-1: Atomic and Molecular Structure & Periodic properties 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1 .8,1.9	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO-2:** Describe the concept of symmetry, chilarity and optical activity and synthesize hiraldrug molecule.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1,2.2,2.3	Unit-2: Stereochemistry Organic reactions an synthesis of adrug molecule 2.1,2.2,2.3,2.4,2.5,2.6,2.7, 2.8,2.9	SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO-3:**Explain and apply theconceptofIntermolecularforces,Hydrogenbond,andtransitionmetalcomplexes	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1,3.2,3.3	Unit-3: Intermolecular forces and Transition metal complexes 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3 .8,3.9	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO-4:** Predict the concept of thermodynamics, free energy and entropy and apply Nerns equation, water chemistry as well as explain concept of acid-base metalurgy EMF cell and corrosion.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1,4.2,4.3	Unit-4: Use of free energy i chemical equilibrium 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4. 8,4.9	SL 4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO-5:** Collectively aim to equip students with a comprehensive understanding of the theoretical principles, practical methodologies, and diverse applications of various spectroscopic techniques.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1,5.2,5.3	Unit-5: Spectroscopic techniques and applications 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5. 8,5.9	SL 5.1

Semester-I

Course Title: Mathematics –I

Course Code: - **BSC 102**

Prerequisite: Students should review the fundamentals of calculus and basic knowing of differential and integration.

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

Course Outcomes (CO):

BSC 102.1

Define and understand the concept of limits, Evaluate limits algebraically and graphically, Apply the basic rules of differentiation, including the power rule, product rule, quotient rule, and chain rule. Use linear approximation and differentials to estimate values of functions

BSC 102.2

Define and understand the basic concepts of matrices, Differentiate between different types of matrices Perform basic matrix operations, Use matrices to represent and solve systems of linear equations. Explore more advanced topics, such as linear transformations, matrix norms, and applications in optimization and computer graphics.

BSC 102.3

Define and compute partial derivatives of functions of several variables, Define and compute the gradient vector of a scalar function, Apply the chain rule to compute derivatives of composite functions involving multiple variables, Identify critical points of multivariable functions.

BSC 102.4

Understand the definition of a first-order ordinary differential equation, Solve separable differential equations using the separation of variables technique, Sketch direction fields to visualize the behavior of solutions, Apply first-order ODEs to model and analyze various phenomena

BSC 102.5

Understand and state the Fundamental Theorem of Calculus, both parts and apply the Fundamental Theorem to evaluate definite integrals. Apply integration techniques, including substitution, integration by parts, and partial fractions.

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Basic Science Course (BSC)	**BSC 102**	**Mathematics -I**	4	0	1	1	6	4

Legend:

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

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

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

SL: Self Learning,

C: Credits

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

Scheme of Assessment:

Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+ CT+SA +CAT +AT)		
BSC	**BSC 102**	**Mathematics -I**	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

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

BSC 102.1

Define and understand the concept of limits, Evaluate limits algebraically and graphically, Apply the basic rules of differentiation, including the power rule, product rule, quotient rule, and chain rule. Use linear approximation and differentials to estimate values of functions

Approximate Hours

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

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO1.1 Understand the concept of local and global extrema. **SO1.2** Understand the geometric interpretation of the derivative as the slope of a tangent line **SO1.3** Apply implicit differentiation to find derivatives of implicitly defined functions **So1.4** Understand the hypothesis of L' Hospital's rule **So1.5** Understand the concept of curvature.	-	**Unit-1.0** 1.1.Rolle's Theorem, 1.2. Mean value theorems 1.3. applications, extreme values of functions 1.4.linear approximation, Indeterminate forms 1.5.L' Hospital's rule 1.6 Tutorial-1 1.7. curvature, 1.8. Radius of curvature 1.9evolutes and involutes 1.10Expansion of functions by Maclaurin's series 1.11Expansion of functions by Taylor's series for one variable 1.12 Tutorial- 2	**SL.1** Define the derivative of a function at a point using the limit definition.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Analyze and sketch the graph of a function using information from its derivative.
ii. Identify critical points, inflection points, and concavity.
iii. Apply L'Hôpital's Rule to find limits involving indeterminate forms

BSC 102.2

Define and understand the basic concepts of matrices, Differentiate between different types of matrices Perform basic matrix operations, Use matrices to represent and solve systems of linear equations. Explore more advanced topics, such as linear transformations, matrix norms, and applications in optimization and computer graphics.

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 Define and understand the basic concepts of matrices, determinant, etc **SO2.2** Perform basic matrix operations, including addition, subtraction, and scalar multiplication **SO2.3** Understand the connection between matrix equations and systems of linear equations **SO2.4** Define and compute the determinant of a matrix **SO2.5** Understand numerical techniques	-	**Unit-2.0** 2.1.Rank of a Matrix 2.2. Determinant, 2.3. Inverse of a matrix, 2.4-Nullity 2.5. system of linear equations, 2.6.Symmetric,skew-symmetric 2.7.orthogonal matrices 2.8. Eigen values and Eigen vectors,orthogonal transformation, 2.9. diagonalization of matrices, Cayley-Hamilton Theorem, 2.10. linear systems of equations, 2.11 linear independence and linear dependence 2.12 Tutorial-1	**SL.1** Explore more advanced topics, such as linear transformations, matrix norms, and applications in optimization and computer graphics

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Write the application of Matrices in Real Life.
ii. Write the properties of Eigen values.
iii. Write a short note on types of matrix with example.
iv. Describe the method of calculation of rank with example

BSC 102.3

Define and compute partial derivatives of functions of several variables, Define and compute the gradient vector of a scalar function, Apply the chain rule to compute derivatives of composite functions involving multiple variables, Identify critical points of multivariable functions.

Approximate Hours

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

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Define and compute partial derivatives of functions of several variables **SO3.2** Understand the directional derivative and its relation to the gradient vector **SO3.3** Apply the chain rule to compute derivatives of composite functions involving multiple variables **SO3.4** Understand mixed partial derivatives and Clairaut's theorem **SO3.5** Identify critical points of multivariable functions	-	**Unit-3.0** 3.1. Limit and continuity 3.2. total derivative, 3.3. Euler's theorem on Homogeneous function. 3.4. Application of Euler's theorem in approximation and errors, 3.5. Application of Euler's theorem in errors 3.6.Tangent plane and normal line. 3.7. maxima, minima 3.8 saddle points, 3.9. Method of Lagrange multipliers 3.10. partial derivatives 3.11 Questions of partial differential. 3.12 Tutorial-1	**SL.1** Apply Lagrange multipliers to solve constrained optimization problems

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Write the Application of Euler's theorem in real life.
ii. Explain the difference between differential and partial differential
iii. Write the properties of maxima, minima.
iv. Define saddle points, point of inflection.

BSC 102.4

Understand the definition of a first-order ordinary differential equation, Solve separable differential equations using the separation of variables technique, Sketch direction fields to visualize the behavior of solutions, Apply first-order ODEs to model and analyze various phenomena

Approximate Hours

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

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO4.1 Understand the definition of a first-order ordinary differential equation **SO4.2** Solve separable differential equations using the separation of variables technique **SO4.3** Identify and use integrating factors to solve linear first-order ODEs **SO4.4** Identify autonomous differential equations and their significance **SO4.5** Recognize and solve exact differential equations	-	**Unit-4.0** 4.1.Order and degree of equation 4.2Exact equations. 4.3.Questions of Exact equations , 4.4. Linear equations 4.5 Tutorial-1 4.6. Bernoulli's equations. 4.7. Equations not of first degree: 4.8.Equations solvable for p, 4.9.Equations solvable for y, 4.10. Equations solvable for x 4.11 Equations Clairaut's type 4.12 Tutorial-2	**SL.1** Apply first-order ODEs to model and analyze various phenomena, such as population growth, chemical reactions, and electrical circuits

SW-4 Suggested Sessional Work (SW):

a. Assignments:

I. Explain degree and order of differential equation with example.

BSC 102.5

Understand and state the Fundamental Theorem of Calculus, both parts and apply the Fundamental Theorem to evaluate definite integrals. Apply integration techniques, including substitution, integration by parts, and partial fractions.

Approximate Hours

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

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO4.1 Understand and state the Fundamental Theorem of Calculus **SO4.2** Find anti derivatives of elementary functions **SO4.3** Understand the concept of a definite integral as a limit of Riemann sums **SO4.4** Interpret definite integrals as areas under curves **SO4.5** Understand and evaluate improper integrals.	-	**Unit-5.0** 5.1.Evaluation of definite and improper integrals, 5.2. Beta and Gamma functions 5.3. Properties of Beta and Gamma functions, 5.4 Relation between Beta and Gamma functions 5.5. Double integrals (cartesian), 5.6 questions of double integrals 5.7. Change of order of integration in double integrals, 5.8 Change of order of integration questions 5.9. Triple integrals (cartesian), 5.10. simple applications involving cubes and sphere 5.11 Rectangular parallelepipeds 5.12 Tutorial-1	**SL.1** Apply calculus techniques to analyze curves defined in polar form

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. Write the application of double and tripal integration.
ii. Write the Properties of Beta and Gamma functions.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
CO1- BSC102.1 Define and understand the concept of limits, Evaluate limits algebraically and graphically, Apply the basic rules of differentiation, including the power rule, product rule, quotient rule, and chain rule. Use linear approximation and differentials to estimate values of functions	12	1	1	14
CO1- BSC102.2 Define and understand the basic concepts of matrices, Differentiate between different types of matrices Perform basic matrix operations, Use matrices to represent and solve systems of linear equations. Explore more advanced topics, such as linear transformations, matrix norms, and applications in optimization and computer graphics.	12	1	1	14
CO1- BSC102.3 Define and compute partial derivatives of functions of several variables, Define and compute the gradient vector of a scalar function, Apply the chain rule to compute derivatives of composite functions involving multiple variables, Identify critical points of multivariable functions.	12	1	1	14
CO1- BSC102.4 Understand the definition of a first-order ordinary differential equation, Solve separable differential equations using the separation of variables technique, Sketch direction fields to visualize the behavior of solutions, Apply first-order ODEs to model and analyze various phenomena**.**	12	1	1	14
BSC102.5 Understand and state the Fundamental Theorem of Calculus, both parts and apply the Fundamental Theorem to evaluate definite integrals. Apply integration techniques, including substitution, integration by parts, and partial fractions.	12	1	1	14
Total Hours	60	5	5	70

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution					Total Marks
		R	U	A			
CO-1	Single-variable Calculus	02	04	05			07
CO-2	Matrices	03	07	04			14
CO-3	Multivariable Calculus	02	06	02			10
CO-4	First order ordinary differential equations	03	03	02			11
CO-5	Integral Calculus.	03	02	02			08
Total		13	22	15			50

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

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

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

Suggested Instructional/Implementation Strategies

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

Suggested Learning Resources:

a) Books :

S. No.	Title	Author	Publisher	Edition & Year

1	Engineering Mathematics-I ,	D.K, Jain	Shree Ram Prakashan.	7th Edition 2015-16
2	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	36th Edition, 2010
3	Engineering Mathematics-I	D.C.Agrawal	Shree Sai Prakashan	10th Edition 2018
4	Higher Engineering Mathematics	B.V. Ramana	Tata McGraw Hill	11th Reprint, 2010.

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Programme Title: B. Tech. Mining Engineering
Course Code: BSC102
Course Title: Mathematics-1

Course Outcomes	Program Outcomes												Program Specific Outcome	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	Engineering knowledge	Problem Solving	Design Skills	Laboratory Skills	Team work	Communication Skills	Ethical and Professional Behavior	Lifelong Learning	Global and Societal Impact	Project Management	Adaptability	Professional Development	Apply electrical and interdisciplinary knowledge to analyze, design and manufacture products to address the needs of the society	Apply state of the art tools and techniques to conceptualize, design and introduce new products, processes, systems and services
CO1: Define and understand the concept of limits, Evaluate limits algebraically and graphically, Apply the basic rules of differentiation, including the power rule, product rule, quotient rule, and chain rule. Use linear approximation and differentials to estimate values of functions	3	1	2	2	2	2	3	1	2	2	1	2	2	2
CO 2: Define and understand the basic concepts of matrices, Differentiate between different types of matrices Perform basic matrix operations, Use matrices to represent and solve systems of linear equations. Explore more advanced topics, such as linear transformations, matrix norms, and applications in optimization and computer graphics.	2	2	3	2	1	2	2	1	1	1	2	3	2	2
CO 3: Define and compute partial derivatives of functions of several variables, Define and compute the gradient vector of a scalar function, Apply the chain rule to compute derivatives of composite functions involving multiple variables, Identify critical points of multivariable functions.	2	2	1	1	2	2	2	1	1	2	1	2	2	1
CO 4: Understand the definition of a first-order ordinary differential equation, Solve separable differential equations using the separation of variables technique, Sketch direction fields to visualize the behavior of solutions, Apply first-order ODEs to model and analyze various phenomena.	3	2	2	2	3	1	3	1	2	1	2	2	3	3
CO 5: Understand and state the Fundamental Theorem of Calculus, both parts and apply the Fundamental Theorem to evaluate definite integrals. Apply integration techniques, including substitution, integration by parts, and partial fractions.	2	2	2	2	1	1	3	1	1	1	2	2	3	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self- Learning(SL)
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2	**CO1:** Define and understand the concept of limits, Evaluate limits algebraically and graphically, Apply the basic rules of differentiation, including the power rule, product rule, quotient rule, and chain rule. Use linear approximation and differentials to estimate values of functions	SO1.1, SO1.2 SO1.3, SO1.4 SO1.5		Unit-1.Single-variable Calculus 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10, 1.11,1.12	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO 2:** Define and understand the basic concepts of matrices, Differentiate between different types of matrices Perform basic matrix operations, Use matrices to represent and solve systems of linear equations. Explore more advanced topics, such as linear transformations, matrix norms, and applications in optimization and computer graphics.	SO2.1, SO2.2 SO2.3, SO2.4 SO2.5		Unit-2Matrices 2.1,2.2,2.3,2.4,2.5.2.6,2.7,2.8,2.9,2.10,2.11,2.12	SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2	**CO 3:** Define and compute partial derivatives of functions of several variables, Define and compute the gradient vector of a scalar function, Apply the chain rule to compute derivatives of composite functions involving multiple variables, Identify critical points of multivariable functions.	SO3.1,SO3.2 SO3.3,SO3.4 SO3.5		Unit-3:Multivariable Calculus 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11,3.12	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2	**CO 4:** Understand the definition of a first-order ordinary differential equation, Solve separable differential equations using the separation of variables technique, Sketch direction fields to visualize the behavior of solutions, Apply first-order ODEs to model and analyze various phenomena**.**	SO4.1, SO4.2 SO4.3, SO4.4 SO4.5		Unit-4: First order ordinary differential equations 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9 ,4.10,4.11, 4.12	SL 4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2	**CO 5:** Understand and state the Fundamental Theorem of Calculus, both parts and apply the Fundamental Theorem to evaluate definite integrals. Apply integration techniques, including substitution, integration by parts, and partial fractions.	SO5.1, SO5.2 SO5.3, SO5.4 SO5.5		Unit5: Integral Calculus. 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.95.10,5.11,5.12	SL 5.1

Semester-I

Course Code: **ESC104/ESC104-L**

Course Title : Programming for Problem Solving

Pre-requisite: Student should have basic knowledge programming.

Rationale: Problem solving skills can help people develop more skills and build a promising career.

Course Outcomes:

ESC104/ESC104-L.1: Understand the basic concept of Programming languages, software, algorithm and flowchart.

ESC104/ESC104-L.2: Acquire knowledge regarding the building blocks of programming language.

ESC104/ESC104-L.3: Apply python for solving basic programming solutions.

ESC104/ESC104-L.4: Create algorithms using learnt programming skills.

ESC104/ESC104-L.5: Understand real world problems and developing computer solutions for those.

Scheme of Studies:

Code	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)	**ESC104/ESC104-L**	Programming for Problem Solving	3	4	2	1	10	5

Legend:

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

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

SW: 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

Code	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)		
ES	**ESC104/ESC104-I**	Programming for Problem Solving	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.

ESC104/ESC104-L.1: Understand the basic concept of Programming languages, software, algorithm and flowchart.

Approximate Hours

Item	Appx. Hrs.
Cl	7
LI	4
SW	2
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO1.1. Understand types of programming languages. **SO1.2.**Utilize Operating System **SO1.3.**Compare compiler, linker, loader **SO1.4.**Create algorithm and flow charts for problem	**LI.1.1.** Running instructions in Interactive interpreter and a Python Script. **LI.1.2.** Write a program to purposefully raise Indentation Error and Correct it.	**Unit-1 Introduction to Programming** **1.1** Evolution of languages: Machine languages, Assembly languages, High-level languages construction eras. **1.2** Software requirements for programming **1.3** System software like operating system **1.4** compiler, linker, loader **1.5** Application programs like editor. **1.6** Algorithm specification of algorithm **1.7** . Flowcharts	1. Different types of programming languages examples.

SW-1 Suggested Sessional Work (SW):

a. **Assignments:**
   1. Create algorithms for some real-life problems.
   2. Create flowcharts for problems.

b. **Mini Project:**
   i. Flow diagram of working of a university.

ESC104/ESC104-L.2: Acquire knowledge regarding the building blocks of programming language.

Approximate Hours

Item	Appx. Hrs.
Cl	12
LI	10
SW	2
SL	1
Total	25

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1. ToUnderstand the datatypes **SO2.2.**Identify Expressions **SO2.3.**Apply operators **SO2.4.**Use list, string tuples	**LI.2.1.** Write a program to demonstrate basic data type in python. **LI.2.2.** Write a program to compute distance between two points taking input from the user Write a program add.py that takes 2 numbers as command line arguments and prints its sum. **LI.2.3.** Using a for loop, write a program that prints out the decimal equivalents of 1/2, 1/3, 1/4, . 1/10. **LI.2.4.** Write a program using a for loop that loops over a sequence. What is sequence? **LI.2.5.** Write a program using a while loop that asks the user for a number, and prints a countdown from that number to zero.	**Unit-2 Data types and Operators, Variables, Sequences and Iteration** 2.1. Data Types 2.2. Different types of Data types 2.3. Expressions, Precedence Rules 2.4. Operators 2.5. Types of Operators 2.6. Local Variables 2.7. Global Variables 2.8. List 2.9. String 2.10. Tuples 2.11. Sequence Mutations 2.12. Accumulation Patterns.	1. Operator precedence

SW-2 Suggested Sessional Work(SW):

a. Assignments:

1. Compare List and Tuples.
2. String functions with example.

b. Mini Project:

Create a Calculator.

ESC104/ESC104-L.3: Gain an understanding of the various types of Conditional Statements, Loops, Arrays and Strings.

Approximate Hours

Item	Appx. Hrs.
Cl	10
LI	8
SW	2
SL	1
Total	21

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1. To Understand the loop types **SO2.2.**Identify the looping Expressions **SO2.3.**Apply arrays **SO2.4.** Use of user defined data type	**LI.3.1.** Write a Program for checking whether the given number is an even number or not. Using a for loop. **LI.3.2.** Write a program using a while loop that asks the user for a number, and prints a countdown from that number to zero. **LI.3.3.** Write function to compute gcd, lcm of two numbers. **LI.3.4.** Write a program to implement Merge sort. Write a program to implement Selection sort, Insertion sort	**Unit-3 : Conditional Statements, Loops, Arrays and Strings, User Defined Data Types** 3.1 If-else statement, 3.2 For loop, 3.3 While Loop, 3.4 Nested Iteration, 3.5 Concept and use of arrays 3.6 Declaration and usage of arrays, 3.7 , 2-dimensionalarrays, 3.8 Different types of user defined datatypes 3.9 Structure 3.10 Union	i. Loops to access array elements

SW-3 Suggested Sessional Work(SW):

a. Assignments:

1. Compare the looping statements
2. Use of user defined data type with example.

b. Mini Project:

Create a stopwatch.

ESC104/ESC104-L.4: Familiarize with a concise overview of the Dictionaries and methods.

Approximate Hours

Item	Appx. Hrs.
Cl	10
LI	4
SW	2
SL	1
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1. Understand the concepts of Dictionaries and Dictionary Accumulation **SO2.2.**Identify the Functions/Methods **SO2.3.**Apply functions **SO2.4.**Use of Functions/Methods	**LI.4.1.** Write a program to count the numbers of characters in the string and store them in a dictionary data structure. **LI.4.2.**Write a program to use split and join methods in the string and trace a birthday of a person with a dictionary data structure.	**Unit-4 :Dictionaries and Dictionary Accumulation, Functions/Methods** 4.1 Dictionary Basics 4.2 Operations 4.3 Methods, accumulation. 4.4 Advantage of modularizingprogram into functions. 4.5 Functiondefinition. 4.6 Function invocation. 4.7 Positional Parameter Passing 4.8 Passing arrays to functions 4.9 Recursion 4.10 Library Functions	i. Preparation of process Dictionary ii. A typical Positional Parameter Passing .

SW-4 Suggested Sessional Work(SW):

a. Assignments:

1. Write a program that reads a string from keyboard and prints the unique words
2. Use of user defined function with example.

b. Mini Project:

Map Two Lists into A Dictionary.

ESC104/ESC104-L.5: Comprehend the functions of different File Handling and Memory Management.

Approximate Hours

Item	Appx. Hrs.
Cl	6
LI	4
SW	2
SL	1
Total	13

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO2.1 Understanding the file handling task **SO2.2** know the functions of file handling **SO2.3** Importance of .csv file **SO2.4** Use of Memory Management	**LI.5.1.** Write a programto countfrequency 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: File Handling and Memory Management** 5.1 File Handling 5.2 Memory Management 5.3 Concepts of files and basic file operations. 5.4 Writing Data to a .csv File. 5.5 Reading Data to from a .csv File. 5.6Memory Management Operations.	1. Role of file handling. 2.Working of .csv file

SW-5 Suggested Sessional Work (SW):

a. Assignments:

List the different file handling functions .

b. Mini Project:

Data base management of any fields by using file handling.

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)
ESC104/ESC104-L.1**:** At the end of this chapter the student will know the basic concept of programming.	7	4	2	1	14
ESC104/ESC104-L.2**:**At the end of this chapter the student will useOperatorsin programs.	12	10	2	1	25
ESC104/ESC104-L.3:At the end of this chapter the student will describe the control flow statements.	10	8	2	1	21
ESC104/ESC104-L.4:At the end of this chapter the student will make function and dictionary	10	4	2	1	17
ESC104/ESC104-L.5: Comprehend the functions of .csv and filehandling functions.	6	4	2	1	13
Total Hours	45	30	10	5	90

Suggestion for End Semester Assessment

Suggested Specification Table(ForESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CT101.1	Understand the basic concept of Programming languages, software, algorithm and flowchart.	02	05	01	08
CT101.2	Acquire knowledge regarding the building blocks of programming language.	02	03	05	10
CT101.3	Apply python for solving basic programming solutions.	02	03	07	12
CT101.4	Create algorithm using learnt programming skills.	1	3	7	10
CT101.5	Understand real world problems and developing computer solutions for those.	1	05	05	10
Total		13	26	13	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.

Suggested Learning Resources:

a. Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Programming for Problem Solving	R.S. Salaria, Khanna	Khanna Publishing House	2021, 4th Edition
2	Taming Python by Programming	Jeeva Jose	Khanna Publishing House	2019, 3rd Edition
3	Learning Python	Mark Lutz	O'Reilly Media	2013, 5th Edition

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

COs, POs and PSOs Mapping

Program: B. Tech. Mining Engineering
Course Code : ESC104/ESC104-L
Course Title: Problem Solving and Programming

Course Outcomes	Program Outcomes												Program Specific Outcome				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PS0 5
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct studies of difficult problems	Utilization of modern tools	Engineers and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-longlearning	Use fundamental knowledge of math, science, and engineering to comprehend, evaluate, and create computer Programmes in the fields of algorithms, multimedia, big data analytics, machine learning, artificial 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.
CO 1: Understand the basic concept of Programming languages, software, algorithm and flowchart.	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1	2
CO 2 : Acquire knowledge regarding the building blocks of programming language	1	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1	3
CO 3: Apply python for solving basic programming solutions.	2	2	1	1	1	2	2	2	1	2	1	2	1	1	2	2	2
CO 4: Create algorithms using learnt programming skills	3	2	2	2	3	2	3	2	2	1	2	3	3	3	3	2	2
CO5:Understand real world problems and developing computer solutions for those.	-	-	-	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&PSOsNo.	Cos No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning(SL)
PO1,2,3,4,5,6,7,8 ,9,10,11,12 PSO1,2,3,4,5	CO 1: Understand the basic concept of Programming languages, software, algorithm and flowchart.	SO1.1 SO1.2 SO1.3 SO1.4	LI.1.1,LI1.2	Unit-1Introduction to Programming 1.1,1.2,1.3,1.4,1.5,1.6,1.7	SL 1.1
PO1,2,3,4,5,6,7,8 ,9,10,11,12 PSO1,2,3,4,5	CO 2 : Acquire knowledge regarding the building blocks of programming language.	SO2.1 SO2.2 SO2.3 SO2.4	LI.2.1,LI2.2,LI 2.3,LI.2.4,LI.2. 5	Unit-2Datatypes and Operators, Variables, Sequences and Iteration 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9,2.10,2.1 1,2.12	SL 2.1
PO1,2,3,4,5,6,7,8 ,9,10,11,12 PSO1,2,3,4,5	CO 3: Apply python for solving basic programming solutions. .	SO3.1 SO3.2 SO3.3 SO3.4	LI3.1,LI3.2,LI3 .3,LI.3.4	Unit-3Conditional Statements, Loops, Arrays and Strings, User Defined Data Types 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,	SL 3.1
PO1,2,3,4,5,6,7,8 ,9,10,11,12 PSO1,2,3,4,5	CO 4: Create algorithms using learnt programming skills.	SO4.1 SO4.2 SO4.3 SO4.4	LI4.1,LI.4.2	Unit-4Dictionaries and Dictionary Accumulation, Functions/Methods: 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,	SL 4.1
PO1,2,3,4,5,6,7,8 ,9,10,11,12 PSO1,2,3,4,5	CO 5: Understand real world problems and developing computer solutions for those.	SO5.1 SO5.2 SO5.3 SO5.4	LI.5.1,LI5.2	Unit-5 File Handling and Memory Management: 5.1,5.2,5.3,5.4,5.5,5.6	SL 5.1

Semester-I

Course Code: **ESC105/ESC105-L**

Course Title: Manufacturing Practice Workshop

Pre- requisite: Basic knowledge of mathematical skill with some scientific temperament.

Rationale: It is a place of work for preparing variety of jobs/products by using different kinds of Instruments, hand tools and Machines. In order to prepare the products in workshop, the workshop is divided into many branches according to nature of work. Ex: 1.Fitting shop 2. Welding shop 3. Sheet metal shop 4. M/c Shop 5. Foundry & Forging shop etc

Course Outcomes:

ESC105/ESC105-L.1: Understand various production processes, selecting appropriate methods for different material, optimizing manufacturing efficiency and ensuring product quality.

ESC105/ESC105-L.2: Acquired proficiency in using hand tools, understanding different types of fits and tolerances, interpreting engineering drawing and precision measurement techniques.

ESC105/ESC105-L.3: Develop fundamental skills such as measuring , cutting and joining wood. Gain expertise in handling various carpentry tools and machinery.

ESC105/ESC105-L.4: Appreciate and access the use of casting processes in manufacturing and understand the working of various casting processes.

ESC105/ESC105-L.5: Analyze and access the importance of welding processes in manufacturing and apply knowledge to select appropriate welding process based on the type of industrial application.

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Engineering ScienceCore (ESC)	**ESC105 /ESC105-L**	Manufacturing Practice Workshop	1	4	1	1	7	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 ofteacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA + ESA)
			Class/Home Assignment5 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)		
ESC	**ESC105/ESC 105-L**	Manufacturing Practice Workshop	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), culminatingin the overall achievement of Course Outcomes (COs) upon the course's conclusion.

ESC105/ESC105-L.1: Understand various production processes, selecting appropriate methods for different material, optimizing manufacturing efficiency and ensuring product quality.

Approximate Hours

Item	AppX Hrs
Cl	03
LI	12
SW	1
SL	1
Total	17

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO1.1 Understand various manufacturing processes, materials and technologies. **SO1.2** Acquire knowledge in cost estimation resource management and sustainable manufacturing practices.	1.1Safety aspects pertaining to common manufacturing practices. 1.2 Introduction of tools and machines used in each processes. 1.3 Basic instructions and procedures for using lathe and drilling machine. 1.4 Drawing of a simple workpiece for carrying out various lathe /drilling operations 1.5 Demonstration of different operations during actual performance of work. 1.6 Fire Safety Instructions during the work.	**Unit-1.0**Manufacturing Methods-casting, forming, machining, joining, advanced manufacturing methods, CNC machining, Additive manufacturing. 1.1 Define manufacturing And various methods. 1.2 Introduction to casting, forming, machining, joining and advanced manufacturing methods. 1.3 Introduction to CNC machine.	1. Introduction to additive manufacturing .

SW-1 Suggested Sessional Work (SW):

a. Assignments:

Mechanical properties of engineering materials. Explain advanced manufacturing methods

ESC105/ESC105-L.2: Acquired proficiency in using hand tools , understanding different types of fits and tolerances, interpreting engineering drawing and precision measurement techniques.

Approximate Hours

Item	AppX Hrs
Cl	03
LI	12
SW	1
SL	1
Total	17

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO2.1 Understand different cutting tools like hacksaw, chisels etc. SO2.2 acquire knowledge of various fitting and assembly techniques.	2.1 Safety instructions for using various fitting hand tools. 2.2 Tools Introduction 2.3 Instructions for using proper tools in the correct way 2.4 Drawing of a simple workpiece for carrying out different fitting operations. 2.5 Demonstration of different inspection , checking and measuring methods used for proper fitting work. 2.6 Actual performance of a small simple job.	**Unit-2 Fitting operations & power tools** 2.1 Tools used in fitting shop 2.2 types of clamping tools, marking tools, cutting tools, striking tools. 2.3 Various operations performed on fitting shop	i. Types of drilling tools and threading tools.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Explain different striking tools with neat sketch
ii. Explain different types of vices used in fitting shop.

ESC105/ESC105-L.3:. Develop fundamental skills such as measuring , cutting and joining wood. Gain expertise in handling various carpentry tools and machinery

Approximate Hours

Item	AppX Hrs
Cl	03
LI	12
SW	1
SL	1
Total	17

Session Outcomes (SOs)	**LaboratoryInstruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO3.1 proficiency in measuring cutting and assembling wood. **SO3.2** acquire knowledge in using various tools like saws, drills and planes **SO3.3** understand joinery techniques, wood finishing and safety practices	3.1 Safety instructions for using various carpentry tools. 3.2 Carpentry tools introduction. 3.3 Instructions for using proper tools in the correct way 3.4 Drawing of a simple workpiece for preparation of common carpentry joinery work. 3.5 Demonstration of different inspection , checking and measuring methods used for proper carpentry work. 3.6 Production of any one type of joints listed below- Dovetail Joint/Corner Joint/Mortise and Tenon Joint etc.	**Unit-3 : Carpentry shop** 3.1 Introduction to carpentry shop 3.2 different methods of seasoning of timber 3.3 carpentry tools	i. Defects in timber

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Explain the different operation performed in wood working

ii. Sketch and describe the different joints made in carpentry shop.

iii. Explain the different types of wood working machines used in modern wood work.

ESC105/ESC105-L.4: Appreciate and access the use of casting processes in manufacturing and understand the Working of various casting processes.

Approximate Hours

Item	AppX Hrs
Cl	03
LI	12
SW	1
SL	1
Total	17

Session Outcomes (SOs)	LaboratoryInstruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 The production of cast metal component, quality control measures and adherence to manufacturing standards	4.1 Safety instructions for foundry shop, pattern making , mould preparation. 4.2 Foundry tools introduction. 4.3 Instructions for using proper tools in the correct way 4.4 Drawing of a simple work piece for preparation of a pattern. 4.5 Instructions for sand preparation, mould preparation, melting and casting properly in the safe manner. 4.6 Production of a simple casting.	**Unit-4 : Metal casting** 4.1 Introduction to foundry shop. 4.2 Pattern, Mould , Casting , pattern allowances , moulding sand . 4.3 Casting procedure , core , gating system.	i. Types of moulding sand.

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Explain different defects in casting.

ii. Explain different casting terms like runner , riser , mould et

ESC105/ESC105-L.5: : Analyze and access the importance of welding processes in manufacturing and apply knowledge to select appropriate welding process based on the type of industrial application.

Item	AppX Hrs
Cl	03
LI	12
SW	1
SL	1
Total	17

Session Outcomes (SOs)	**LaboratoryInstruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO5.1 Performing set up, adjustment of flame and gas pressure, and shutdown procedure for oxyacetylene welding and cutting equipment. SO5.2 Acquire knowledge about setting up and shutting down SMAW equipment.	5.1 Safety instructions for welding shop. 5.2 Welding tools introduction for Electric Arc Welding process. 5.3 Instructions for using proper tools in the correct way. 5.4 Drawing of a simple welded joint viz. Square butt joint, T joint , Lap joint etc. 5.5 Demonstration of producing a square butt joint using MMAW process. 5.6 Actual production of a welded joint as described above	**Unit 5: welding shop** 5.1 introduction to welding shop, classification of welding process 5.2 gas welding and its equipments and techniques 5.3 electric arc welding and brazing process	1. study of TIG and MIG welding process

SW-5 Suggested Sessional Work (SW):

a.Mini Project:

1.What are different types of joints in welding shop?
2.What is the function of flux in gas welding?.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Laboratory Instruction (LI)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
ESC105/ESC105-L.1: Understand various production processes, selecting appropriate methods for different material, optimizing manufacturing efficiency and ensuring product quality.	3	1	12	1	17
ESC105/ESC105-L.2: Acquired proficiency in using hand tools , understanding different types of fits and tolerances, interpreting engineering drawing and precision measurement techniques.	3	1	12	1	17
ESC105/ESC105-L.3: Develop fundamental skills such as measuring , cutting and joining wood. Gain expertise in handling various carpentry tools and machinery.	3	1	12	1	17
ESC105/ESC105-L.4: Appreciate and access the use of casting processes in manufacturing and understand the working of various casting processes.	3	1	12	1	17
ESC105/ESC105-L.5: Analyze and access the importance of welding processes in manufacturing and apply knowledge to select appropriate welding process based on the type of industrial application.	3	1	12	1	17
Total Hours	15	5	60	5	85

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Manufacturing Methods-casting, forming, machining, joining, advanced manufacturing methods, CNC machining, Additive manufacturing	04	05	01	10
CO-2	Fitting operations & power tools	05	04	01	10
CO-3	Carpentry shop	-	05	05	10
CO-4	Metal casting	04	04	02	10
CO-5	Welding shop	05	03	02	10
Total		18	21	11	50

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

The end of semester assessment for Manufacturing Practice Workshop 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	Elements of Workshop Technology	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K.	Media promoters and publishers private limited, Mumbai	Vol. I 2008 and Vol. II 2010
2	Manufacturing Engineering and Technology	Kalpakjian S. And Steven S. Schmid	Pearson Education India	Edition, 2002
3	Manufacturing Technology	Rao P.N	Tata McGraw Hill House	Vol. I and Vol. II 2007
4	Processes and Materials of Manufacture	Roy A. Lindberg	Prentice Hall India,	4th edition, 1998
5	Lecture note provided by Dept. of Mechanical Engineering, AKS University, Satna .			

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Cos, POs and PSOs Mapping

Course Title: B. Tech. Mining Engineering

Course Code: ESC105/ESC105-L

Course Title: Manufacturing Practice Workshop

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO 2	PO3	PO4	PO5	PO 6	PO7	PO8	PO9	PO1 0	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Engin e ering knowl edge	Pro b lem anal ysis	Desi g n/dev elop ment of soluti ons	Cond uct invest igations of compl ex probl ems	Mod e rn tool usage	The engi neer and soci ety	Enviro nment and sustain ability:	Ethics	Indiv idual and team work :	Com muni c ation:	Project manag ement and finance :	Life-long learnin g	Mechanical System Design and Analysis	Manufacturin g Processes and Automation	Computatio nal Modeling and Simulation.	Product Innovation and Developme nt
CO1 : Understand various production processes, selecting appropriate methods for different material, optimizing manufacturing efficiency and ensuring product quality.	2	1	2	2	3	2	2	2	2	1	3	2	2	2	1	2
CO 2 : Acquired proficiency in using hand tools , understanding different types of fits and tolerances, interpreting engineering drawing and precision measurement techniques.	1	1	1	1	3	2	2	2	2	1	2	2	1	2	1	2
CO3 : Develop fundamental skills such as measuring , cutting and joining wood. Gain expertise in handling various carpentry tools and machinery.	2	2	1	1	3	1	2	2	2	1	1	2	1	2	1	1
CO 4: Appreciate and access the use of casting processes in manufacturing and understand the working of various casting processes.	2	2	2	1	3	2	2	2	2	1	2	2	1	2	1	2

CO 5: Analyze and access the importance of welding processes in manufacturing and apply knowledge to select appropriate welding process based on the type of industrial application.	2	1	1	1	1	3	2	2	2	1	2	2	1	2	1	1

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO-1: Understand various production processes, selecting appropriate methods for different material, optimizing manufacturing efficiency and ensuring product quality.	SO1.1 SO1.2	1.1 1.2 1.3 1.4 1.5 1.6	Unit-1.0 Manufacturing Methods-casting,forming ,machining, joining,advancedmanufacturing methods, CNC machining, Additive manufacturing 1.1,1.2,1.3	SL 1.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO 2 : Acquired proficiency in using hand tools , understanding different types of fits and tolerances, interpreting engineering drawing and precision measurement techniques.	SO2.1 SO2.2	2.1 2.2 2.3 2.4 2.5 2.6	Unit-2 Fitting operations & power tools 2.1, 2.2, 2.3	SL 2.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO3 : Develop fundamental skills such as measuring , cutting and joining wood. Gain expertise in handling various carpentry tools and machinery.	SO 3.1 SO 3.2 SO 3.3	3.1 3.2 3.3 3.4 3.5 3.6	Unit-3 : Carpentry shop 3.1, 3.2,3.3	SL 3.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO 4: Appreciate and access the use of casting processes in manufacturing and understand the working of various casting processes.	SO4.1	4.1 4.2 4.3 4.4 4.5 4.6	Unit-4 : Metal casting 4.1, 4.2,4.3	SL4.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO 5: Analyze and access the importance of welding processes in manufacturing and apply knowledge to select appropriate welding process based on the type of industrial application.	SO5.1 SO5.2	5.1 5.2 5.3 5.4 5.5 5.6	Unit 5: Welding Shop 5.1,5.2,5.3	SL 5.1

Semester-I

Course Code: **HSMC01**

Course Title : **Communication Skills (English)**

Pre-requisite: Students must have basic knowledge of English language.

Rationale: In order to compete in this fast growing world, LSWR skills of the students should be well developed and enhanced. Besides, they must have effective communication skills as it plays a vital role in shaping individual's personality and career. It also boosts the confidence and prepares them to face the audience fearlessly.

Course Outcomes:

HSMC01.1: Students will be able to speak confidently in public as all the topics chosen emphasis on improving speaking skills and developing self confidence amongst them.

HSMC01.2: Students will be able to interact properly with improved Leadership Skills, Problem Solving Skills, Social skills and Communication Skills. Students will also be able to understand the Importance of Team Work.

HSMC01.3: Students will be able to communicate effectively in Hindi and English languages without hindrances.

HSMC01.4: Students will be able to convey their messages accurately by understanding the significance of grammar as it plays a vital role in improving speaking and writing skills.

HSMC01.5: The Understanding of Indian Culture and English Language will be developed through the study of Dramas and Poems written by Indian Writers.

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Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of Studies(Hours/Week)					Total Credits(C)
			CI	LI	SW	SL	Total Hours(CI+LI+SW+SL)	
HSMC	HSMC01	Communication Skills (English)	3	0	1	1	5	3

Legend: **Legend:**

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

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

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

SL: Self Learning,

C: Credits

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

Scheme of Assessment:
Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
HSMC	HSMC01	Communication Skills (English)	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.

HSMC01.1: Students will be able to speak confidently in public as all the topics chosen emphasis on improving speaking skills and developing self confidence amongst them.

Approximate Hours

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

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Students will be able to introduce themselves **SO1.2** Understand the concept of Oral Presentation **SO1.3** Students will be able to dress and present effectively **SO1.4** Understand the importance of Body Language **SO1.5** Students will be able to influence mass through skit and dramas.		**Self-grooming, Basic Etiquettes and Presentation Skill** **1.1** Self-introduction **1.2** Practice Sessions **1.3** Oral Presentation **1.4** Characteristics of presentation. **1.5** Presentation topics (The importance of Education, The importance of English in Today's World and Necessity of uniforms in a college) **1.6** Professional dressing and grooming etiquettes. **1.7** Body Language tips and techniques. **1.8** Role play sessions on following topics: Classroom interaction, Hospital Scene and Scene at Railway station **1.9** Performance by Students	**1.** Prepare a presentation on the given topics.

SW-1 Suggested Sessional Work (SW):

a. Assignments: 1. Body language tips

HSMC01.2: Students will be able to interact properly with improved Leadership Skills, Problem Solving Skills, Social skills and Communication Skills. Students will also be able to understand the Importance of Team Work.

Approximate Hours

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

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 Understand the techniques of Group Discussion **SO2.2**Understand the concept of Debate **SO2.3** Students will be able to design a professional resume and crack interview **SO2.4** Explain the concept of how to ace in an interview.	.	**UNIT 2:** Confidence building skills, Interview Skills and Resume Writing **2.1**Group Discussion **2.2**Do's and Donts of GD **2.3** Group Discussion sessions on impact of Covid 19 on mental health, impact of social media on lives, pros and cons of technology **2.4** Difference between GD and Debate. **2.5** Do's and Don'ts of Debate. **2.6** Debate topics on Should the Use of Plastic Be Banned? Should Parents Decide Which Career Their Children Will Pursue?, Is Artificial Intelligence Useful or Dangerous? **2.7** Interviews and their Kinds **2.8**Mock Interview Session **2.9** Resume Writing.	**1.** Prepare debate on given topics

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Resume writing

HSMC01.3: Students will be able to communicate effectively in Hindi and English languages without hindrances

Approximate Hours

Item	Appx. Hrs
Cl	10
LI	0
SW	1
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 Students will be able to organize and prepare speeches. **SO3.2** Students will be able to think and speak instantaneously. **SO3.3** To make them understand the inquiry procedure at public places. **SO3.4** To enable them to communicate effectively through phones.	.	**Unit-3 :Public Speaking Skills& Conversational Skills** **3.1** Speech **3.2** Types of Speech **3.3** Speech /Anchoring on (National Science Day, Valedictory Speech, Patriotic speech). **3.4** Performance in the class. **3.5** Extempore **3.6** Extempore Topics on (Pros and Cons of Online teaching, Environment Conservation and Education of a Girl Child) **3.7** Practice Session **3.8** Conversational Topics (Inquiry at bank, Airport, Station and Hospitals). **3.9** Telephonic Conversation (Describing about Your College Day to Your Parents from Hostel, **3.10** Talking with Customer Care Executive of Any E-Commerce Company). Revision	1. Prepare a speech on the following topics.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Talking with custmer

HSMC01.4: Students will be able to convey their messages accurately by understanding the significance of grammar as it plays a vital role in improving speaking and writing skills.

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)
SO4.1 Understanding about the use of Prepositions. **SO4.2**Students will be able to understand the usage of Tenses **SO4.3**Understand the concept of Active and Passive Voice **SO4.4**To understand the usage of Modals		**Unit-4: Functional Grammar and Vocabulary Building** **4.1** Prepositions (Place, Time and Direction) **4.2** MCQ based Questions on Prepositions. **4.3** Gap filling using prepositions. **4.4** Tenses **4.5** Present Tense **4.6** Past Tense **4.7** Future Tense **4.8** Voice (Active and Passive) **4.9** Modals.	1. Prepare the structure of Tenses and Active Passive.

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Prsesnt tense

HSMC01.5:The Understanding of Indian Culture and English Language will be developed through the study of Dramas and Poems written by Indian Writers.

Approximate Hours

Item	Appx. Hrs
CI	8
LI	0
SW	1
SL	1
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO5.1 Students will be able to understand the value of Indian Literature (R.K. Narayan) **SO5.2** Students will be able to understand the value of Indian Literature (Nissim Ezekiel) **SO5.3** Students will be able to understand the value of Indian Literature (Khushwant Singh) **SO5.4** Students will be able to understand the value of Indian Literature (Mulk Raj Anand) **SO5.5** Students will be able to understand the value of Indian Literature (Premchand)		**Unit 5-Indian Writing in English& Hindi** **5.1** The Axe- R.K. Narayan **5.2** About the Author - R.K. Narayan **5.3** The Night of the Scorpion- Nissim Ezekiel **5.4** About the Poet - Nissim Ezekiel **5.5** The Portrait of a Lady – Khushwant Singh **5.6** About the author- Khushwant Singh **5.7** The Lost Child- Mulk Raj Anand **5.8** The Shroud- Premchand	Prepare the summary of all the topics (The Axe, The Night of the Scorpion, The Portrait of a Lady, The Lost Child he Shroud).

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. Shroud premchand

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (CI+SW+Sl)
CO101.1: Students will be able to speak confidently in public as all the topics chosen emphasis on improving speaking skills and developing self confidence amongst them.	9	1	1	11
CO101.2: Students will be able to interact properly with improved Leadership Skills, Problem Solving Skills, Social skills and Communication Skills. Students will also be able to understand the Importance of Team Work.	9	1	1	11
CO101.3: Students will be able to communicate effectively in Hindi and English languages without hindrances.	10	1	1	12
CO101.4: Students will be able to convey their messages accurately by understanding the significance of grammar as it plays a vital role in improving speaking and writing skills.	9	1	1	11
CO101.5: The Understanding of Indian Culture and English Language will be developed through the study of Dramas and Poems written by Indian Writers.	8	1	1	10
Total Hours	45	5	5	55

Suggestion for End Semester Assessment

Suggested Specification Table(ForESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Self Grooming, Basic Etiquettes and Presentation.	03	01	01	05
CO-2	Confidence Building and Interview Skills.	02	06	02	10
CO-3	Public Speaking Skills and Conversational Skills	03	07	05	15
CO-4	Functional Grammar and Vocabulary Building	-	10	05	15
CO-5	Indian Writings in English and Hindi	03	02	-	05
Total		11	26	13	50

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

The end of semester assessment for communication skills English 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. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
8. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition&Year
1	Communication Skills	Dr. Meenu Pandey	Nirali Praksahan.	February 2019
2	A Practical Guide to English Grammar	K.P. Thakur	Bharti Bhawan Publishers & Distributors.	9th Edition, 2017
3	Living English Structure	W. Stannard Allen	Dorling Kindersley India Pvt. Ltd.	Fifth Edition,
4	Communication Skills for Engineers	Muralikrishna C., Sunita Mishra	Pearson, New Delhi.	Second edition(2010)
5.	Advanced Language Practice,	Michael Vince	Macmillan Education, Oxford	2003.
6.	English Conversation Practise	Grant Taylor	Tata McGraw Hill Education Private Limited.	2007
7.	Six Weeks to Words of Power	Wilfred Funk	W.R. Goyal Publishers and Distributors.	2005

Curriculum Development Team

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COs, POs and PSOs Mapping

Program Title: B. Tech Mining Engineering (English) Course Code:HSMC01 Course Title: Communication Skills

Course Outcomes	Program Outcomes												Program Specific Outcome			
	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 investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Students will be able to speak confidently in public as all the topics chosen emphasis on improving speaking skills and developing self confidence amongst them.	1	1	2	2	3	3	2	2	1	1	1	1	1	1	1	1
CO-2: Students will be able to interact properly with improved Leadership Skills, Problem Solving Skills, Social skills and Communication Skills. Students will also be able to understand the Importance of Team Work.	1	1	1	1	3	3	2	2	2	2	1	1	1	1	1	2
CO-3: Students will be able to communicate effectively in Hindi and English languages without hindrances.	1	1	2	1	2	3	1	2	1	1	1	1	1	1	1	1
CO-4: Students will be able to convey their	1	1	1	1	1	3	1	2	1	1	1	1	1	1	1	1

messages accurately by understanding the significance of grammar as it plays a vital role in improving speaking and writing skills.																
CO-5: The Understanding of Indian Culture and English Language will be developed through the study of Dramas and Poems written by Indian Writers.	**1**	**1**	**2**	**1**	1	3	1	2	1	1	**1**	**1**	**1**	**1**	**1**	**1**

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

POs & PSOs No.	Cos No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning (SL)
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO-1:** Students will be able to speak confidently in public as all the topics chosen emphasis on improving speaking skills and developing self confidence amongst them.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1: Self Grooming, Basic Etiquettes and Presentation** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO-2:** Students will be able to interact properly with improved Leadership Skills, Problem Solving Skills, Social skills and Communication Skills. Students will also be able to understand the Importance of Team Work.	SO2.1 SO2.2 SO2.3 SO2.4		**Unit-2: Confidence Building and Intervie Skills** 2.1,2.2,2.3,2.4,2.5,2.6,2.7, 2.8,2.9	SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO-3:** Students will be able to communicate effectively in Hindi and English languages without hindrances.	SO3.1 SO3.2 SO3.3 SO3.4		**Unit-3: Public Speaking Skills and Conversational Skills** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO-4:**Students will be able to convey their messages accurately by understanding the significance of grammar as it plays a vital role in improving speaking and writing skills.	SO4.1 SO4.2 SO4.3 SO4.4		**Unit-4:Functional Grammar an Vocabulary Building** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	SL 4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**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 SO5.2 SO5.3 SO5.4 SO5.5		**Unit 5:Indian Writings in English and Hindi** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8	SL 5.1

Semester-I

Course Code: **HSMC08**

Course Title : **Sustainable Development Goals (SDGs)**

Pre-requisite: Student should have basic knowledge of Environment, Natural resources, Climate change and sustainability.

Rationale: To inculcate the knowledge base on sustainable development with a view to balance our economic, environmental and social needs, allowing prosperity for now and future generations. To train students to undertake major initiatives in the efficient management of natural resources and the prevention of environmental pollution with focus on Sustainable Development.
To use environmental management tools that help to improve the quality of environment, to assess local vulnerabilities with respect to climate, natural disasters and to achieve sustainable developmental needs.

Course Outcomes:

HSMC08 .1: Examine critically the 17 newly minted UN Sustainable Development Goals and understand the historical evolution, key theories, and concepts of sustainable development.
HSMC08 .2: Identify and apply methods for assessing the achievement of sustainable development and discover the science, technology, economics, and politics underlying the concepts of sustainability.
HSMC08 .3: Understand the implications of overuse of resources, population growth and economic growth and sustainabilityand explore the challenges the society faces in making transition to renewable resource use.
HSMC08 .4: Develop skills to understand attitudes on individuals, society and their role regarding causes and solutions in the field of sustainable development and apply critical thinking skills to evaluate the quality, credibility and limitations of an argument for solution.
HSMC08 .5: Describe the steps of the design thinking methodology and how design thinking can accelerate effective SDG implementation. Deepen knowledge and pedagogical tools to incorporate values-based education for sustainable development in educational Programmes and processes.

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours (CI+LI+SW+SL	
HSMC	**HSMC08**	Sustainable Development Goal	2	0	1	1	4	2

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

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

Scheme of Assessment:
Theory

Code	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)		
HSMC	HSMC08	Sustainable Development Goal	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.

HSMC08 .1: Examine critically the 17 newly minted UN Sustainable Development Goals and understand the historical evolution, key theories, and concepts of sustainable development.

Approximate Hours

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

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

SW-1 Suggested Sessional Work (SW):

a. Assignments:

Overview of SDGs, Sustainable Consumption and Production, Details of 17 SDGs

HSMC08 .2: : Identify and apply methods for assessing the achievement of sustainable development and discover the science, technology, economics, and politics underlying the concepts of sustainability and measuring.

Approximate Hours

Item	Appx. Hrs.
Cl	06
LI	0
SW	1
SL	1
Total	8

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

SW-2 Suggested Sessional Work (SW):

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

HSMC08 .3: Understand the implications of overuse of resources, population growth and economic growth and sustainability and explore the challenges the society faces in making transition to renewable resource use.

Approximate Hours

Item	Appx. Hrs.
Cl	06
LI	0
SW	1
SL	1
Total	8

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

SW-3 Suggested Sessional Work (SW):

a. Assignments:

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

HSMC08 .4: Develop skills to understand attitudes on individuals, society and their role regarding causes and solutions in the field of sustainable development and apply critical thinking skills to evaluate the quality, credibility and limitations of an argument for solution.

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Approximate Hours

Item	Appx. Hrs.
Cl	06
LI	0
SW	1
SL	1
Total	8

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

SW-4 Suggested Sessional Work (SW):

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

HSMC08 .5: Describe the steps of the design thinking methodology and how design thinking can accelerate effective SDG implementation. Deepen knowledge and pedagogical tools to incorporate values-based education for sustainable development in educational programme and processes.

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Approximate Hours

Item	Appx. Hrs.
Cl	06
LI	0
SW	1
SL	1
Total	8

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

SW-5 Suggested Sessional Work (SW):

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

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (SI)	Total hour (Cl+SW+Sl)
HSMC08 .1: Examine critically the 17 newly minted UN Sustainable Development Goals and understand the historical evolution, key theories, and concepts of sustainable development.	6	1	1	8
HSMC08 .2: Identify and apply methods for assessing the achievement of sustainable development and discover the science, technology, economics, and politics underlying the concepts of sustainability.	6	1	1	8
HSMC08 .3: Understand the implications of overuse of resources, population growth and economic growth and sustainability and explore the challenges the society faces in making transition to renewable resource use.	6	1	1	8
HSMC08 .4: Develop skills to understand attitudes on individuals, society and their role regarding causes and solutions in the field of sustainable development and apply critical thinking skills to evaluate the quality, credibility and limitations of an argument for solution.	6	1	1	8
HSMC08 .5: Describe the steps of the design thinking methodology and how design thinking can accelerate effective SDG implementation. Deepen knowledge and pedagogical tools to incorporate values-based education for sustainable development in educational Programmes and processes.	6	1	1	8
Total Hours	30	5	5	40

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

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

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

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

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

Suggested Instructional/Implementation Strategies:

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

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition&Year
1	The Economics of Sustainable Development: The Case of India (Natural Resource Management and Policy)"	Surender Kumar and Shunsuke Managi	Springer Switzerland	2009
2	Corporate Social Responsibility in Developing and Emerging Markets	Onyeka Osuji	Cambridge	New Edition June 2022
3	Smart Cities for Sustainable Development	Ram Kumar Mishra, Ch Lakshmi Kumari, Sandeep Chachra, P.S. Janaki Krishna	Springer Switzerland	March 2022
4	Sustainable Development: Linking Economy, Society, Environment	Tracey Strange and Anne Bayley		
5	Management Of Resources For Sustainable Devpt	Sushma Goyal	The Orient Blackswan	2016
6	Energy, Environment and Sustainable Development: Issues and Policies	S. Ramaswamy Sathis G. Kumar	Regal Publications	2009
7	The New Map: Energy, Climate, and the Clash of Nations	Daniel Yergin	Penguin Press	September 2015
8	Contributions of Education for Sustainable Development (ESD) to Quality Education:	Laurie, R., Nonoyama-Tarumi, Y., Mckeown, R., & Hopkins, C.	A Synthesis of Research. Journal of Education for Sustainable Development, 10(2), 226–242.	2016
9	Sustainable Results in Development: Using the SDGs for Shared Results and Impact	OECD	OECD Publishing, Paris	2019
10	Development Discourse and Global History from colonialism to the sustainable development goals	Ziai, Aram	Routledge, London & New York	2016
11	Sustainable Development Goals An Indian Perspective,	Hazra, Somnath., Bhukta, Anindya	Springer Switzerland	2020

12	Environmental Ecology,Biodiversity and Climate Change	HM Saxena	Rawat Publication	January 2021
13	https://www.un.org/sustainabledevelopment/			
14	https://www.aiu.ac.in/documents/AIU_Publications/UN-SDG goals			
15	https://www.unesco.org/en/education-sustainable-development			
16	https://onlinecourses.nptel.ac.in/noc23_hs57/preview			
17	ttps://www.iau-hesd.net/news/5180-berlin-declaration-education-sustainable development-adopted-unesco-esd-conference-17-19			

Curriculum Development Team

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COs, POs and PSOs Mapping

Program: B. Tech. Mining Engineering
Course Code: HSMC08
Course Title: Sustainable Development Goals

Course Outcomes	Program Outcomes												Program Specific Outcome				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PS0 5
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct studies of difficult problems	Utilization of modern tools	Engineers and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-longlearning	Use fundamental knowledge of math, science, and engineering to comprehend, evaluate, and create computer Programmes in the fields of algorithms, multimedia, big data analytics, machine learning, artificial 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.
CO1. Need and Importance of Sustainable Development	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1	2
CO2. Education for Sustainable Development (ESD):Tools, Systems, and Innovation for Sustainability	1	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1	3
CO3.Discuss the sustainable production and consumption	2	2	1	1	1	2	2	2	1	2	1	2	1	1	2	2	2
CO4. How Climate Change may be Threat to Sustainable Development	3	2	2	2	3	2	3	2	2	1	2	3	3	3	3	2	2
CO5. Role of Corporations and Ecological Sustainability	-	-	-	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)
PO1,2,3,4,5,6,7,8 ,9,10,11,12 PSO1,2,3,4,5	CO1. Need and Importance of Sustainable Development	SO1.1 SO1.2 SO1.3 SO1.4		Unit 1: Introduction to Sustainable Development 1.1,1.2,1.3,1.4,1.5,1.6	SL 1.1
PO1,2,3,4,5,6,7,8 ,9,10,11,12 PSO1,2,3,4,5	CO2. Education for Sustainable Development (ESD):Tools, Systems, and Innovation for Sustainability	SO2.1 SO2.2 SO2.3 SO2.4		Unit-2Special focus on SDG 4-Quality Education and Lifelong Learning: 2.1,2.2,2.3,2.4,2.5,2.6	SL 2.1
PO1,2,3,4,5,6,7,8 ,9,10,11,12 PSO1,2,3,4,5	CO3.Discuss the sustainable production and consumption	SO3.1 SO3.2 SO3.3 SO3.4		Unit-3.0 Understanding the SDGs 3.1,3.2,3.3,3.4,3.5,3.6	SL 3.1
PO1,2,3,4,5,6,7,8 ,9,10,11,12 PSO1,2,3,4,5	CO4. How Climate Change may be Threat to Sustainable Development	SO4.1 SO4.2 SO4.3 SO4.4		Unit-4.0 Climate Change, Energy and Sustainable Development 4.1,4.2,4.3,4.4,4.5,4.6	SL 4.1
PO1,2,3,4,5,6,7,8 ,9,10,11,12 PSO1,2,3,4,5	CO5. Role of Corporations and Ecological Sustainability	SO5.1 SO5.2 SO5.3 SO5.4		Unit-5.0 Sustainable Business Practices 5.1,5.2,5.3,5.4,5.5,5.6	SL 5.1

Semester-I

Course Code: HSMC09

Course Title: Sports And Yoga

Pre-requisite: Student should have basic knowledge of Sports And Yoga concepts

Rationale: Students of Yoga should have a legal understanding of Yoga and its original text Yoga. At the same time, they should also have adequate knowledge Yoga practices in which they should have knowledge of its basic principles and elements.

Course Outcomes:

HSMC09.1: Awake the students understand the importance of **Introduction of Yoga.**
HSMC09.2: To make the students understand the importance of **Fundamentals of Yoga**
HSMC09.3 To expose the students to a variety of physical and yogic activities aimed at stimulating their continued Inquiry about Yoga, physical education, health and fitness.
HSMC09.4 To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury and **Yoga & Lifestyle**
HSMC09.5 To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health

Scheme of Studies:

Code	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)	HSMC09	Sports And Yoga	2	0	1	1	4	2

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

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

Scheme of Assessment:
Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment(PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA+ESA)
			Class/HomeAssignment5number 3 marks each (CA)	Class Test2 (2bestoutof3) 10 marks each(CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
PCC	**HSMC09**	Sports And Yoga	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.

HSMC09. 1: To make the students understand the importance of **Introduction of Yoga.**

Approximate Hours

Item	AppXHrs
Cl	06
LI	0
SW	0
SL	0
Total	06

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 Student will able to Understand the Meaning & Importance of Yoga **SO1.2** Student will able to Describe theElements of Yoga,astang yoga SO1.3Student will able to Describe Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas SO1.4Student will able to Understand the Concept of Yoga for concentration & related Asanas SO1.5Student will able to Understand the Concept ofRelaxation Techniques for improving concentration - Yog-nidra		**Unit-1. Introduction of Yoga** – 1.1 Meaning & Importance of Yoga 1.2 Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas 1.3Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana&Shashankasana) 1.4Relaxation Techniques for improving concentration - Yog-nidra 1.5Relaxation Techniques for improving concentration - Yog-nidra 1.6 Relaxation Techniques for improving concentration - Yog-nidra	

HSMC09. 2: To make the students understand the importance of **Fundamentals of Yoga**

Approximate Hours

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

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 Student will able to Understand **Fundamentals of Yoga** **SO2.2**Student will able to Understand the Effect of yoga on the functioning of Various Body Systems	.	**Unit-2. Fundamentals of Yoga** 2.1 Purpose yoga , definition of yoga , need and use of yoga for students. 2.2 Effect of yoga on the functioning of Various Body Systems. 2.3 Effect of yoga on the functioning of Various Body Systems 2.4Circulatory System, 2.5Respiratory System, 2.6 Neuro- System , Muscular System etc.	1. Effect of yoga on the functioning of Various Body Systems

SW 2 Sessional Work

a. **Assignments**
   1. Case study

HSMC09. 3: To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.

Approximate Hours

Item	AppXHrs
Cl	06
LI	0
SW	1
SL	1
Total	8

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO3.1 Student will able to Understand Meaning & Importance **Physical Fitness, Wellness & Lifestyle** **SO3.2**Student will able to Understand the Components of Physical fitness **SO3.3** Student will able to Describe **SO3.4** Student will able to Understand of Health related fitness **SO3.5** Student will able to Understand of Preventing Health **SO3.6** Student will able to Describe Concept of Positive Life	.	**Unit-3. Physical Fitness, Wellness & Lifestyle** 3.1 o Meaning & Importance of Physical Fitness & Wellness 3.2 Components of Physical fitness 3.3 Components of Health related fitness 3.4 Components of wellness 3.5 Preventing Health Threats through Lifestyle Change 3.6 Concept of Positive Lifestyle	1. **Physical Fitness**

SW 3 Sessional Work

a.Assignments

1. Physical fitness

HSMC09. 4: To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury and **Yoga & Lifestyle**

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)**
SO4.1 Student will able to Understand Asanas as preventive measures **SO4.2**Student will able to Understand the Hypertension, Obesity, Back Pain, Diabetes,Asthema,	.	**Unit-4. Yoga & Lifestyle** 4.1 Asanas as preventive measures. 4.2 Hypertension: Tadasana, Vajrasana, PavanMuktasana, ArdhaChakrasana, Bhujangasana, Sharasana. 4.3 Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana, ArdhMatsyendrasana. 4.4 Back Pain: Tadasana, ArdhMatsyendrasana, Vakrasana, Shalabhasana, Bhujangasana. 4.5 Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana,PavanMuktasana, ArdhMatsyendrasana. 4.6 Asthema: Procedure, Benefits & contraindications for Sukhasana, Chakrasana, Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana.	1. Asanas as preventive measures

SW 4 Sessional Work

a.Assignments

1.Case study

HSMC09. 5: To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health **& Postures.**

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)
SO5.1 Student will able to Understand the Meaning and Concept of Postures **SO5.2**Student will able to Understand the Causes of Bad Posture SO5.3 Student will able to Describe Concept & advantages of Correct Posture	.	**Unit-5. Postures** 5.1 Meaning and Concept of Postures. 5.2 Causes of Bad Posture. 5.3 Advantages& disadvantages of weight training. 5.4 Concept& advantages of Correct Posture. 5.5 Common Postural Deformities – Knock Knee; Flat Foot; Round Shoulders; 5.6 Lordosis,Kyphosis, Bow Legs and Scoliosis.	1.Meaning and Concept of Postures

SW-5 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Yoga & Lifestyle
   ii. Physical Fitness, Wellness & Lifestyle

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour(Cl+ SW+Sl)
C01:To make the students understand the importance of **Introduction of Yoga**	6	0	0	**6**
C02: To make the students understand the importance of **Fundamentals of Yoga** .	6	1	1	**8**
C03:To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.	6	1	1	**8**
C0.4: To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury and Yoga & Lifestyle	6	1	1	**8**
CO5 To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health **&Postures**	6	1	1	**8**
Total Hours	30	4	4	**38**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	**U**	**A**	
CO-1	Introduction of Yoga	10	10	00	20
CO-2	Fundamentals of Yoga	10	10	00	20
CO-3	Physical Fitness, Wellness & Lifestyle	05	05	00	20
CO-4	Yoga & Lifestyle	05	05	00	20
CO-5	Postures	05	05	00	20
Total		25	25	00	100

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

The end of semester assessment for yoga and sports 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 Yoga centers
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog, Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
9. Brainstorming

Suggested Learning Resources:

(a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Elements of Workshop Technology	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K.	Media promoters and publishers private limited, Mumbai	Vol. I 2008 and Vol. II 2010
2	Manufacturing Engineering and Technology	Kalpakjian S. And Steven S. Schmid	Pearson Education India	Edition, 2002
3	Manufacturing Technology	Rao P.N	Tata McGraw Hill House	Vol. I and Vol. II 2007
4	Processes and Materials of Manufacture	Roy A. Lindberg	Prentice Hall India,	4th edition, 1998
5	Lecture note provided by Dept. of Mechanical Engineering, AKS University, Satna .			

Curriculum Development Team

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Cos, Pos and PSOs Mapping

Program Title: B. Tech. Mining Engineering

Course Code: HSMC09

Course Title: Sports and yoga

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
	Engineering knowledge	Problem analysis	Design/development of solutions	Conducting vestigations ofcomplex problems	Modern toolusage	The engineer and society	Environment and sustain ability:	Ethics	Individual andteamwork:	Communication:	Project management andfinance:	Life-longlearning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of mining engineering.
CO1: To make the students understand the importance of Introduction of Yoga	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**2**	**2**	**1**	**1**	**2**	**2**	**3**	**2**	**1**
CO 2 To make the students understand the importance of Fundamentals of Yoga	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**
CO3 To expose the students to a variety of physical and yogic activities aimed continued inquiry about Yoga, physical education, health and fitness.	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO 4: To create a safe, progressive, methodical and efficient activity.	**2**	**2**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO5: To develop among students an appreciation of physical activity as a lifetime pursuit health & Postures.	**1**	**2**	**1**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

POs &PSOs No.	Cos No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,6 7,8,9 PSO1,2,3,4,5	CO-1:. To make the students understand the importance of **Introduction of Yoga.**	SO1.1 SO1.2 SO1.3 SO1.4		Unit-1.0 **Introduction of Yoga** 1.1,1.2,1.3,1.4,1.5,1.6,	SL 1.1
PO1,2,3,4,5,6 7,8,9 PSO1,2,3,4,5	CO 2 : To make the students understand the importance of **Fundamentals of Yoga**	SO2.1 SO2.2 SO2.3 SO2.4		Unit-2 **Fundamentals of Yoga** 2.1,2.2,2.3,2.4,2.5,2.6,	SL 2.1
PO1,2,3,4,5,6 7,8,9 PSO1,2,3,4,5	CO3 : To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness	SO3.1 SO3.2 SO3.3 SO3.4		Unit-3 : **Physical Fitness, Wellness & Lifestyle** 3.1,3.2,3.3,3.4,3.5,3.6,	SL 3.1
PO1,2,3,4,5,6 7,8,9 PSO1,2,3,4,5	CO 4: To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury and Yoga & Lifestyle	SO4.1 SO4.2 SO4.3 SO4.4		Unit-4**Yoga &Lifestyle**: 4.1,4.2,4.3,4.4,4.5,4.6,4.	SL 4.1
PO 1,2,3,4,5,6,7,8,9, PSO 1,2,3,4,5,	Co-5- To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health **& Postures.**			Unit 5- **Postures** **5.1,5.2,5.3,5.4,5.5,5.6**	SL 5.1

Semester-II

Course Title: Physics-1

Course Code: **BSC 101/ BSC 101-L**

Prerequisite: Students should review the fundamentals of Electrostatics Magneto statics. Wave optics, and Modern physics

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

Course Outcomes (CO):

BSC 101/ BSC 101-L.1

Find how to extend the basic concepts of motion of charged particles in electric magnetic fields to solve numerical problems and to relate to applications to electron optic device and CRO.

BSC 101/ BSC 101-L.2

Apply concepts in interference and diffraction to solve relevant numerical problems and to relate to relevant engineering applications.

BSC 101/ BSC 101-L.3

Learn the basic concepts of dual nature of matter and wave packet and apply them to analyze various relevant phenomenon and to solve related numerical problem.

BSC 101/ BSC 101-L.4

Recall the basic concepts of crystal structure and apply them in solving numerical problems based on them in relating to applications for determination of crystal structure

BSC 101/ BSC 101-L.5

Relate the basic idea of total internal reflection to the propagation of light in an optical fiber and make use of the fiber concepts to solve numerical problems and relate to applications in engineering..

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Basic Science Course (BSC)	**BSC 101/ BSC 101-L**	Physics-1	4	2	1	1	8	5

Legend:

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

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

SW: 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

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
ESC	**BSC 101/ BSC 101-L**	Physics-1	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.

BSC 101/ BSC 101-L.1
Find how to extend the basic concepts of motion of charged particles in electric magnetic fields to solve numerical problems.

Approximate Hours

Item	AppX Hrs
Cl	12
LI	4
SW	1
SL	1
Total	18

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

SO1.1 Understand the concept of Electric charge electric field intensities. **SO1.2** Understand the electrostatic potential, Calculation of electric field and electrostatic potential for a charge distribution **SO1.3** Understand the Dielectrics, Dielectric substance in an electric field **So1.4** Understand Biot Savart law & its application **So1.5** Understand the magnetic materials.	1. Measuring the magnetic field for a straight conductor and on circular conductor loops 2. Measuring the magnetic field for a straight conductor and on circular conductor loops at small currents -	**Unit-1.0** 1.1 Electric charge electric field intensities 1.2 electrostatic potential, Calculation of electric field and electrostatic potential for a charge distribution 1.3 Introduction to. Quantization & conservation of charge 1.4 Coulomb's law, vector form of Coulomb's law 1.5 superposition principle, charge densities, electric field 1.6 Dielectrics, Dielectric substance in an electric field, V-I phase dependence for ideal & real dielectrics 1.7 Biot Savart law & its application 1.8 current carrying conductor moving charge in a magnetic field 1.9 comparison of electric field and magnetic field 1.10 magnetic induction and intensity, magnetization 1.11 classification of magnetic materials. 1.12 study	**1** Define Electric charge electric field intensities

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

i. Analyze and sketch the graph of a V-I phase dependence for ideal & real dielectrics
ii. Calculation of electric field and electrostatic potential for a charge distribution

BSC 101/ BSC 101-L.2

Apply concepts in interference and diffraction to solve relevant numerical problems and to relate to relevant engineering applications.

Approximate Hours

Item	AppX Hrs
Cl	12
LI	4
SW	1
SL	1
Total	18

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

SO2.1 Define and understand the basic concepts of coherent sources, etc **SO2.2** Define and understand the basic concepts of Interference of light. **SO2.3** Understand the Michelson's Interferometer, experiments and their applications **SO2.4** Define and understand the basic concepts of diffraction of light. **SO2.5** Understand dispersive power of grating and, resolving power of grating.	**1.** To determine the Refractive Index of Prism by using spectrometer.. 2..To determine the wavelength of sodium light by using Newton's Ring apparatus -	**Unit-2.0** **2.1** coherent sources, principle of superposition **2.2** Interference:-, definition and types of interference **2.3** Interference from parallel thin films **2.4** wedge shaped films **2.5** Newton's rings **2.6** Michelson's Interferometer, experiments and their applications **2.7** Michelson's Interferometer, experiments and their applications **2.8** Diffraction:- Fresnel diffraction , Fraunhofer diffraction from a single slit diffraction **2.9** double slit diffraction **2.10** N-Slit Diffraction grating **2.11** dispersive power of grating and, resolving power of grating. 2.12 study	**`1** Define coherent sources, principle of superposition.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Write the application of Interference of light in daily life.
ii. Write the application of diffraction of light in daily life.
iii. Write a short note on Newton's rings with example.

BSC 101/ BSC 101-L.3

Learn the basic concepts of dual nature of matter and wave packet and apply them to analyze various relevant phenomenon and to solve related numerical problem

Approximate Hours

Item	AppX Hrs
Cl	12
LI	4
SW	1
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Define Quantum mechanics. **SO3.2** Understand the Wave particle duality **SO3.3** Explain operators in quantum mechanics . **SO3.4** Understand Uncertainty principle with elementary proof and applications **SO3.5** To Understand Time-dependent and time independent Schrodinger equation for wave function.	1. To determine Planck's Constant 2. work function using photo electric effect. -	**Unit-3.0** 3.1 Introduction to Quantum mechanics 3.2 Wave particle duality 3.3 de-Broglie's concept of matter waves 3.4 Free-particle wave function and wave-packets 3.5 Phase & Group velocities and their relationship 3.6 Compton Effect 3.7 Uncertainty principle with elementary proof and applications 3.8 Uncertainty principle with elementary proof and applications 3.9 operators 3.10 Time-dependent and time independent Schrodinger equation for wave function. 3.11 Time-dependent and time independent Schrodinger equation for wave function. 3.12 study	**1** Define Wave particle duality.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Write the Application of Uncertainty principle with elementary proof in real life.

BSC 101/ BSC 101-L.4

Recall the basic concepts of crystal structure and apply them in solving numerical problems based on them in relating to applications for determination of crystal structure

Approximate Hours

Item	AppX Hrs
Cl	12
LI	4
SW	1
SL	1
Total	18

<table>
<tr><th>Session Outcomes

(SOs)</th><th>Laboratory Instruction

(LI)</th><th>Class room Instruction

(CI)</th><th>Self Learning

(SL)</th></tr>
<tr><td>SO4.1

Understand the Free electron theory of metals

SO4.2

Understand the Fermi level of Intrinsic and extrinsic

SO4.3

Understand the Kronig-Penney model and origin of energy bands.

SO4.4

Understand the intrinsic & extrinsic semiconductor

SO4.5

Understand the tunnel diode, and it's applications</td><td>1.To draw the characteristics curve of

p-n junction.

2.To draw the characteristics curve of zener diode

-</td><td>Unit-4.0
4.1 Free electron theory of metals

4.2 Fermi level of Intrinsic and extrinsic

4.3 Kronig-Penney model (no derivation) and origin of energy bands.
4.4 classification of conductors, semiconductors and insulators on the basis of energy band theory

4.5 classification of conductors, semiconductors and insulators on the basis of energy band theory
4.6 semiconductors and it's classification
4.7 semiconductors and it's classification

4.8 intrinsic & extrinsic semiconductor
4.9 P-N junction
4.10 Zener diode

4.11 tunnel diode, and it's applications, Hall effect

4.12 Study</td><td>.1

Define Free electron theory of metals</td></tr>
</table>

SW-4 Suggested Sessional Work (SW):

a. Assignments:

1. Explain Kronig-Penney model and origin of energy bands.

BSC 101/ BSC 101-L.5

Relate the basic idea of total internal reflection to the propagation of light in an optical fiber and make use of the fiber concepts to solve numerical problems and relate to applications in engineering..

Approximate Hours

Item	AppX Hrs
Cl	12
LI	4

SW	1
SL	1
Total	17

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO5.1 Understand and state the Fundamental properties of laser beam **SO5.2** Understand and state the Einstein's theory of matter radiation interaction and A and B coefficients **SO5.3** Understand the different typs of lasers **SO5.4** Understand Solid-State laser (Ruby & Nd-YAG) **SO5.5** Understand applications of lasers in science, engineering and medicine.	1.To study the intensity distribution due to diffraction from single slit and to determine the slit width. 2.Study the characteristics of led and laser sources. -	**Unit-5.0** **5.1** Absorption **5.2** Stimulated and Spontaneous emission **5.3** coherence, pumping, population Inversion **5.4** Principle & properties of laser beam **5.5** Einstein's theory of matter radiation interaction and A and B coefficients **5.6** different types of lasers: gas laser (He-Ne), **5.7** different types of lasers: gas laser (He-Ne), **5.8** Solid-State laser (Ruby & Nd-YAG) **5.9** solid-state laser (Ruby & Nd-5.10 YAG) **5.11** applications of lasers in science, engineering and medicine. **5.12** applications of lasers in science, engineering and medicine.	**1** Define Absorption, Stimulated and Spontaneous emission, coherence, pumping, population Inversion. .

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. Write the Principle & properties of laser beam.

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)

BSC 101/ BSC 101-L.1 Find how to extend the basic concepts of motion of charged particles in electric magnetic fields to solve numerical problems and to relate to applications to electron optic device and CRO.	12	4	1	1	18
‘BSC 101/ BSC 101-L.2 Apply concepts in interference and diffraction to solve relevant numerical problems and to relate to relevant engineering applications.	12	4	1	1	18
BSC 101/ BSC 101-L.3 Learn the basic concepts of dual nature of matter and wave packet and apply them to analyze various relevant phenomenon and to solve related numerical problem.	12	4	1	1	18
CO4- - BSC 101.4 Recall the basic concepts of crystal structure and apply them in solving numerical problems based on them in relating to applications for determination of crystal structure	12	4	1	1	18
CO5- - BSC 101.5 Relate the basic idea of total internal reflection to the propagation of light in an optical fiber and make use of the fiber concepts to solve numerical problems and relate to applications in engineering	12	4	1	1	18
Total Hours	60	20	5	5	90

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Electrostatics & Magneto statics	02	04	05	11
CO-2	Wave optics	03	07	04	14
CO-3	Quantum mechanics	02	06	02	10
CO-4	Introduction to solids & semiconductors	03	03	02	08
CO-5	Lasers	03	02	02	07
Total		13	22	15	50

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

The end of semester assessment for Physics-1 will be held with written examination of 50 marks

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

Suggested Instructional/Implementation Strategies

1. Improved Lecture

2. Tutorial

3. Presentation

4. Group Discussion

5. Online sources

6 .Seminar

7. Workshop

Suggested Learning Resources:

a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	AICTE's Prescribed Textbook: Physics (Introduction to Electromagnetic Theory) with Lab Manual	Bhattacharya & Nag, Engineering Physics	Khanna Book Publishing Company.	2^{nd} Edition 2021
2	Introduction to Electrodynamics	David Griffiths	Tata McGraw Hill	11th Reprint, 2010.
3	Physics	Halliday and Resnick	Tata McGraw Hill	10th Edition 2018
4	Electricity, magnetism and light	W. Saslow	Academic Press	1^{st} Edition 2002
5	Engineering Physics	Malik, Singh	Tata McGraw Hill	10th Edition 2020

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Cos, POs and PSOs Mapping

Programme Title: B. Tech. Mining Engineering
Course Code: BSC101/ BSC101-L
Course Title: Physics-I

Course Outcomes	Program Outcomes												Program Specific Outcome	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
	Engineering knowledge	Problem Solving	Design Skills	Laboratory Skills	Team work	Communication Skills	Ethical and Professional Behavior	Lifelong Learning	Global and Societal Impact	Project Management	Adaptability	Professional Development	Apply Electrical and interdisciplinary knowledge to analyze, design and manufacture products to address the needs of the society.	Apply state of the art tools and techniques to conceptualize, design and introduce new products, processes, systems and services.
CO1: Find how to extend the basic concepts of motion of charged particles in electric magnetic fields to solve numerical problems and to relate to applications to electron optic device and CRO.	2	2	3	2	2	1	1	2	2	1	1	2	2	2
CO2: Apply concepts in interference and diffraction to solve relevant numerical problems and to relate to relevant engineering applications.	3	2	1	3	1	2	1	2	2	2	2	2	2	2
CO3: Learn the basic concepts of dual nature of matter and wave packet and apply them to analyze various relevant phenomenon and to solve related numerical problem.	3	3	2	1	1	2	2	2	2	1	2	3	2	2
CO4: Recall the basic concepts of crystal structure and apply them in solving numerical problems based on them in relating to applications for determination of crystal structure	2	3	3	2	3	2	1	3	2	1	2	2	2	3
CO5: Relate the basic idea of total internal reflection to the propagation of light in an optical fiber and make use of the fiber concepts to solve numerical problems and relate to applications in engineering	2	3	3	1	2	3	2	3	1	2	2	2	3	2

Legend:1–Low,2–Medium, 3–High

Course Curriculum Map

POs &PSOs No.	Cos No.& Titles	SOsNo.	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	**CO1:** Find how to extend the basic concepts of motion of charged particles in electric magnetic fields to solve numerical problems and to relate to applications to electron optic device and CRO.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1, 2	**Unit-1:** Electrostatics & Magneto statics 1.1, 1.2, 1.3, 1.4, 1.5, 1.6,1.7,1.8,1.9,1.10,1.11,1.12	SL 1.1
PO:1,2,3,4,5,6,7,8 ,9,10,11,12 PSO 1, 2	**CO2:** Apply concepts in interference and diffraction to solve relevant numerical problems and to relate to relevant engineering applications.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	1,2,	**Unit-2**: Wave optics 2.1,2.2,2.3,2.4,2.5,2.6, 2.7, 2.8, 2.9,2.10,2.11,1.12	SL 2.1
PO:1,2,3,4,5,6,7,8 ,9,10,11,12 PSO 1, 2	**CO3:** Learn the basic concepts of dual nature of matter and wave packet and apply them to analyze various relevant phenomenon and to solve related numerical problem.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	1,2	**Unit-3 :**Quantum mechanics 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11,3.12	SL 3.1
PO:1,2,3,4,5,6,7,8 ,9,10,11,12 PSO 1, 2	**CO4:** Recall the basic concepts of crystal structure and apply them in solving numerical problems based on them in relating to applications for determination of crystal structure	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	1, 2`	**Unit-4:**Introduction to solids & semiconductors 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 4.11,4.12	SL 4.1
PO:1,2,3,4,5,6,7,8 ,9,10,11,12 PSO 1, 2	**CO5:** Relate the basic idea of total internal reflection to the propagation of light in an optical fiber and make use of the fiber concepts to solve numerical problems and relate to applications in engineering	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	1,2	**Unit 5:** Lasers 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9,5.10,5.11,5.12	SL 5.1

Semester-II

Course Code: BSC104

Course Title : Mathematics -II

Pre- requisite:

Objective of this course is to familiarize the prospective engineers with techniques in Ordinary and partial differential equations and Laplace transform. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Rationale:

The program aims to develop the tool of power series and Fourier series for learning advanced engineering mathematics

Course Outcome:

BSC104.1 Understand the importance of Laplace transform and elementary properties of Laplace transform

BSC104.2 To introduce effective mathematical tools for the solutions of ordinary differential equations and solutions with Bessel functions and Legendre functions

BSC104.3 Demonstrate an understanding of the Vector Calculus

BSC104.4 Define and recognize the method to solve Sequences and series

BSC104.5 Students will create the concept of a Partial Differential Equations

Scheme of Studies:

Code	**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)	BSC104	Engineering Mathematics-II	4	0	1	1	8	4

Legend:

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

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

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

SL: Self Learning,

C: Credits.

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

Scheme of Assessment:
Theory

Code	**Course Code**	**Course Title**	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA +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)	End Semester Assessment (ESA)	
PCC	**BSC104**	Engineering Mathematics-II	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.

BSC104.1 Understand the importance of Laplace transform and elementary properties of Laplace transform

Approximate Hours

Item	AppX Hrs
Cl	13
LI	0
SW	1
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO1.1 Understand the concept ofLaplace transform of elementary functions **SO1.2** Understand the Laplace transform of derivatives **SO1.3** Understand the Inverse Laplace transform **SO1.4** Understand the Application of Laplace transform SO1.5 To define Laplace theory		**Unit-1.0** 1.1 Introduction of Laplace transform 1.2 Laplace transform of elementary functions 1.3 Linearity property 1.4 Properties of Laplace transform, 1.5 Laplace transform of derivatives 1.6 Laplace transform of Integral 1.7 Multiplication by t^n 1.8 Division by t 1.9 Inverse Laplace transform 1.10 First shifting theorem 1.11 Second shifting Property 1.12 Convolution theorem 1.13 Application of Laplace transform	**1.1** Change of scale property

SW-1 Suggested Sessional Work (SW):

a. Assignments:

1. Example on Properties of Laplace transform
2. Example on Laplace transform of derivatives
3. Example on Laplace transform of Integral

BSC104.2 To introduce effective mathematical tools for the solutions of ordinary differential equations and solutions with Bessel functions and Legendre functions

Approximate Hours

Item	AppXHrs
Cl	11
LI	0
SW	1
SL	1
Total	13

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning**
SO2.1Understand the concept Solving Second order linear differential, SO2.2 Understand the Solution by variation of parameters SO2.3 Understand the Power series solutions: SO2.4 Understand the Legendre's equations and Legendre polynomials		**2.1** Linear differential Equation with constant coefficients **2.2** Complimentary Function and Particular integral Second order linear differential Equations with variable coefficients: **2.3** Solution by Inspection Method **2.4** Solution by change of dependent variable **2.5** Solution by change of Independent variable **2.6** Solution by variation of parameters **2.7** Power series solutions(Frobenius method): **2.8** Series for Ordinary Point **2.9** Legendre's equations and **2.10** Bessel's equation and **2.11** Tutorial	**SL2.1**Examples of Fresenius method

SW-2 Suggested Sessional Work (SW):

a. Assignments:

1. Example on Solution by variation of parameters
2. Example on Power series solutions:

BSC104.3 Demonstrate an understanding of the Vector Calculus

Approximate Hours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO3.1 understand the scalar and vector point function SO3.2 Understand the Line integrals, Surface integrals Volume integrals SO3.3 Understand the Gradient ,Curl,divergence SO3.4Understand the Gauss Divergence theorems, Stoke's theorems		3.1 Differentiation of vector 3.2 scalar and vector point function 3.3 Directional derivatives 3.4 Gradient 3.5 Curl 3.6 Divergence 3.7 Line integrals, 3.8 Surface integrals 3.9 Volume integrals 3.10 Green's theorems 3.11 Gauss Divergence theorems 3.12 Stoke's theorems	**SL.1**Examples on Stoke's theorems

SW-3 Suggested Sessional Work (SW):

a. Assignments:

1. Example on Directional derivatives
2. Example on Gradient

BSC104.4 Define and recognize the method to solve Sequences and series

Approximate Hours

Item	AppXHrs
Cl	13
LI	0
SW	1
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO4.1 Understand Convergence and Divergence of sequence SO4.2 Understand the Tests for convergence SO4.3Understand Fourier series SO4.4 understand and Calculation of limits		**4.1** Limits of sequence of numbers **4.2** Convergence and Divergence of sequence **4.3** Cauchy sequence **4.4** Calculation of limits **4.5** Infinite series **4.6** Tests for convergence **4.7** Rabbe test and logarithmic test **4.8** Comparison test **4.9** Fourier series **4.10** Even and odd function **4.11** Half range sine and cosine series **4.12** Half range cosine series **4.13** Parseval's theorem.	**SL4.1**Some theorem on sequence

SW-4 Suggested Sessional Work (SW):

a. Assignments:

1. Example on Cauchy sequence
2.Example on Testsfor convergence

BSC104.5 Students will create the concept of a Partial Differential Equations

Approximate Hours

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

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Understand the Solutions of first order linear PDE **SO5.2** Understand the Solution to homogenous and Non-homogenous linear PDE **SO5.3** Understand the First order PDE **SO5.4** Understand PDE of Second order by particular integral method		5.1 Definition of Partial Differential Equations 5.2 First order PDE 5.3 Solutions of first order linear PDE 5.4 Solution to homogenous PDE 5.5 Non-homogenous linear PDE 5.6 PDE of Second order by complimentary function and 5.7 PDE of Second order by particular integral method. 5.8 Lagrange's Linear equation, 5.9 Charpit's method 5.10 Separation of variable method for the solution of heat equations 5.11 wave equations	**SL.1** Problems on PDE

SW-5 Suggested Sessional Work (SW):

a. **Assignments**

1. Example on linear PDE
2.Example on Solution to homogenous PDE
3.Example on Lagrange's Linear equation,
4.Example on PDE of Second order by complimentary function and5.Example on Charpit's method

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
CO1-BSC104.1 Understand the importance of Laplace transform and elementary properties of Laplace transform	13	1	1	15
CO2- BSC104.2 To introduce effective mathematical tools for the solutions of ordinary differential equations and solutions with Bessel functions and Legendre functions	11	1	1	13
CO3- BSC104.3 Demonstrate an understanding of the Vector Calculus	12	1	1	14
CO4- BSC104.4 Define and recognize the method to solve Sequences and series	13	1	1	15
CO5- BSC104.5 Students will create the concept of a Partial Differential Equations	11	1	1	13
Total Hours	60	5	5	70

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**				**Total Marks**
		R	**U**	**A**		
CO-1	Understand the importance of Laplace transform and elementary properties of Laplace transform	03	01	01	-	05
CO-2	To introduce effective mathematical tools for the solutions of ordinary differential equations and solutions with Bessel functions and Legendre functions	02	06	02		10
CO-3	Demonstrate an understanding of the Vector Calculus	03	07	05		15
CO-4	Define and recognize the method to solve Sequences and series	-	10	05		15
CO-5	Students will create the concept of a Partial Differential Equations	03	02	0		05
Total		11	26	13		50

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

The end of semester assessment for Introduction to 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. Presentation
4. Group Discussion
5. Online sources
6. Seminar
7. Works

Suggested Learning Resources:

a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Engineering Mathematics-II	D.K, Jain	Shree Ram Prakashan.	7th Edition 2015-16
2	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	36th Edition, 2010
3	Engineering Mathematics-II	D.C.Agrawal	Shree Sai Prakashan	10th Edition 2018
4	Higher Engineering Mathematics	B.V. Ramana	Tata McGraw Hill	11th Reprint, 2010.

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COs, POs and PSOs Mapping

Programme Title: B. Tech. Mining Engineering
Course Code: BSC104
Course Title: Mathematics-II

Course Outcomes	Program Outcomes												Program Specific Outcome	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
	Engineering knowledge	Problem Solving	Design Skills	Laboratory Skills	Team work	Communication Skills	Ethical and Professional Behavior	Lifelong Learning	Global and Societal Impact	Project Management	Adaptability	Professional Development	Apply electrical and interdisciplinary knowledge to analyze, design and manufacture products to address the needs of the society	Apply state of the art tools and techniques to conceptualize, design and introduce new products, processes, systems and services
CO1-Understand the importance of Laplace transform and elementary properties of Laplace transform	3	3	2	2	2	1	1	2	2	1	2	2	2	3
CO2-To introduce effective mathematical tools for the solutions of ordinary differential equations and solutions with Bessel functions and Legendre functions	3	3	3	3	2	2	1	3	2	2	2	3	3	2
CO3-Demonstrate an understanding of the Vector Calculus	3	2	3	2	2	1	2	2	2	2	2	3	3	2
CO4- Define and recognize the method to solve Sequences and series	3	3	2	2	2	2	2	3	2	2	2	2	2	3
CO5- Students will create the concept of a Partial Differential Equations	3	3	3	3	2	3	2	3	2	2	2	2	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	**CO1-**Understand the importance of Laplace transform and elementary properties of Laplace transform	SO1.1 SO1.2 SO1.3 SO1.4		Unit-1.0 Laplace Transform1.1,1.2,1.3,1.4,1.5,1.6.1.7,1.8,1.9,1.10,1.11,1.12,1.13	SL1.1
PO:1,2,3,4,5,6,7,8,9,10 ,11,12 PSO 1,2	**CO2-**To introduce effective mathematical tools for the solutions of ordinary differential equations and solutions with Bessel functions and Legendre functions	SO2.1 SO2.2 SO2.3 S02.4		Unit-2 Ordinary differential equations of higher orders:2.1, 2.2, 2.3, 2.4,2.5,2.6,2.7,2.8,2.9,2.10,2.11	SL2.1
PO:1,2,3,4,5,6,7,8,9,10 ,11,12 PSO 1,2	**CO3-**Demonstrate an understanding of the Vector Calculus	SO3.1 SO3.2 SO3.3 SO3.4		Unit-3Vector Calculus 3.1, 3.2, 3.3, 3.4, 3.5 ,3.6,3.7,3.8,3.9,3.10,3.11,3.12	SL3.1
PO:1,2,3,4,5,6,7,8,9,10 ,11,12 PSO 1,2	**CO4-** Define and recognize the method to solve Sequences and series	SO4.1 SO4.2 SO4.3 SO4.4		Unit-4 Sequences and series 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8,4.9,4.10,4.11,4.12,4.13	SL4.1
PO:1,2,3,4,5,6,7,8,9,10 ,11,12 PSO 1,2	**CO5-** Students will create the concept of a Partial Differential Equations	SO5.1 SO5.2 SO5.3 SO5.4		Unit-5Partial Differential Equations5.1, 5.2, 5.3, 5.4, 5.5, 5.6 ,5.7,5.8,5.9,5.10,5.11	SL5.1

Semester-II

Course Code: MIN-101

Course Title: Basic Mining Engineering

Pre-requisite: Student should have basic knowledge of Mining overview, Rocks, Minerals.

Rationale: The students studying Mining engineering should possess foundational understanding about historical rocks and minerals and basic knowledge of mining methods. Additionally, students ought to acquire fundamental insights into various general regulations, acts and administration as per requirement of mining industries.

Course Outcomes:

MIN101.1: Describe about geology of coal and other minerals.

MIN101.2: Explain about mines act and regulations.

MIN 101.3: Summarize about mining methods such as opencast mining and Underground mining.

MIN101.4: Illustrate about Environmental impact assessment and its management plan.
MIN101.5: Utilize the vocational training knowledge in his professional career.

Scheme of Studies:

Code	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)	MIN101	Basic Mining Engineering	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.

Scheme of Assessment:

Theory

<table>
<tr><th rowspan="3">Code</th><th rowspan="3">Course Code</th><th rowspan="3">Course Title</th><th colspan="8">Scheme of Assessment(Marks)</th></tr>
<tr><th colspan="6">Progressive Assessment(PRA)</th><th rowspan="2">End Semester Assessment
(ESA)</th><th rowspan="2">Total Marks
(PRA+ESA)</th></tr>
<tr><th>Class/Home Assignment 5 number 3 marks each (CA)</th><th>Class Test2 (2bestout of3) 10 marks each(CT)</th><th>Seminar one (SA)</th><th>Class Activity any one (CAT)</th><th>Class Attendance (AT)</th><th>Total Marks (CA+CT+SA+CAT+AT)</th></tr>
<tr><td>PCC</td><td>MIN 101</td><td>Basic Mining Engineering</td><td>15</td><td>20</td><td>5</td><td>5</td><td>5</td><td>50</td><td>50</td><td>100</td></tr>
</table>

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.

MIN101.1: Describe about geology of coal and other minerals**.**

Approximate Hours

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

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 Basic idea of Geology and branches. **SO1.2**Rock types and importance **SO1.3**Minerals importance **SO1.4**Uses of various minerals **SO1.**5 Prospecting and exploration .		**Unit-1.0 Mining Geology** 1.1 Internal structure of earth. 1.2 Geology & its branches. 1.3 Rocks and its type 1.4 Mineral & its Type 1.5 Ferrous minerals 1.6 Coal 1.7 Metal 1.8 prospecting & exploration 1.9 Different types of drilling for exploration	1. Types of rock and Minerals 2. Importance of Minerals.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

Rock types and minerals importance.

MIN101.2: Explain about mines act and regulations

Approximate Hours

Item	Approx Hrs
Cl	9
LI	0
SW	2
SL	2
Total	13

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1 Knowledge a brief on Mining in Ancient India **SO2.2 Understand the** mines safety rules as per DGMS **SO2.3 U**nderstand the Mining administrations. **SO2.4**Toknow the mining acts. **SO2.5** Learn about the career in Mining.		**Unit-2 Mining administration** 2.1 Brief on Mining in Ancient India & Kautilya Athashatra 2.2 Mines safety –mines safety-DGMS. 2.3 CIM- appointment of CIM /IM & role of DGMS. 2.4 Indian bureau of mines, CIMFR – Coal India and its subsidiary companies. 2.5 NLC, SCCL, AGENCIES of commercial mining of coal, 2.6 Acts, rules & regulation related to mining in India 2.7 Types of additives used in Portland cement clinker manufacture. 2.8 Research institution- CIMFR, IIT 2.9 mine planning, careers in mining.	i. Learning about the mining administration ii. Mining careers

SW-2 Suggested Sessional Work (SW):

a. **Assignments:**

Role of DGMS in Mining sector

Role of IBM in Mining sector

b. **Mini Project**:

Marking of major Coal belts in India map

MIN101.3: Summarize about mining methods such as opencast mining and Underground mining.

Approximate Hours

Item	Approx Hrs
Cl	09
LI	0
SW	2
SL	2
Total	13

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO3.1 Describe type of Mining Coal & Metal. **SO3.2**Able to select mining methods **SO3.3**Explain the underground mining **SO3.4**Explain the Opencast mining **SO3.5** Analyze the mining system		**Unit-3:Mining Methods** 3.1 Definition type of Mining Coal 3.2 Definition type of Mining Metal 3.3 Selection of Mining methods 3.4 Stripping ratio-box cut-dump for OB 3.5 Stripping ratio-box cut-dump for Coal 3.6 Stripping ratio-box cut-dump for Metal 3.7 Dragline system-unit operations 3.8 Over burden removal, dumping of OB, 3.9 Type of HEMM	i. Type of coal **ii.** Opencast Mining

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i) Illustrate the various mining methods.

ii) Draw and explain the HEMM

b.Mini Project:

Make a tale chart of Pit top lay out model.

MIN101.4: Illustrate about Environmental impact assessment and its management plan.

Approximate Hours

Item	Approx Hrs
Cl	9
LI	0
SW	2
SL	2
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO4.1Explain Mining Contribution To civilization **SO4.2 Implement** National Mineral Policy **SO4.3 Acts** MMDR Act 2015 **SO4.4 Analyze** environmental impact of mining **SO4.5** Induce EIM		**Unit-4: Environmental Impact** 4.1 Mining contribution to civilization. 4.2 National mineral policy 4.3 MMDRact2015 4.4 Describe coal statistics etc. 4.5 Environmental impact of mining (land water & air). 4.6 Environmental impact control methods 4.7 Benches-bench dimensions 4.8 Production 4.9 Face drilling	i. Importance of mining in society. ii. MMDR Act issue by DGMS

SW-4 Suggested Sessional Work (SW):

a. **Assignments:**
   Discuss national mineral policy
   Describe environmental impact
b. **Other Activities (Specify):**
   Power Point Presentation of NMP 2020.

MIN101.5: Utilize the vocational training knowledge in his professional career.

Approximate Hours

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

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning (SL)
SO5.1 Observe In UG Coal/Metal mines. **SO5.2**Preparation of Surface Layout. **SO5.3**Comprehend Pit top-Haulage system. **SO5.4**Analyze ventilation system in u/g mines. **SO5.**5Discuss lighting systems in mines.		**Unit 5:Vocational training aids** 5.1 What do we see/observe in UG Coal/Metal mines. 5.2 Surface Layout-It includes offices, coal handling plant(CHP)or ore handling plant 5.3 Siding, coal/ore transport system 5.4 Pit top-Haulage Winder main mechanical ventilator its type 5.5 fan house, lamp room, first aid room 5.6 man riding system, entrance to travelling road ways 5.7 Depillaring face ventilation, brattice cloth, air crossing 5.8 conveyor or rope haulage system(in inclines) 5.9 lighting system electric substation	1.Observation about underground opencast mining.

SW-5-Suggested Sessional Work (SW):

a. Assignments:

Describe rope haulage system in incline.
Stipulate standards of electricity as per DGMS

b.Mini Project:

Draw a layout of rope haulage system.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour(Cl+SW+Sl)
MIN 101.1: Describe about geology of coal and other minerals.	9	1	2	12
MIN101.2: Explain about mines act and regulations.	9	2	2	13
MIN 101.3: Summarize about mining methods such as opencast mining and Underground mining.	9	2	2	13
MIN 101.4: Illustrate about Environmental impact assessment and its management plan.	9	2	2	13
MIN 101.5: Utilize the vocational training knowledge in his professional career.	9	2	1	12
Total Hours	45	9	9	63

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Describe about geology of coal and other minerals.	03	01	01	05
CO-2	Explain about mines act and regulations.	02	06	02	10
CO-3	Summarize about mining methods such as opencast mining and Underground mining.	03	07	05	15
CO-4	Illustrate about Environmental impact assessment and its management plan.	03	07	05	15
CO-5	Utilize the vocational training knowledge in his professional career.	03	02	-	05
Total		14	23	13	50

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

The end of semester assessment for Basic Mining Engineering 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 mining industries
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	Elements Of Mining Technology	D.J. Deshmukh	Denett & Co. Nagpur, New Delhi, Chennai Pune	2016
2	Introduction To Mining	Dr. G.K. Pradhan	Mine Tech Publication	2020

(b) Link https://nptel.ac.in/

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Cos. Pos and PSOs Mapping

Program Title: B. Tech. Mining Engineering

Course Code: MIN-101

Course Title: Basic Mining Engineering

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability:	Ethics	Individual and team work:	Communication:	Project management and finance:	Life-long learning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of mining engineering.
CO1:Describe about geology of coal and other minerals.	1	2	1	1	1	2	1	2	2	1	1	2	2	3	2	1
CO 2 Explain about mines act and regulations.	1	1	2	2	1	2	3	2	1	1	2	2	2	1	2	1
CO3Summarize about mining methods such as opencast mining and Underground mining.	1	1	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO 4: Illustrate about Environmental impact assessment and its management plan.	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO5:Utilize the vocational training knowledge in his professional career.	1	2	1	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

Pos & PSOs No.	Cos No & Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction (CI)	Self Learning(SL)
PO1,2,3,4,5,67, 8,9,10,11,12 PSO1,2,3,4	CO1: Describe about geology of coal and other minerals.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 Mining Geology 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 2 Explain about mines act and regulations.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2Mining administration 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9	SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO3 Summarize about mining methods such as opencast mining and Underground mining.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3: Mining Methods 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8, 3.9	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 4: Illustrate about Environmental impact assessment and its management plan.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4:Environmental Impact 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	SL 4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 5: Utilize the vocational training knowledge in his professional career.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit5:Vocational training aids 5.1,5.2,5.3,5.4,5.5, 5.6, 5.7, 5.8, 5.9	SL 5.1

Semester-II

Course Code: **BSC105**

Course Title: Biology for Engineers.

Pre-requisite: Student should have basic knowledge of biology

Rationale: Engineering combines scientific knowledge with creative activities to move beyond current knowledge and produce original solutions to important problems. Biological systems are subject to the laws of chemistry and physics, which are also the basis of engineering, biological systems can provide excellent examples of the applications of statics, dynamics, chemical affinities, energy relations, and other concepts taught in undergraduate engineering science courses.

Course Outcomes:

BSC105.1: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry
BSC105. 2: To convey the classification of organism underlying criterion, such as morphological, biochemical or ecological be highlighted.
BSC105. 3: To convey that “Genetic`s is to biology what Newton’s laws are to Physical Sciences” and Understand the molecular basis of coding and decoding genetic information is universal
BSC105 4: To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine. To convey that without catalysis life would not have existed on earth
BSC105. 5: To convey the concept of microbes and their role in environment.

Scheme of Studies:

Code	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)	**BSC105**	Biology for Engineers	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.

`**Scheme of Assessment:**

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment(PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test2 (2 best out Of 3) 10 mark each(CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
Program Core (PCC)	**BSC105**	Biology for Engineers	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.

BSC1051: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry

Approximate Hours

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

Session Outcomes (SOs)	**Class room Instruction (CI)**	**Self-Learning (SL)**
1.1: Why we need to study biology 1.2 To know the differences and similarities between human eye and camera. 1.3 Analyze the mechanism of birds flying with Aircraft 1.4 .Gain knowledge about the role of biology with discoveries in living world. 1.5 To understand the concept and amazing facts about living organisms.	**Unit1**. Introduction 1.1-Introduction to biology branches 1.2scopes 1.3: comparison between eye and 1.4 camera 1.5: Comparison between Bird flying and 1.6aircraft 1.7 Important discoveries of biology. 1.8 Living organisms, 1.9characteristics of living organism	1.1: Importance of Biology in engineering 1.2 Discuss how biological observations of 18^{th} Century that lead to major discoveries

Sessional Work (SW1)

a. Assignments

1. Living organism

BSC105.2: To convey the classification of organism underlying criterion, such as morphological, biochemical or ecological be highlighted

Approximate Hours

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

Session Outcomes (SOs)	Class room Instruction (CI)	Self-Learning (SL)
2.1 Hierarchy of life forms at phenomenological level. 2.2: Understand ultra structure of prokaryotic and eukaryotic organism, 2.3 Study mode of nutrition in organism. 2.4 To understand the major types of kingdoms	**Unit2**. *Classification* 2.1 Discuss classification based on cellularity- 2.2Unicellular or multicellular 2.3: Discuss classification based on Ultra structure 2.4 prokaryotes or eukaryotes. 2.5 classification based on energy and 2.6Carbon utilization – 2.7 Molecular taxonomy- 2.8 Three major kingdoms 2.9 life.	2.1: Study different examples of uni and multicellular examples 2.2: Gain knowledge about the basic structure of cell and functions of cell organelles

SW-2 Suggested Sessional Work (SW):

a.Assignments:

Kingdoms life

BSC1053: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences and Understand the molecular basis of coding and decoding genetic information is universal

.

Approximate Hours

Item	Appx.Hrs.
Cl	9
LI	0
SW	1
SL	4
Total	14

Session Outcomes (SOs)	Class room Instruction (CI)	Self-Learning (SL)
3.1 Illustrate how genetic material passes from parent to offspring? Concepts of recessiveness and dominance. 3.2: Understand the cell cycle and its importance and types of cell division. 3.3: Able to realize concept of mapping of phenotype to genes. 3.4 Discuss about the single gene disorders in humans. 3.5 Analyze the molecular basis of information transfer and study the DNA structure and compacting of genome 3.6 Gaining knowledge about the universality and degeneracy of genetic code.	Unit 3.Genetics & Information Transfer 3.1: Mendel's laws, Concept of segregation and independent assortment. Concept of allele. 3.2: Meiosis and 3.3 Mitosis 3.4: Genome mapping 3.5: Gene disorders in humans 3.6 DNA as a genetic material. 3.7 Hierarchy of DNA structure- from single stranded to double helix to 3.8 nucleosomes. 3.9 Concept of genetic code	3.1: Build-up the concept on the phenotype and genotype. Concepts of excessiveness and dominance 3.2 basic knowledge of cell and cell theory 3.3: concepts of physical and genetic mapping. 3.4: Boost your knowledge on some genetic disorders in human. And mutation.

SW-3 Suggested Sessional Work (SW):

a. **Assignments:**
   Cell theory

BSC105.4 To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine. To convey that without catalysis life would not have existed on earth

Approximate Hours

Item	Approx Hrs
Cl	9
LI	0
SW	1
SL	3
Total	14

Session Outcomes (SOs)	Class room Instruction (CI)	Self-Learning (SL)
4.1: In this context discuss monomeric units and polymeric structures. 4.2To know about the structure and functions of carbohydrates. 4.3: Able to know about the building blocks of proteins. 4.4: Understand proteins- structure and function. Hierarchy in protein structure. Primary secondary, tertiary and quaternary structure. 4.5: Analyze the how does an enzyme catalyze reactions?	Unit 4- Biochemistry and metabolism and Enzymes 4.1 Molecules of life 4.2: Discuss about sugars, starch and cellulose. 4.3: Amino acids 4.4: proteins 4.5: Enzyme 4.6 classification. 4.7Mechanism of enzyme 4.8 action 4.9 Life	4.1: Study about the various disorders related to carbohydrate metabolism. 4.2 Learn names of essential and non essential amino acids. 4.3 To know about the important enzymes of human body and discuss two examples.

SW-4 Suggested Sessional Work (SW):

a. **Assignments:**
   Amino acids

BSC105.5: To convey the concept of microbes and their role in environment.

Approximate Hours

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

Session Outcomes (SOs)	Class room Instruction (CI)	Self-Learning (SL)
5.1: Gain the knowledge of different microscopic techniques. 5.2: To gain knowledge about different bacterial species and strain. 5.3: Understand principle and types of sterilization used in microbiology. 5.4: Study the different components used in media and preparation of medium 5.5 Analyze the microbial growth curve.	**Unit 5**. Microbiology 5.1 Microscopy 5.2 Microscopy continue 5.3 Concept of species 5.4 strains 5.5 Sterilization 5.6 media 5.7compositions. 5.8 Growth 5.9 kinetics.	5.1: Concept of single celled organisms 5.2 Ecological aspects of single celled organisms

SW-5 Suggested Sessional Work (SW):

a. **Assignments:**

Organisms Concept

Brief of Hours suggested for the Course Outcome:-

Course Outcomes(COs)	Class lecture(CI)	Self-Learning (SL)	Sessional work (SW)	Total Hours (CI+SL+SW)
CO 1: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.	9	2	1	12
CO 2: To convey the classification of organism underlying criterion, such as morphological, biochemical or ecological be highlighted.	9	2	1	12
CO 3: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" and Understand the molecular basis of coding and decoding genetic information is universal	9	4	1	14
CO 4 To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine. To convey that without catalysis life would not have existed on earth	9	3	1	13
CO5: To convey the concept of microbes and their role in environment	9	2	1	12
Total Hours	45	13	5	63

Suggested Specification Table (For ESA)

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Group Discussion
4. Role play
5. Presentations
6. Extempore
7. Speeches
8. Brainstorming

Suggested Learning Resources:

(a) Books:

S. no.	Title	Author	Publisher	Edition & Year
1	Biology for engineers	Arthur T Johansson	CRC Press	4^{th} , 2018

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Cos, POs and PSOs Mapping

Programme Title: B. Tech. Mining Engineering
Course Code: BSC105
Course Title: Biology for engineers

Course Outcomes	Program Outcomes												Program Specific Outcome	
	PO 1	PO 2	PO 3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO10	PO1 1	PO1 2	PSO 1	PSO 2
	Engineering knowledge	Problem Solving	Design Skills	Laboratory Skills	Team work	Communication Skills	Ethical &Professional Behavior	Lifelong Learning	Global and Societal Impact	Project Management	Adaptability	Professional Development	Apply electrical and interdisciplinary knowledge to analyze, design and manufacture products to address the needs of the society	Apply state of the art tools and techniques to conceptualize, design and introduce new products, processes, systems and services
CO1: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.	3	3	2	3	3	2	1	2	3	2	2	3	3	2
CO2:To convey the classification of organism underlying criterion, such as morphological, biochemical or ecological be highlighted.	3	3	3	2	2	2	1	2	1	2	2	2	2	2
CO3:To convey that “Genetics is to biology what Newton’s laws are to Physical Sciences” andUnderstand the molecular basis of coding and decoding genetic information is universal	3	3	2	2	3	1	2	2	1	2	2	3	2	2
CO4 To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine. To convey that without catalysis life would not have existed on earth	3	3	2	2	2	1	1	3	2	2	2	2	3	3
BSC107.5:To convey the concept of microbes and their role in environment	3	3	3	3	2	3	2	3	2	2	2	2	3	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Instruction Laboratory (LI)	Classroom Instruction(CI)	Self-Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2	**CO1:** To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.	SO1.1, SO1.2 SO1.3, SO1.4 SO1.5		Unit-1. Introduction 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	SL 1.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2	**CO2:**To convey the classification of organism underlying criterion, such as morphological, biochemical or ecological be highlighted.	SO2.1, SO2.2 SO2.3, SO2.4		Unit-2 Classification analytic methods using R 2.1, 2.2, 2.3, 2.4,2.5,2.6,2.7,2.8,2.9	SL 2.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2	**CO3:**To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" and Understand the molecular basis of coding and decoding genetic information is universal	SO3.1,SO3.2 SO3.3,SO3.4 SO3.5, SO3.6		Unit-3 : Genetics& Information Transfer 3.1, 3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9	SL 3.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2	**CO4** To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine. To convey that without catalysis life would not have existed on earth	SO4.1, SO4.2 SO4.3, SO4.4 SO4.5		Unit-4 : Biochemistry and metabolism and Enzymes 4.1, 4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	SL 4.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2	**CO.5:**To convey the concept of microbes and their role in environment	SO5.1, SO5.2 SO5.3, SO5.4 SO5.5		Unit-5 : Microbiology 45.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9	SL 5.1

Semester-II

Course Code: **ESC101/ ESC101-L**

Course Title : **Basic Electrical Engineering**

Pre-requisite: Students should have basic knowledge of Basic Circuit Elements with brief information of AC, DC, and electromagnetic concepts.

Rationale: A process of introducing formal knowledge of basic electrical elements and AC, DC, and magnetic circuit in electrical and electronic devices along with necessary knowledge about single-phase Transformer and DC machine.

Course Outcomes:

ESC101/ ESC101-L.1: Apply network theorems to solve electrical DC circuits.

ESC101/ ESC101-L.2: Understand the concept of sinusoidal quantities and solve single phase AC circuits.

'ESC101/ ESC101-L.3: Analyze the three phase AC circuits and solve series and parallel magnetic circuits.

ESC101/ ESC101-L.4: Understand the basic operating principle, types, efficiency of Transformers

ESC101/ ESC101-L.5: Understand the basic operating principle, types of machines.

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours(CI+LI+SW+SL)	
Engineering Science Courses (ESC)	**ESC101/ ESC101-L**	BASIC ELECTRICAL ENGINEERING	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.

Scheme of Assessment:
Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+AT)		
ESC	**ESC101/ ESC101-L**	BASIC ELECTRICAL ENGINEERING	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

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

`

ESC101/ ESC101-L.1: Apply network theorems to solve electrical DC circuits.

Approximate Hours

Item	AppX Hrs
Cl	07
LI	12
SW	2
SL	1
Total	22

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Understand the Classification of electrical elements. **SO1.2** Understand the concept of voltage and current source. **SO1.3** Understand the concept of mathematical analysis based on KCL and KVL. **SO1.4** Analyze differen network theorems. **SO1.5** Understand the concept of star-delta transformation..	1. Verification of KVL. 2. Verification of KCL. 3. Identification of different electrical and electronic components. 4. Calculation of Power, Impedance and P.F. in R-L-C Circuits. 5. Verification of Superposition Theorem. 6. Verification of Thevenin's Theorem.	**Unit-1:DC Network** 1.1 Classification of elements – active, passive, unilateral, bilateral, linear, nonlinear, lumped and distributed 1.2 classification of voltage 1.3 current sources 1.4 mesh and nodal analysis 1.5 Superposition theorem 1.6 Star-Delta Transformations (Numerical only). 1.7 Thevenin's theorem (Only independent sources).	1. Learn the theoretical concept of circuit element.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Numerical Problems on mesh and nodal analysis.

b. Mini Project:

i. Derive different network theorems.

ESC101/ ESC101-L.2: Understand the concept of sinusoidal quantities and solve single phase AC circuits.

Approximate Hours

Item	AppX Hrs
Cl	7
LI	2
SW	2
SL	1
Total	12

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO2.1 To Understand the concept of sinusoidal periodic waveforms. **SO2.2** To understand the concept of phase difference. **SO2.3**To understand the different triangles. **SO2.4** To understand the different connections. **SO2.5`** To define power triangle	1. Study about different types of connection in AC circuit.	**Unit-2Single-Phase AC Circuits** 2.1 Sinusoidal periodic waveforms: frequency, cycle, time period, peak value, root mean square value, average value, form factor and peak factor. 2.2 Phasor representation of alternating quantities. 2.3 Concept of phase difference 2.4 The j operator 2.5 Rectangular and polar form 2.6 Power Triangle 2.7 Impedance Triangle	1. Remember different concept related to the Sinusoidal Periodic Waveform.

SW-2 Suggested Sessional Work(SW):

a. **Assignments:**
   i. Numerical Problems on Sinusoidal Network.
   ii. Numerical Problems on Power Triangle and Impedance Triangle.
   iii. Numerical Problems on Series and Parallel Circuit.

b. **Mini Project:**
   a. Draw the chart of Phasor Representation.

ESC101/ ESC101-L.3: Analyze the three phase AC circuits and solve series and parallel magnetic circuits.

Approximate Hours

Item	AppX Hrs
Cl	9
LI	4
SW	2
SL	1
Total	16

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO3.1 To Understand the basic concept of three-phase AC circuit. **SO3.2**To understand the different types of connection of three-phase winding. **SO3.3**To Understand the three-phase power equations. **SO3.4**To Understand the concepts of magnetic circuit. **SO3.5** To understand the concept of leakage flux and fringing.	1. Study about the different types of three-phase AC circuits. 2. Study different concepts related with Magnetic Circuit.	**Unit-3 :Three-Phase AC Circuit** 3.1 Introduction 3.2 phase sequence 3.3 balanced load 3.4 Connection of Three-phase Windings (delta and star connection): line and phase quantities. 3.5 phasor diagrams 3.6 Three phase power equations in balanced conditions (Elementary Numerical). 3.7 Magnetic Circuits: Introduction 3.8 magneto motive force (MMF) 3.9 magnetic field strength magnetic flux reluctance Comparison of the electric and magnetic circuits.	1. Basic principle of three-phase AC Circuit.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Numerical Problems on three-phase load.

b. Mini Project

1. Numerical Problems on Magnetic circuit.

ESC101/ ESC101-L.4: Understand the basic operating principle, types, efficiency of Transformers.

Approximate Hours

Item	AppX Hrs
Cl	10
LI	8
SW	2
SL	2
Total	22

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 To Understand the constructional and operational features of Single-phase Transformer. **SO4.2** Understanding the classification of Transformer. **SO4.3**Understand the different concept related with transformer **SO4.4** Derive EMF equation of transformer. **SO4.5** Understand the Phasor Diagram at different loads.	1. Study the construction details of transformer. 2. Perform open circuit and Short Circuit test on single-phase transformer. 3. Study and Verification of Transformer Ratio Polarity. 4. Perform Back to back Test on Transformer	**Unit-4: Single-Phase Transformer** 4.1 Introduction 4.2 principles of operation 4.3 Construction 4.4 classification of transformers 4.5 Rating of transformer 4.6 EMF equation 4.7 ideal and practical transformer 4.8 phasor diagram under no load and loaded conditions 4.9 losses 4.10 efficiency calculations Condition of Maximum Efficiency All day efficiency (Elementary Numerical)	i. Remember different parts of transformer. ii. Calculate Losses and Efficiency of transformer.

SW-4 Suggested Sessional Work(SW):

a. Assignments:

i. Numerical Problems on transformer

c. **Mini Project:**

i. Draw phasor diagram of transformer at different loads.

ESC101/ ESC101-L.5: Understand the basic operating principle, types of machines.

Approximate Hours

Item	AppX Hrs
Cl	12
LI	4
SW	1
SL	1
Total	18

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO5.1 Understand the constructional details of DC machines. **SO5.2**Derive EMF and Torque equations. **SO5.3** Evaluate different types of dc machine. **SO5.4** Understanding the Electrical Installation. **SO5.5** To define MCB	1. Study different components of DC Motor and Three Phase Starter. 2. Study of different components of Induction Motor and Star-Delta Starter.	**Unit 5: DC Machines** 5.1 Common Construction features of DC Machines 5.2 EMF equation and torque equation 5.3 types of DC machines (Separately & self-excited) 5.4 Elementary numerical 5.5 Components of LT Switchgear 5.6 Switch fuse unit(SFU) 5.7 MCB 5.8 Types of wires and cables 5.9 Earthing 5.10 ELCB 5.11 MCCB 5.12 Torque equation	1. Remember the Constructional features of DC Machine.

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. Numerical Problem based on EMF and Torque equation of DC machine.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Lecture (Ll)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
ESC101/ ESC101-L.1: Apply network theorems to solve electrical DC circuits.	7	12	2	1	22
ESC101/ ESC101-L.2: Understand the concept of sinusoidal quantities and solve single phase AC circuits.	7	2	2	1	12
ESC101/ ESC101-L.3: Analyze the three phase AC circuits and solve series and parallel magnetic circuits.	9	4	2	1	16
ESC101/ ESC101-L.4: Understand the basic operating principle, types, efficiency of Transformers.	10	8	3	2	22
ESC101/ ESC101-L.5: Understand the basic operating principle, types of machines.	12	4	1	1	18
Total Hours	45	30	10	6	90

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	DC Network	03	01	01	05
CO-2	Single-Phase AC Circuit	02	03	02	07
CO-3	Three-Phase AC Circuit	02	04	04	10
CO-4	Single-Phase Transformer	03	07	05	15
CO-5	DC Machines	01	06	06	13
Total		11	23	16	50

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

The end of semester assessment for Process calculation 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 electrical power plant
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook, Twitter,Whatsapp,Mobile,Onlinesources)
9. Brainstorming

Suggested Learning Resources:

(a) **Books**:

S. No.	Title	Author	Publisher	Edition & Year
1	Basic Electrical Engineering	Fitzrald and Higgonbothom	Tata McGraw-Hill	Fifth
2	Theory and Problems of Basic Electrical Engineering	D.P. Kothari and I. J. Nagrath	Prentice Hall India Learning Private Limited	2016 - Second
3	Basic Electrical Engineering	D. C. Kulshreshtha	McGraw Hill	2009
4	Fundamentals of Electrical Engineering	Ashfaq Hussain	Dhanpat Rai and Co	Third
5	Lecture note provided by Dept. of electrical engineering, AKS University, Satna.			

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Cos, POs and PSOs Mapping

Program Title: B. Tech. Mining Engineering
Course Code: ESC101/ ESC101-L
Course Title: Mine Electrical Technology

Course Outcomes	Program Outcomes												Program Specific Outcome	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
	Engineering knowledge	Problem Solving	Design Skills	Laboratory Skills	Teamwork	Communication Skills	Ethical and Professional Behavior	Lifelong Learning	Global and Societal Impact	Project Management	Adaptability	Professional Development	Apply Electrical and interdisciplinary knowledge to analyze, design and manufacture products to address the needs of the society.	Apply state of the art tools and techniques to conceptualize, design and introduce new products, processes, systems and services.
CO1: Apply network theorems to solve electrical DC circuits.	2	2	3	2	2	1	1	1	2	1	1	2	2	2
CO2: Understand the concept of sinusoidal quantities and solve single phase AC circuits.	2	2	1	3	1	2	1	1	1	1	2	2	2	2
CO3:Analyze the three phase AC circuits and solve series and parallel magnetic circuits.	3	3	2	1	1	2	2	2	1	1	2	3	1	2

CO 4: Understand the basic operating principle, types, efficiency of Transformers.	2	3	3	2	3	2	1	3	2	1	2	2	3	3
CO 5: Understand the basic operating principle, types of machines.	2	3	3	1	2	3	2	3	1	2	2	2	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	CO-1: Apply network theorems to solve electrical DC circuits.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1, 2, 3, 4, 5,6	**Unit-1: DC Network** 1.1, 1.2, 1.3, 1.4, 1.5, 1.6,1.7	SL 1.1
PO:1,2,3,4,5,6,7,8 ,9,10,11,12 PSO 1, 2	CO-2: Understand the concept of sinusoidal quantities and solve single phase AC circuits.	SO2.1 SO2.2 SO2.3 SO2.4	1	**Unit-2**: **Single-Phase AC Circuit** 2.1,2.2,2.3,2.4,2.5,2.6, 2.7	SL2.1
PO:1,2,3,4,5,6,7,8 ,9,10,11,12 PSO 1, 2	CO-3: Analyze the three phase AC circuits and solve series and parallel magnetic circuits.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	1, 2	**Unit-3 :Three-Phase AC Circuit** 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9	SL3.1
PO:1,2,3,4,5,6,7,8 ,9,10,11,12 PSO 1, 2	CO-4: Understand the basic operating principle, types, efficiency of Transformers.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5 SO4.6	1,2,3,4	**Unit-4:Single-Phase Transformer** 4.1, 4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9, 4.10	SL 4.1
PO:1,2,3,4,5,6,7,8 ,9,10,11,12 PSO 1, 2	CO-5: Understand the basic operating principle, types of machines.	SO5.1 SO5.2 SO5.3 SO5.4	1,2	**Unit 5: DC Machines** 5.1,5.2,5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12	SL 5.1

Course Code: **ESC 102/ ESC 102-L**

Course Title : Engineering Graphics & Design

Pre- requisite: Student should have basic knowledge of Geometry, Geometrical Shapes, basic knowledge of Computer, Mouse and keyboard use, navigating menus and dialogs, managing files and directories, etc.

Rationale: The students studying Graphics are essential in mechanical engineering, allowing engineers to visualize and communicate complex ideas clearly and concisely. Using graphics, engineers can create detailed plans for construction projects, analyses structural components, and convey design concepts to clients and stakeholders.

Course Outcomes:

ESC 102/ ESC 102-L.1: Get introduced with Engineering Graphics and visual aspects of design.
ESC 102/ ESC 102-L.2: Know and use common drafting tools with the knowledge of drafting standards.
ESC 102/ ESC 102-L.3: Apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints.
ESC 102/ ESC 102-L.4: Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.
ESC 102/ ESC 102-L.5: To make the student understand the viewing perception of a solid object in Isometric and perspective Projection, Design modulation and simulation by Auto CAD

Scheme of Studies:

Code	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 (ESC)	**ESC 102/ ESC 102-L**	Engineering Graphics & Design	1	4	1	1	7	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.

Scheme of Assessment:

Theory

`Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test2 (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)		
ESC	**ESC 102/ ESC 102-L**	Engineering Graphics & Design	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), culminatingin the overall achievement of Course Outcomes (COs) upon the course's conclusion.

ESC 102/ ESC 102-L.1: Get introduced with Engineering Graphics and visual aspects of design.

Approximate Hours

Item	AppX Hrs
Cl	03
LI	12
SW	2
SL	1
Total	18

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO1.1 Proficiency in using plain scales for measurement and drawing and understanding of representative factors in scales. SO1.2 Construction of ellipses, parabolas, and hyperbolas using various methods SO1.3 Knowledge and construction of special curves like cycloids, epicycloids, hypocycloids, involutes, and Archimedean spirals. SO1.4 Application of these curves in various engineering and mathematical contexts.	**Unit-1.0 ENGINEERING CURVES & SCALE** **Practice of Following** 1.1 Construction of ellipse by different methods; Normal and Tangent . 1.2. Construction of parabola by different methods; Normal and Tangent. 1.3Construction of involute such as polygons and circle 1.4 Construction of Cycloid, Epi-cycloid, Hypo-cycloid 1.5 Construction of Simple Scale, 1.6 Diagonal Scale & Scale of Chord	**Unit-1.0 ENGINEERING CURVE& SCALE** 1.1Introduction of Engineering Drawing, Drawing material and their uses Application of mini drafter, compass, divider, French curves, pencils grades and their uses. 1.2 Construction of ellipse by different methods; Normal and Tangent .Construction of parabola by different methods; Normal and Tangent. 1.3 Construction of Cycloid, Epi-cycloid, Hypo-cycloid.	**1.** Construction of Involutes

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Ellipes by concentric circle method, Cycloid, Involutes of Circle

b. Mini Project:

i. Model of Hexagon, Pentagon, Square

ESC 102/ ESC 102-L.2: Know and use common drafting tools with the knowledge of drafting standards.

Approximate Hours

Item	AppX Hrs
Cl	03
LI	12
SW`	2
SL	1
Total	18

Session Outcomes (SOs)	**LaboratoryInstruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO2.1 Differentiate between various types of projections when and where each type of projection is commonly used in engineering and technical design. SO2.2 Be able to create orthographic projection views of objects, including front view, top view, and side views. SO2.3 Able to project points and lines onto different planes using orthographic projection. SO2.4 Learn how to find the traces of straight lines in orthographic projection and use these traces to determine the positions of lines in different planes.	Unit-2.0 Projection of Point and Line Practice of Following 2.1 Projection of Point 2.2 Projection of Point in different co-ordinate 2.3 Projection of Straight Line 2.4 Projection of Straight Line in different Position w.t.r. H.P. & V.P`. 2.5 Projection of Straight Line in different Position w.t.r. H.P. & V.P. 2.6 Projection of Straight Line in different Position w.t.r. H.P. & V.P.	Unit-2.0 Projection of Point and Line 2.1 Introduction of Projection 2.2 Projection of Point 2.3 Projection of Straight Line	1.Point Projection in different co-ordinate

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Projection of point &

b. Mini Project

1. Projection of Straight Line

ESC 102/ ESC 102-L.3: Apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints.

Approximate Hours

Item	AppX Hrs
Cl	03
LI	14
SW	2
SL	1
Total	20

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Projection of Planes like circle and polygons in different positions. SO3.2 Projection of polyhedrons like prisms, pyramids, and solids of revolutions like cylinder, cones in different positions	**Unit-3.0 Projection of Plane & Solid** **Practice of Following** 3.1 Introduction ,Projection of plane 3.2 plane perpendicular to any one and parallel to other 3.3 plane perpendicular to any one and inclinedl to other 3.4 Introduction ,Projection of solid 3.5 Axis of solid perpendicular to any one and parallel to other 3.6 Axis of solid perpendicular to any one and inclinedl to other 3. 7 Axis of solid inclined to both the plane HP&VP	**Unit-3.0 Projection of Plane & Solid** 3.1Introduction of Projection Plane 3.2 Projection of Plane in different position 3.3Introduction of projection of Solid	1.Preojection of Plane in different Position w.t.r. H.P. & V.P.

SW-3 Suggested Sessional Work (SW):

a. **Assignments:**

i. Draw three problems of projection of plane

b. **Mini Project:**

1.. Draw three problems of projection of solid

ESC 102/ ESC 102-L.4: Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.

Approximate Hours

Item	AppX Hrs
Cl	03
LI	12
SW	2
SL	1
Total	18

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO4.1 Learn the techniques for sectioning right solids using both normal and inclined planes. SO4.2 solve practical problems related to the section of solids and planes. SO4.3 Learn the parallel line method and radial-line method for developing surfaces in right solids including how to create accurate representations.	**Unit-4.0 Development of Solid & Section of Solid** **Practice of Following** 4.1 Sectioning of Cone 4.2 Sectioning of pyramid 4.3 Sectioning of Cylinder & Prism 4.4 Development of cylinder and prism 4.5 Development and sectioning of pyramid 4.6 development and sectioning of cone	**Unit-4.0 Development of Solid & Section of Solid** 4.1 Introduction of Sectioning and sectioning lines 4.2 Sectioning of Cone 4.3 Sectioning of pyramid	1. Development and sectioning of cylinder

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Develop prism and cylinder

b. Min Project

1. Develop pyramid and Cone

ESC 102/ ESC 102-L.5: To make the student understand the viewing perception of a solid object in Isometric and perspective Projection, Design modulation and simulation by Auto

Approximate Hours

Item	AppX Hrs
Cl	03
LI	12
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 - Students will learn about the scale and the specific axes used in isometric drawings. SO5.2 - Students will learn the process of converting two-dimensional orthographic (multi view) drawings into isometric projections. SO5.3 - Students will learn solving practical design and projection problems using CAD software and how to use CAD tools to create detailed drawings and projections of objects.	**Unit-5.0 Isometric projection and Auto CAD** **Practice of Following** 5.1 Introduction of isometric scale and vies 5.2 Isometric view of circle, cylinder and cone 5.3 Isometric view of prism 5.4 Isometric view of pyramid 5.5 Isometric view by othographic view 5.6 Drawing of different orthographic view of planes and solid by Auto CAD commands	**Unit-5.0 Isometric projection and Auto CAD** 5.1Introduction of Isometric Projection 5.2 Isometric view of circle, cylinder and cone 5.3 Isometric view of prism and pyramid	1. Draw Isometric view of plane and solid

SW-5 Suggested Sessional Work (SW):

a. **Assignments**
   Draw Isometric view of a cone resting centrally on a cube

b. Mini Project

1. Explain five edit and draw commands

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Lab Lecture (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+LI+SW+SI)
ESC 102/ ESC 102-L.1: Get introduced with Engineering Graphics and visual aspects of design.	3	12	2	1	18
ESC 102/ ESC 102-L.2: Know and use common drafting tools with the knowledge of drafting standards.	3	12	2	1	18
ESC 102/ ESC 102-L.3: Apply computer aided drafting technique`e to represent line, surface or solid models in different Engineering viewpoints.	3	14	2	1	20
ESC 102/ ESC 102-L.4: Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.	3	12	2	1	18
ESC 102/ ESC 102-L.5: To make the student understand the viewing perception of a solid object in Isometric and perspective Projection, Design modulation and simulation by Auto CAD	3	12	2	1	18
Total Hours	15	62	10	5	92

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Get introduced with Engineering Graphics and visual aspects of design.	03	01	01	05
CO-2	Know and use common drafting tools with the knowledge of drafting standards.	02	06	02	10
CO-3	Apply computer aided drafting technique to represent line, surface or solid models in different Engineering viewpoints.	03	07	05	15
CO-4	Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.	-	10	05	15
CO-5	Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.	03	02	-	05
Total		11	26	13	50

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

The end of semester assessment for Engineering Graphics & Design 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 Mining 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	Computer Aided Engg drawing	VTU Belgaum	Visvesvaraya Tech. University	Revised edition 21 edition 2020
2	Engineering Drawing	Bhatt N.D., Panchal V.M. & Ingle P.R.,	Charotar Publishing House	1999
3	Engineering Drawing	R.K. Dawan	S. Chand Publication.	1985
4	Engineering Drawing	Agrawal and Agrawal	TMH	2018
5	Training Manual			
6	Training Manual			
7	Lecture note provided by Dept. of Mechanical Engineering, AKS University, Satna .			

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Cos, POs and PSOs Mapping

Course Title: B. Tech Mining Engineering

Course Code : ESC 102/ ESC 102-L

Course Title: Engineering Graphics and Design

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
	Engin e ering knowl edge	Pro b lem anal ysis	Desig n/dev elop ment of soluti ons	Cond uct inves t igatio ns of comp l ex probl ems	Mod en tool usage	The engi neer and soci ety	Enviro nment and sustain ability:	Ethics	Indiv idual and team work :	Com muni c ation:	Project manag ement and finance :	Life-long learnin g	The ability toapply technical & engineering knowledge for Drawing	Ability to understand the day to plant operational problems of Product drawing	Ability to understand the latest Drafting by Auto CAD.	Ability to usethe research based innovative knowledge for SDGs
CO1 : Get introduced with Engineering Graphics and visual aspects of design.	1	1	2	2	2	2	3	1	2	2	1	2	2	2	1	1
CO 2 : Know and use common drafting tools with the knowledge of drafting standards.	1	2	2	2	1	2	2	1	1	1	2	3	2	2	2	1
CO3 : Apply computer aided drafting technique to represent line, surface or solid models in different Engineering viewpoints.	2	2	1	1	2	2	2	1	1	2	1	2	2	1	2	2
CO 4: Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.	3	2	2	1	3	1	3	1	2	1	1	2	3	3	3	2
CO 5: Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.	1	2	2	1	1	1	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	CO1 : Get introduced with Engineering Graphics and visual aspects of design.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1,1.2,1.3,1.4,1.5,1.6	Unit-1.0 ENGINEERING CURVE& SCALE 1.1,1.2,1.3,	SL 1.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4,	CO 2 : Know and use common drafting tools with the knowledge of drafting standards.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1,2.2,2.3,2.4,2.5,2.6	Unit-2 Projection of Point and Line 2.1, 2.2, 2.3,	SL 2.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4,	CO3 : Apply computer aided drafting technique to represent line, surface or solid models in different Engineering viewpoints.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1,3.2,3.3,3.4,3.5,3.6,3.7	Unit-3 : Projection of Plane & Solid 3.1, 3.2,3.3,	SL 3.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4,	CO 4: Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1,4.2,4.3,4.4,4.5,4.6	Unit-4 : Development of Solid & Section of Solid 4.1, 4.2,4.3,	SL 4.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 5: Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1,5.2,5.3,5.4,5.5,5.6	Unit 5: Isometric projection and Auto CAD 5.1,5.2,5.3,	SL 5.1

Semester-II

Course Code: **HSMC07**

Course Title: Indian Knowledge System

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

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

Course Outcomes:

HSMC07. 1: To understand the ancient civilization, Indian Knowledge Systems, Concept of Panch Mahabhuta, Origin of name Bharat Varsha, Ancient Rivers, Ancient Universities and ancient agriculture.

HSMC07.II: Students will have the ability to learnabout ancient books, Religious places,basic concept of Indian dance, music and arts, and fundamental aspects of Sangeeta and Natyashashtra etc.

HSMC07.III: Student will be able to gain knowledge on Vedic Science, Astronomy, Astrovastu, Vedic Mathematics, Aeronautics, Metallurgy, Nakhatras, Panchang, Concept of Zero, Pi and point etc.

HSMC07. IV: Understanding onancient Engineering, Science and Technology, Town Planning, Temple architecture, Chemistry and Metallurgy, Metal manufacturing etc.

HSMC07. V: Student will able to understand about the Life, Nature and Health through basic concept of Ayurveda andYoga, Traditional Medicinal Systems, Ethnomedicine, Nature conservation, World Heritage Sites etc.

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours CI+LI+SW+SL	
ESC	**HSMC07**	Indian Knowledge System	2	0	1	1	4	2

Legend:

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

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

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

SL: Self Learning,

C: Credits.

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

Scheme of Assessment:
Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
ESC	**HSMC07**	Indian Knowledge System	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

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

HSMC07. 1.To understand Indian Civilization and Indian Knowledge Systems

Approximate Hours

Item	Approximate Hours
CI	6
LI	0
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 1.1. Understand Overview of Indian Knowledge Systems (IKS) SO1.2. Understand Classification of Ancient IKS texts SO 1.3. Understand Introduction to Panch Mahabhutas (Earth, Water, Fire, Sky and Air) SO 1.4. Understand Origin of the name Bharatvarsha: the Land of Natural Endowments SO 1.5. Understand Rivers of ancient India (The Ganga, Yamuna, Godawari, Saraswati, Narmada, Sindhu and Kaveri) SO 1.6. Understand Ancient Agriculture and ancient Universities: Takshashila and Nalanda, Gurukul system		**Unit-1. Indian Civilization and Indian Knowledge Systems** 1.1. Overview of Indian Knowledge Systems (IKS) 1.2 Classification of Ancient IKS texts 1.3 Introduction to Panch Mahabhutas (Earth, Water, Fire, Sky and Air) 1.4 Origin of the name Bharatvarsha: the Land of Natural Endowments 1.5 Rivers of ancient India (The Ganga, Yamuna, Godawari, Saraswati, Narmada, Sindhu and Kaveri) 1.6 Agriculture system in ancient India,Ancient Universities: Takshashila and Nalanda, Gurukul system	Golden era of ancient India

SW-1 Suggested Sessional Work (SW):

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

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

HSMC07. 2: Students will have the ability to apply the knowledge gained about Indian Art, Literature and Religious Places

Approximate Hours

Item	Approximate Hours
CI	**6**
LI	**0**
SW	**2**
SL	**1**
Total	**9**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 2.1. Understand the Ancient Indian Books: Vedas, Puranas, Shastras, Upanishads, Mahakavyas (Ramayana & Mahabharata), Smrities, Samhitas SO2.2. Understand the Religious places: Puries, Dhams, Jyotiralinga, Shaktipeeths, Kumbha Mela SO 2.3. Understand the Legendary places of Madhya Pradesh: Ujjain, Chitrakoot, Omkareshwar, Bharhut, Maihar SO 2.4. Understand the Basic concept of Indian Art, Music and Dance, Indian Musical Instruments SO 2.5. Understand the Fundamental aspects of Sangeeta and Natya shastra SO 2.6. Understand the different schools of music, dance and painting in different regions of India		**Unit-2. Indian Art, Literature and Religious Places** 2.1. Ancient Indian Books: Vedas, Puranas, Shastras, Upanishads, Mahakavyas (Ramayana & Mahabharata), Smrities, Samhitas 2.2. Religious places: Puries, Dhams, Jyotiralinga, Shaktipeeths, Kumbha Mela 2.3. Legendary places of Madhya Pradesh: Ujjain, Chitrakoot, Omkareshwar, Bharhut, Maihar 2.4. Basic concept of Indian Art, Music and Dance, Indian Musical Instruments 2.5. Fundamental aspects of Sangeeta and Natya shastra 2.6. Different schools of music, dance and painting in different regions of India	**1.** Indian Art, Music and Dance

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Visit of Chitrakoot, Maihar and Bharhuta

b. Mini Project:

ii. Kumbhmela, Story of Ramayana and Mahabharata

HSMC07. 3: Student will be able to understand Ancient Science, Astronomy and Vedic Mathematics

Approximate Hours

Item	Approximate Hours
CI	6
LI	0
SW	2
SL	1
Total	9

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

SW-3 Suggested Sessional Work (SW):

a. Assignments:

1. Varanamala of Hindi language based on classification of sounds on the basis of their origin

b. Mini Project:

1. Nakshatras, Navagraha and their related plants

HSMC07. 4: Understand the Engineering, Technology and Architecture

Approximate Hours

Item	Approximate Hours
CI	6
LI	0
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 4.1. Understand the Engineering Science and Technology in Vedic and Post Vedic Era SO 4.2. Understand the Town and Home planning, Sthapatyaveda SO 4.3. Understand the Chemistry and Metallurgy as gleaned from archeological artifacts SO 4.4. Understand the Chemistry of Dyes, Pigments used in Paintings, Fabrics, Potteries and Glass SO 4.5. Understand the Temple Architecture: Khajuraho, Sanchi Stupa, Chonsath Yogini temple SO 4.6. Understand the Mining and manufacture in India of Iron, Copper, Gold from ancient times		**Unit-4. Engineering, Technology and Architecture** 4.1. Engineering Science and Technology in Vedic and Post Vedic Era 4.2. Town and Home planning, Sthapatyaveda 4.3. Chemistry and Metallurgy as gleaned from archeological artifacts 4.4 Chemistry of Dyes, Pigments used in Paintings, Fabrics, Potteries and Glass 4.5. Temple Architecture: Khajuraho, Sanchi Stupa, Chonsath Yogini temple 4.6. Mining and manufacture in India of Iron, Copper, Gold from ancient times	1. Ancient Science, Astronomy and Vedic Mathematics

SW-4 Suggested Sessional Work (SW):

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

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

HSMC07. 5: Understand about the Life, Nature and Health

Approximate Hours

Item	Approximate Hours
CI	6
LI	0
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 5.1. Understand the Fundamentals of Ayurveda (Charaka & Shushruta) and Yogic Science (Patanjali), Ritucharya and Dinacharya SO 5.2. Understand the Traditional system of Indian medicines (Ayurveda, Siddha, Unani and Homoeopathy) SO5.3. Understand Fundamentals of Ethnobotany and Ethnomedicines of India SO 5.4. Understand the Nature Conservation in Indian ancient texts SO 5.5. Understand the Introduction to Plant Science in Vrikshayurveda SO 5.6. Understand the World Heritage Sites of Madhya Pradesh: Bhimbetka, Sanchi, Khajuraho		**Unit-5. Life, Nature and Health** 5.1. Fundamentals of Ayurveda (Charaka & Shushruta) and Yogic Science (Patanjali), Ritucharya and Dinacharya 5.2. Traditional system of Indian medicines (Ayurveda, Siddha, Unani and Homoeopathy) 5.3. Fundamentals of Ethnobotany and Ethnomedicines of India 5.4. Nature Conservation in Indian ancient texts 5.5 Introduction to Plant Science in Vrikshayurveda 5.6. World Heritage Sites of Madhya Pradesh: Bhimbetka, Sanchi, Khajuraho	1. Concept of Ayurveda and Yoga

SW-5 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Visit to world Heritage Site Khajuraho

b. **Mini Project:**
   i. Ritucharya and Dincharya, Ethnomedicinal plants

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
HSMC07. 1: To understand Indian Civilization and Indian Knowledge Systems	6	2	1	9
HSMC07. 2: Students will have the ability to apply the knowledge gained about Indian Art, Literature and Religious Places	6	2	1	9
HSMC07.3: Student will be able to understand the Ancient Science, Astronomy and Vedic Mathematics	6	2	1	9
HSMC07.4: Understand the Engineering, Technology and Architecture	6	2	1	9
HSMC07. 5: Understand about the Life, Nature and Health	6	2	1	9
Total	30	10	5	45

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

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

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

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

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

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method

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

Suggested Learning Resources:
(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	An Introduction of Indian Knowledge Systems: Concept and Applications	Mahadevan, B.; Bhat V. R. and Pavana, Nagendra R. N.	Prentice Hall of India.	2022
2	Indian Knowledge Systems: Vol. I and II.	Kapoor, Kapil and Singh, A. K.	D.K. Print World Ltd	2005
3	Science of Ancient Hindus: Unlocking Nature in Pursuit of Salvation	Kumar, Alok	Create pace Independent Publishing	2014
4	A History of Agriculture in India	Randhava, M.S.	ICAR, New Delhi	1980
5	Panch Mahabhuta,	Yogcharya, Jnan Dev	Yog Satsang Ashram	2021
6	The Indian Rivers	Singh, Dhruv Sen	Springer	2018
7	The Wonder That Was India	Basam, Arthue Llewllyn	Sidgwick & Jackson	1954
8	Ancient Cities, Sacred Skies: Cosmic Geometries and City Planning in Ancient India	Malville, J. MacKim & Gujaral, Lalit M.	IGNCA & Aryan Books International, New Delhi	2000
9	The Natya Shastra of Bharat Muni	Jha, Narendra	Innovative Imprint, Delhi	2023
10	Astronomy in India: A Historical Perspective	Padmanabhan, Thanu	Indian National Science Academy, New Delhi & Springer (India).	2010
11	History of Astronomy in India 2nd Ed.	Sen, S.N. and Shukla, K.S.	INSA New Delhi	2001
12	History of Indian Astronomy A Handbook	Ramasubramanian, K.; Sule, Aniket and Vahia, Mayank	Science and Heritage Initiative, I.I.T. Mumbai and Tata Institute of Fundamental Research, Mumbai	2016
13	Indian Mathematics and Astronomy: Some Landmarks	Rao, Balachandra S.	Jnana Deep Publications, Bangalore, 3rd Edition	. 2004
14	Vedic Mathematics and Science in Vedas	Rao, Balachandra S.	Navakarnataka Publications, Bengaluru	2019
15	A History of Hindu Chemistry	Ray, Acharya Prafulla Chandra	Repbl Shaibya Prakashan Bibhag, Centenary Edition, Kolkata	1902
16	Early Indian Architecture: Cities and City Gates	Coomeraswamy, Anand	Munciram Manoharlal Publishers	2002
17	Theory and Practices of Temple Architecture in Medieval India: Bhojas samrangasutradhar and	Hardy, Adams	Dev Publishers & Distributors.	2015

	the Bhojpur Line Drawings			
18	Indian Science and Technology in Eighteenth Century	Dharmpal	Academy of Gandhian Studies, Hyderabad.	1971
19	Science in India: A Historical Perspective	Subbarayappa, B.V.	Rupa New Delhi	2013
20	Fine Arts & Technical Sciences in Ancient India with special reference to Someswvara's Manasollasa	Mishra, Shiv Shankar	Krishnadas Academy, Varanasi	1982
21	Fundamental Principles of Ayurveda, Volume One	Lad, Vasant D.	The Ayurvedic Press, Alboquerque, New Mexico.	2002
22	Charak Samhita, Chaukhamba	Pandey, Kashinath and Chaturvedi Gorakhnath	Vidya Bhawan, Varanasi	
23	Ayurveda: The Science of Self-Healing	Lad, Vasant D.	Lotus Press: Santa Fe	1984
24	Ayurveda: Life, Health and Longevit	Svoboda, Robert E	Penguin: London	1992
25	Plants in the Indian Puranas	Sensarma, P.	Naya Prokash, Calcutta	1989
26	Indian Cultural Heritage Perspective for Tourism	Singh, L. K.	Gyan Publishing House, Delhi	2008
27	Glimpses of Indian Ethnobotany	Jain, S.K.	Oxford & IBH Publishing Company Private Limited, New Delhi	1981
28	Manual of Ethnobotany	Jain, S.K.	Scientific Publishers, Jodhpur	2010

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CO, PO and PSO Mapping

Program: B. Tech. Mining Engineering

Course Code : HSMC07

***Course Title:* Indian Knowledge System**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
	Engin e ering knowl edge	Pro b lem anal ysis	Desig n/dev elop ment of soluti ons	Cond uct inves t igatio ns of comp l ex probl ems	Mod en tool usage	The engi neer and soci ety	Enviro nment and sustain ability:	Ethics	Indiv idual and team work :	Com muni c ation:	Project manag ement and finance :	Life-long learnin g	The ability toapply technical & engineering knowledge for Drawing	Ability to understand the day to plant operational problems of Product drawing	Ability to understand the latest Drafting by Auto CAD.	Ability to usethe research based innovative knowledge for SDGs
CO1 : Get introduced with Engineering Graphics and visual aspects of design.	1	1	2	2	2	2	3	1	2	2	1	2	2	2	1	1
CO 2 : Know and use common drafting tools with the knowledge of drafting standards.	1	2	2	2	1	2	2	1	1	1	2	3	2	2	2	1
CO3 : Apply computer aided drafting technique to represent line, surface or solid models in different Engineering viewpoints.	2	2	1	1	2	2	2	1	1	2	1	2	2	1	2	2
CO 4: Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.	3	2	2	1	3	1	3	1	2	1	1	2	3	3	3	2
CO 5: Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.	1	2	2	1	1	1	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)
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4,5	IKS. 1:To understand Indian Civilization and Indian Knowledge Systems	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5 SO1.6		Unit-1. Indian Civilization and Indian Knowledge Systems 1.1,1.2,1.3,1.4,1.5,1.6	SL 1.1
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4,5	IKS. 2: Students will have the ability to apply the knowledge gained about Indian Art, Literature and Religious Places	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5 SO2.6		Unit-2. Indian Art, Literature and Religious Places 2.1,2.2,2.3,2.4,2.5,2.6	SL 2.1
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4,5	IKS.3: Student will be able to understandthe Ancient Science, Astronomy and Vedic Mathematics	SO3.1S O3.2 SO3.3 SO3.4 SO3.5 SO3.6		Unit-3. Ancient Science, Astronomy, Mathematics 3.1,3.2,3.3,3.4,3.5,3.6	SL 3.`1
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4,5	IKS.4: Understand the Engineering, Technology and Architecture	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5 SO4.6		Unit-4. Engineering, Technology and Architecture 4.1,4.2,4.3,4.4,4.5,4.6	SL 4.1
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4,5	IKS. 5: Understand about the Life, Nature and Health	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5 SO5.6		Unit-5. Life, Nature and Health 5.1,5.2,5.3,5.4,5.5,5.6	SL 5.1

Semester-II

Course Title: Design Thinking & Idea Lab

Course Code: **ESC 103-L**

Pre-requisite: **There is no such pre requisite for Design Thinking and Idea. This course is intended for students from any discipline who require an understanding of design thinking for brand, product, and service development.**

Rationale: Students will learn a series of design thinking concepts, methods and techniques that are used to bring about innovation in business and in the social sector.
The course will be a mix of lecture, case discussions, participative and immersive learning. It will be a predominantly student driven learning to acquire the requisite skills.

Course Outcomes:

ESC 103-L 1.1: Identify the problems that fall under the purview of human centered design process for creative problem solving.

ESC 103-L1.2: Create empathy maps to visualize user attitudes and develop innovative products or services for a customer base using ideation techniques.

ESC 103-L1.3: Build simple prototypes for problems using gathered user requirements.

Scheme of Studies:

Code	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	**ESC 103-L**	Design Thinking & Idea Lab	0	2	1	1	4	1

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

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

Scheme of Assessment:

Theory

<table>
<tr><th rowspan="3">Code</th><th rowspan="3">Course Code</th><th rowspan="3">Course Title</th><th colspan="8">Scheme of Assessment(Marks)</th></tr>
<tr><th colspan="6">Progressive Assessment(PRA)</th><th rowspan="2">End Semester Assessment (ESA)</th><th rowspan="2">Total Marks (PRA +ESA)</th></tr>
<tr><th>Class/Home Assignment 5number 3 marks each (CA)</th><th>Class Test2 (2bestout of3) 10 marks each (CT)</th><th>Seminar one (SA)</th><th>Class Activity any one (CAT)</th><th>Class Attendance (AT)</th><th>Total Marks (CA+CT+SA+ CAT+AT)</th></tr>
<tr><td>PCC</td><td>ESC 103-L</td><td>Design Thinking & Idea Lab</td><td>35</td><td>NA</td><td>5</td><td>5</td><td>5</td><td>50</td><td>50</td><td>100</td></tr>
</table>

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.

ESC 103-L.1: Create empathy maps to visualize user attitudes and develop innovative products or services for a customer base using ideation techniques.

Approximate Hours

Item	AppX Hrs
Cl	00
LI	10
SW	2
SL	1
Total	13

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 Identifying the problem that can be solved using Design Thinking approach. SO1.2 Obtain the insights into user's problems and make Problem statement. SO1.3 Carry out Brain storming between the groups and generate as many as ideas possible. SO1.4Obtain the insights to creativity and innovation.	**Unit-1.0INTRODUCTION TO DESIGN THINKING** 1.1 Definition of Design Thinking, 1.2.Need & Objective of Design Thinking. 1. 3. Stages of Design Thinking Process. 1.4Brainstorming. 1.5 Innovative Triangle		1. Develop ability to express their views.

SW-1 Suggested Sessional Work(SW):

a. **Assignments:**

1.Detail explanation of Stages of Design Thinking.

b. **Mini Project:**

1. To create a prototype of users need using Design Thinking Stages.

ESC 103-L.2: Identify the problems that fall under the purview of human centered design process for creative problem solving.

Approximate Hours

Item	AppX Hrs
Cl	00
LI	10
SW	2
SL	1
Total	13

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1 Differentiate between Design thinking and Creative thinking. SO2.2 Learn different types of creative thinking techniques for generating creative ideas. SO2.3 Be able to solve a problem using creativity.	**Unit-2.0: Introduction to Creativity** 2.1 Introduction of Creative Thinking. 2.2 Creative Thinking Process 2.3 Creative Problem Solving. 2.4 Creative Thinking Techniques and Tools. 2.5 Divergent and Convergent Thinking.		1. Different Convergent and divergent thinking tools.

SW-2 Suggested Sessional Work(SW):

a**. Assignments:**

i. Presentation by students’ team on their own creative work.

b.Mini Project:

To create a prototype of a product using their own creativity.

ESC 103-L.3: Build simple prototypes for problems using gathered user requirements.

Approximate Hours

Item	AppX Hrs
Cl	00
LI	10
SW	2
SL	1
Total	13

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO3.1 Understanding of Prototyping. SO3.2 Develop understanding of various prototype testing methods. S03.3 Understanding of Product Design	**Unit-3.0Introduction to Prototype** 3.1 Prototyping as a mindset, prototype examples 3.2 Introduction to Rapid Prototyping. 3.3 Process of prototyping-Minimum Viable prototype 3.4Process of Engineering Product Design 3.5 Stages of Product Design		1.Solving Practical Engineering Problem through Innovative Product Design & Creative Solution

SW-3 Suggested Sessional Work (SW):

a.Assignments:

i. Presentation by student teams on their own developed prototype.

b. Mini Project:

Make a prototype using stages of product design

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Lab Lecture (LI)	Sessional Work (SW)	Self Learning (SL)	Total hour (Cl+LI+SW+SL)
1: Create empathy maps to visualize user attitudes and develop innovative products or services for a customer base using ideation techniques.	00	10	2	1	13
2: Identify the problems that fall under the purview of human centered design process for creative problem solving.	00	10	2	1	13
3: Build simple prototypes for problems using gathered user requirements.	00	10	2	1	13
Total Hours	00	30	06	03	39

Suggestion for End Semester Assessment

Suggested Specification Table(For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Create empathy maps to visualize user attitudes and develop innovative products or services for a customer base using ideation techniques.	07	05	03	15
CO-2	Identify the problems that fall under the purview of human centered design process for creative problem solving.	06	06	03	15
CO-3	Build simple prototypes for problems using gathered user requirements.	07	07	06	20
	Total	20	18	12	50

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

The end of semester assessment for Design Thinking & Idea Lab will be held with practical examination of 50 marks.

Note. Detailed Assessmentrubric need to be prepared by the course wise teachers for above tasks.

Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

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

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition& Year
1	Paul Harris, Basics Design-Design Thinking	Gavin Ambrose	AVA Publishing	2010
2	Prototyping for Designers: Developing the best Digital and Physical Products	Kathryn McElroy	O'Reilly,	2017
3	"Design Thinking – New Product Essentials from PDMA	Michael G. Luchs, Scott Swan, Abbie Griffin	Wiley,	2015

Curriculum Development Team

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Cos. Pos and PSOs Mapping

Course Title: B. Tech Mining Engineering

Course Code: ESC 103-L

Course Title: Design Thinking & Idea Lab

Course Outcomes	Program Outcomes												Program Specific Outcome		
	PO 1	PO 2	PO3	PO4	P O 5	PO 6	PO 7	PO8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2	PSO3
	Engin eering knowl edge	Pro ble man alys is	Desig n/dev elopm entofs olutio ns	Condu ctinves tigatio ns ofcom plex proble ms	Mo dent oolu sage	The engi neer and soci ety	Enviro nment andsus tainabi lity:	Ethics	Indiv idual andte amw ork:	Com muni catio n:	Project manag ementa ndfinan ce:	Life-longlear ning	The ability toapplytech nical &engineeri ngknowled geforDesig n Thinking.	Ability tounderstan dthe day toplantoper ationalprob lemsofProd uct drawing	Apply appropriate techniques and tools
CO1:Create empathy maps to visualize user attitudes and develop innovative products or services for a customer base using ideation techniques.	3	2	1	1	1	1	1	1	2	2	1	2	3	2	2
CO 2: Identify the problems that fall under the purview of human centered design process for creative problem solving.	1	3	1	1	1	1	1	1	2	3	1	2	1	2	1
CO3: Build simple prototypes for problems using gathered user requirements.	2	2	1	1	2	2	2	1	1	2	1	2	2	1	2

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

Pos & PSOs No.	Cos No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2, 9,10,12 PSO1,2	CO1:Create empathy maps to visualize user attitudes and develop innovative products or services for a customer base using ideation techniques.	SO1.1 SO1.2 SO1.3 SO1.4	Unit-1.0INTRODUCTION TO DESIGN THINKING 1.1,1.2,1.3,1.4,1.5.		SL 1.1
PO1,2, 9,10,12 PSO2	CO 2: Identify the problems that fall under the purview of human centered design process for creative problem solving.	SO2.1 SO2.2 SO2.3	Unit-2 Introduction to Creativity 2.1,2.2,2.3,2.4,2.5.		SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,3	CO3: Build simple prototypes for problems using gathered user requirements.	SO3.1 SO3.2 SO3.3	Unit-3:Introduction to Prototype 3.1. 3.2, 3.3, 3.4, 3.5.		SL 3.1`

Semester-III

Course Code: **MIN201/MIN201-L**

Course Title: Mining Geology-I

Pre-requisite: Student should have basic knowledge of scope and purpose of geology, Rocks, Minerals, various methods of age determination of rock and minerals.

Rationale: The students studying Mining field should possess foundational understanding about historical binding of rock and minerals. Helps us identify and mitigate natural hazards such as earthquakes, coastal erosion, flooding, and landslides.

Course Outcomes:

MIN201/MIN201-L:1.1
Describe the origin of earth and its importance in social life.

MIN201/MIN201-L:1.2
Analyze the origin, characteristics features and importance of rocks and minerals.

MIN201/MIN201-L:1.3
Apply the knowledge and identification of physical properties of rocks and minerals.

MIN201/MIN201-L1.4
Identifying Physical and Chemical Properties of Minerals.

MIN201/MIN201-L:1.5
Comprehend the geological formations in India.

Scheme of Studies:

Code	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)	MIN201/MIN201L	Mining Geology-I	4	2	1	1	8	5

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

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

Scheme of Assessment: Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PR+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 anyone (CAT)	Class Attendance(AT)	Total Marks CA+CT+SA +CAT+AT)		
PCC	MIN201	Mining Geology-I	15	20	5	5	5	50	50	100

Scheme of Assessment: Practical

Code	Course Code	Course Title	Scheme of Assessment (Marks)					
			Progressive Assessment (PRA)				End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/Home Assignment 5 number 7 marks each (CA)	Viva	Class Attendance (AT)	Total Marks (CA+VV+ AT)		
PCC	MIN201L	Mining Geology-I-Lab	35	10	5	50	50	100

Course-Curriculum Detailing

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

MIN201/MIN201L1.1: Understanding the origin of earth and its importance in social life

Approximate Hours

Item	Approx. Hrs.
Cl	12
LI	4
SW	1
SL	2
Total	19

Session Outcomes(SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Basic idea of Geology and branches. **SO1.2**Explain the Origin of earth. **SO1.3**Determination of age of earth. **SO1.4**Calculate the age of rock and minerals by various methods. **SO1.5** Analyze the Continental drift theory and Isostacy.	1.1 Identification and description of Crystals. 1.2 Identification and description of two Igneous rocks hand specimen.	**Unit-1.0 Scope and Purpose of Geology** 1.1 Scope of geology 1.2 Branches of Geology 1.3 Origin of Earth 1.4 Evolutionary theory 1.5 Nebular hypothesis 1.6 Age of earth 1.7 Various methods of rocks and minerals age determinations. 1.8 Radiometric method 1.9 Continental drift theory 1.10 Evidence of Continental drift theory 1.11 Isostacy 1.12 Evidence ofIsostacy	1 Basic geology& connected branches. 2 History of earth.

SW-1 Suggested Sessional Work(SW):

a. **Assignments:**
   i.Internal structure of earth.

MIN201/MIN201L1.2: Analyze the origin, characteristics features and importance of rocks and minerals.

Approximate Hours

Item	Approx. Hrs.
Cl	11
LI	4
SW	2
SL	1
Total	18

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1 Describe the principles of erosion and weathering in geological changes. **SO2.2** Evaluate the work done through erosion of rivers. **SO2.3** Analyze the work of wind on the earth's surface. **SO2.4** Comprehend the effect of earthquake on the earth's features. **SO2.**5 Describe the mechanism of volcano.	2.1 Identification and description of two metamorphic rocks hand specimen. 2.2 Identification and description of two Sedimentary rocks hand specimen.	Unit-2 Physical Geology 2.1 Erosion 2.2 Weathering 2.3 River & Type 2.4 River Structure 2.5 Work of River 2.6River erosion 2.7Wind & Air 2.8 Wind erosion 2.9 Earthquake 2.10 Seismograph 2.11 Volcano	i.Earthquake zones in India and their characteristics

SW-2 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Discuss physical and chemical weathering
   ii. Explain work of wind in detail.

b. **Mini Project:**
   Marking of major active volcano zones in world map

MIN201/MIN201L1.3: Apply the knowledge and identification of physical properties of rocks and minerals.

Approximate Hours

Item	Approx. Hrs.
Cl	13
LI	4
SW	2
SL	1
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO3.1 Infer rock cycle. **SO3.2** Explain characteristics of various rock types. **SO3.3** Categorize the structure of Igneous Rocks. **SO3.4** Interpret Origin, Texture, Classification, Structure of Sedimentary rocks. **SO3.5** Relate the classification, Structure of Metamorphic rocks.	3.1 Identification and description of common rock forming minerals. 3.2 Description of petrological microscope.	**Unit-3:Petrology** 3.1 Rocks cycle 3.2 Characteristics of various rock types 3.3 Originof Igneous Rocks 3.4 Texture, 3.5 Classification 3.6 Structure 3.7 Originof Sedimentary 3.8Texture, 3.9 Classification, 3.10 Structure rocks. 3.11 Origin of Metamorphic 3.12Texturerocks, 3.13 Classification,	i. Origin, Texture, Classification, Structure of Sedimentary rocks.

SW-3 Suggested Sessional Work (SW):

a. **Assignments:**
   iii. Explain the rock cycle.
   iv. Write an account for the classification of igneous rocks.

b. **Mini Project:**
   Draw the rock cycle.

MIN201/MIN201L1.4 Identifying Physical and Chemical Properties of Minerals.

Approximate Hours

Item	Approx. Hrs.
Cl	12
LI	4
SW	2
SL	2
Total	20

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 Distinguish various system of crystallography. **SO4.2** Evaluate symmetry system. **SO4.3**Demonstrate elements of crystal system. **SO4.4** Classify minerals. **SO4.**5 Compare the physical and chemical properties of minerals.	4.1 Study of optical properties of rock forming minerals in thin section. 4.2 Description of Brunton compass.	**Unit-4:Mineralogy** 4.1 Mineral group 4.2 Physical Properties-1 4.3 Physical Properties-2 4.4 Chemical Properties 4.5 Optical Properties 4.6Silicate Mineral Structure 4.7 Some common minerals properties 4.8 Crystallography 4.9 Elements of Crystallography 4.10 Elements of symmetry 4.11 Crystal system 4.12 Case Studies	i.Crystallography study. ii.Classify physical and chemical properties.

SW-4 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Write elements of crystal system.
   ii. Describe briefly the physical and chemical properties of minerals.

b. **Mini Project:**
   i. Visit to a mining industry and write a report.

MIN201/MIN201L1.5 Comprehend the geological formations in India.

Approximate Hours

Item	Approx. Hrs.
Cl	12
LI	4
SW	2
SL	1
Total	19

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO5.1 Explain Geological Time Scale. **SO5.2**Demonstrate Physiographic division of India. **SO5.3**IllustrateArchaean and Dharwar system. **SO5.4**Evaluate Cuddapah system **SO5.5**DescribeGondwana super group	5.1 Measurement of dip and strike with the help of Brunton compass 5.2 Study of two important fossils.	**Unit 5: Stratigraphy** 5.1 Introduction 5.2 Principle of Stratigraphy 5.3 Correlation of Stratigraphy 5.4 Lithostratigraphy of India 5.5 Stratigraphy of India 5.6 Geological Time Scale 5.7 Physiographic division of India 5.8 Archean and Dharwar system 5.9 Cuddapah system 5.10 Vindhyan system 5.11 Gondwana super group 5.12 Plate Tectonic	i.Geological time scale.

SW-5 Suggested Sessional Work(SW):

a. Assignments:

i. Explain Geological Time Scale.

ii. Describe Gondwana super group

b. Other Activities(Specify):

List of Organization /Institution in India for regulation of mining industries.

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)
CO-1 Describe the origin of earth and its importance in social life.	12	4	1	2	19
CO-2 Analyze the origin, characteristics features and importance of rocks and minerals.	11	4	2	1	18
CO-3 Acquired the knowledge and identification of physical properties of rocks and minerals.	13	4	2	1	20
CO-4 Identifying Physical and Chemical Properties of Minerals.	12	4	4	2	22
CO-5 Comprehend the geological formations in India.	12	4	2	1	19
Total Hours	60	20	11	7	98

Suggestion for End Semester Assessment

Suggested Specification Table(For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Describe the origin of earth and itsimportance in social life.	03	01	01	05
CO-2	Analyze the origin, characteristics features and importance of rocks and minerals.	02	06	02	10
CO-3	Acquired the knowledge and identification of physical properties of rocks and minerals.	03	07	05	15
CO-4	Identifying Physical and Chemical Properties of Minerals.	-	10	05	15
CO-5	Comprehend the geological formations in India.	03	02	-	05
Total		11	26	13	50

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

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

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

Suggested Instructional/Implementation Strategies:

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

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	A Dictionary of Geology and Earth Sciences	MICHAEL ALLABY	FOURTH EDITION	2009
2	Earth Materials	John Wiley & Sons	Blackwell Publishing	February 2007

(b) Web link:

https://geology.com/

https://archive.nptel.ac.in/Harddisk/Direct_Download.html

https://epathshala.nic.in/

https://swayam.gov.in/

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Cos, Pos and PSOs Mapping

Program Title: B. Tech. Mining Engineering

Course Code: MIN201/MIN201L

Course Title: Mining Geology-I

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering Knowledge	Problemanalysis	Design/development of solutions	Conduct investigationsof complex problems	Modern Toolusage	The engineerandsociety	Environment and sustain ability:	Ethics	Individualandteam work:	Communication	Projectmanagement Andfinance	Life-longlearning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of mining
CO-1 Describe the origin of earth and its importance in social life.	1	2	1	1	1	2	1	2	2	1	1	2	2	3	2	1
CO-2Analyze the origin,characteristics features and importance of rocks & minerals.	1	1	2	2	1	2	3	2	1	1	2	2	2	1	2	1
CO-3Acquired the knowledge and identification of physical properties	1	1	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO-4Identifying Physical and Chemical Properties of Minerals.	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO-5Comprehend thegeological formations in India.	1	2	1	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map

Pos & PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction (CI)	Self-Learning(SL)
PO1,2,3,4,5,67,8,9,10,11,12 PSO1,2,3,4	CO-1 Describe the origin of earth and its importance in social life.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1 1.2	Unit-1.0Scope and purpose of geology 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11,1.12	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO- 2 Analyze the origin, characteristics features and importance of rocks & minerals.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1 2.2	Unit-2 Physical Geology 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9,2.10,2.11,2.12	SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-3 Acquired the knowledge and identification of physical properties.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1 3.2	Unit-3: Petrology 3.1,3.2,3.3,3.4,3.5,,3.6,3.7,3.8,3.9,3.10,3.11,3.12	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-4Identifying Physical and Chemical Properties	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1 4.2	Unit-4:Mineralogy 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.8,4.9,4.10,4.11,4.12	SL 4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO -5Comprehend the geological formations in India.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1 5.2	Unit5:Stratigraphy 5.1,5.2,5.3,5.4,5.5, 5.6,5.7,5.8,5.9,5.10,5.11,5.12	SL 5.1

Semester-III

Course Code: BSC201

Course Title: Mathematics III

Pre- requisite: Students should review the fundamentals of calculus, linear algebra, and differential equations, and matrix operations

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

Course Outcome:

BSC201.1 By the end of the course students are expected to have deep understanding in complex analysis with a focus on Cauchy-Riemann equations, analytic functions, harmonic functions, and conformal mappings.

BSC201.2 By the end of the course students are expected to understand the concept of a contour integral in the complex plane, concept of zeros of analytic functions and behavior of functions near essential singularities.

BSC201.3 The course provides a comprehensive overview of the skills and understanding that students are expected to gain from a course in elementary probability theory and random variables.

BSC201.4 The course provides a comprehensive overview of the skills and understanding that students are expected to gain from a course covering measures of central tendency and measures of dispersion**.**

BSC201.5 The course provides a comprehensive overview of the skills and understanding that students are expected to gain from a course covering correlation and regression, rank correlation, curve fitting, and various tests of significance.

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
BSC	BSC201	Mathematics III	4	0	1	1	6	4

Legend:

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

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

Scheme of Assessment:

Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+AT)		
BSC	BSC201	Mathematics III	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.

BSC201.1

By the end of the course students are expected to have deep understanding in complex analysis with a focus on Cauchy-Riemann equations, analytic functions, harmonic functions, and conformal mappings

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Approximate Hours

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

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self-Learning (SL)**
SO1.1 Understand and state the Cauchy-Riemann equations for a complex-valued function SO1.2 Determine the real and imaginary parts of a complex function and check for analyticity using the Cauchy-Riemann equations SO1.3 Identify and define analytic functions in the complex plane SO1.4 Understand the concept of Represent functions as Taylor and Laurent series; classify singularities and poles. SO 1.5 Evaluate complex integrals using the residue theorem.	-	**Unit-1.0** **Complex Variable:** 1.1Definition of Analytic function 1.2 Cauchy-Riemann equations in Cartesian form and polar form 1.3Questions of Analytic function based on Cartesian form 1.4Questions of Analytic function based on polar form 1.5 Harmonic function and orthogonal functions 1.6Conjugate Method for construction of an analytic function 1.7Milne's method for construction of an analytic function 1.8 Totorial- 1 1.9Conformal mappings, 1.10 questions of Conformal mappings 1.11 Mobius transformations 1.12 Properties of Mobius transformations	1. Apply the Cauchy-Riemann equations to verify the analyticity of a given function.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Write the application of complex function.

ii. Properties of Complex Variables.

iii. Writell formula of complete unit.

BSC201.2

By the end of the course students are expected to understand the concept of a contour integral in the complex plane, concept of zeros of analytic functions and behavior of functions near essential singularities.

Approximate Hours

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

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO2.1 Understand the concept of a contour integral in the complex plane. **SO2.2** Evaluate contour integrals using parametrization and integration techniques. **SO2.3** Apply contour integrals to evaluate complex integrals. **SO2.4** State and understand the Cauchy Integral formula for analytic functions **SO2.5** Apply the Cauchy Integral formula to calculate values of analytic functions		**Unit-2.0** **Complex Variable (Integration)**. 2.1 Cauchy's integral formula for analytic function 2.2Questions of Cauchy's integral formula for simple poles. 2.3 2Questions of Cauchy's integral formula for order poles. 2.4 Residues of an analytic function 2.5 Questions of Residues for simple poles 2.6 5 Questions of Residues for order poles 2.7 Residue theorem and based questions 2.8 Poles analytic function 2.9 Singularities of analytic function 2.10 Zeros of analytic function 2.11 questions of Singularity. 2.12 Tutorial	**.**1.Apply contour integrals to evaluate complex integrals.

SW-2 Suggested Sessional Work (SW):
a. Assignments:
i. write a short notes on singularities.
ii. Define poles and zeros with example.

BSC201.3

The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course in elementary probability theory and random variables

Approximate Hours

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

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self-Learning (SL)**
SO3.1 Understand the fundamental concepts of probability theory **SO3.2** Develop an appreciation for the role of probability in modeling uncertainty and randomness **SO3.** Define probability using a mathematical framework **SO3.4** Understand probability axioms and laws governing probability measures **SO3.5** Classify events as mutually exclusive, exhaustive, dependent, or independent		**Unit-3.0** **Probability and Random Variable** 3.1definition of probability 3.2 Mathematical definition of probability 3.3 Various types of events 3.4 Additive law of probability 3.5 Multiplicative law of probability 3.6 Compound probability 3.7Conditional probability 3.8 Bays rule of probability 3.9Discrete random variable 3.10 Continuous random variable 3.11 Binomial distribution 3.12 Poisson distribution	**SL.1**Analyze compound probability involving multiple events

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i) Define probability using a mathematical framework.

ii) write the application of probability in daily life.

BSC201.4

Students will compute the expression of permutation groups by using permutation multiplication

Approximate Hours

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

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO4.1 Define arithmetic mean and understand its significance **SO4.2** Compute the arithmetic mean for both grouped and ungrouped data **SO4.3** Apply different methods (direct method, assumed mean method) for calculating the arithmetic mean. **SO4.4** Understand the properties of the arithmetic mean, including its sensitivity to extreme values **SO4.5** Define the median and understand its interpretation		**Unit-4.0** **Measures of Central Tendency** 4.1methods of calculating Arithmetic mean 4.2 methods of calculating median 4.3 properties of mean and median 4.4 numericals of mean for different data 4.5 4 numericals of median for different data 4.6 methods of calculating mode 4.8 relation based question of mean median and mode 4.9 Measures of dispersion 4.10 Range 4.11quartile deviation 4.12 standard deviation and its properties	**.1** Define mode and recognize its applications

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. write the application of mean median and mode .

ii. Explain mean with real life example.

BSC201.5

The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course covering correlation and regression, rank correlation, curve fitting, and various tests of significance.

Approximate Hours

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

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self-Learning (SL)**
SO5.1 Define correlation and understand its significance in statistical analysis. **SO5.2** Recognize the types of relationships between variables (positive, negative, or none) based on correlation **SO5.3** Calculate and interpret Pearson's correlation coefficient. **SO5.4** Define and calculate rank correlation coefficients **SO5.5** Understand the use of rank correlation in cases where variables may not have a linear relationship		**Unit-5.0** **5.1** Defination of Correlation 5.2 formula of correlation coefficient 5.3 Questions of correlation coefficient 5.4 Defination of regrattion 5.5 question of line of regrattion 5.6 rank correlation 5.7 fitting of a straight line 5.7 fitting of a second degree parabola 5.8 fitting of different curves 5.9 Tutorial-1 5.10 Test of significance for large sample 5.11 Test of significance for small sample 5.12 Tutorial-2	**SL.1** Define regression analysis and understand its purpose in modeling relationships between variables

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i) Test of significance for large sample.

ii) Write the application of probability in daily life.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
CO1-.1 By the end of the course students are expected to have deep understanding in complex analysis with a focus on Cauchy-Riemann equations, analytic functions, harmonic functions, and conformal mappings.	12	1	1	14
CO1-.2 By the end of the course students are expected to understand the concept of a contour integral in the complex plane, concept of zeros of analytic functions and behavior of functions near essential singularities.	12	1	1	14
CO1-.3 The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course in elementary probability theory and random variables.	12	1	1	14
CO1.4 The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course covering measures of central tendency and measures of dispersion	12	1	1	14
CO1-.5 The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course covering correlation and regression, rank correlation, curve fitting, and various tests of significance.	12	1	1	14
Total Hours	60	5	5	70

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution				Total Marks
		R	U	A		
CO-1	Complex Variable – Differentiation	03	01	01		05
CO-2	Complex Variable – Integration	02	05	01		08
CO-3	Probability and Random Variable	03	05	05		13
CO-4	Measures of Central Tendency and Measures of Dispersion	02	08	05		15
CO-5	Statistics	03	04	02		05
Total		13	23	14		50

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

The end of semester assessment for Mathematics III will be held with written examination of 50 marks

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

Suggested Instructional/Implementation Strategies

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

Suggested Learning Resources:

a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Engineering Mathematics-III	D. K. Jain. Engineering	Shree Ram Prakashan.	1st edition, 2018
2	Engineering Mathematics-III	D.C.Agrawal	Shree Sai Prakashan	2022
3	Introduction to Engineering	H.K.Dass	S Chand Prakashan.	2nd edition, 2014
4	Engineering Mathematics-III	Sonendra Gupta	Dhanpat Rai Publishing	

Link

https://artofproblemsolving.com/wiki/index.php/MathLinks

Curriculum Development Team

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COs, POs and PSOs Mapping

Program Title: B. Tech. Mining Engineering
Course Title: MATHEMATICS-III
Course Code: BSC201

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Advanced Mathematical Knowledge	Problem-solving Skills	Research Abilities	Quantitative Analysis	Teaching and Academia	Theoretical Understanding	Communication Skills	Operations Research	Application in Industry	Engineering and Technology	Government and Public Sector	Consulting	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines	Development of the base for innovation & research in the field of mining engineering.
CO1- Understand the importance of algebraic properties with regard to working within various number systems.	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**2**	**2**	**1**	**-**	**2**	**2**	**3**	**2**	**1**
CO2- Students will determine whether a given binary operation on the given set gives a group structure by applying the axioms.	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**
CO3- The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course in elementary probability theory and random variables..	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO4- comprehensive overview of the skills and understanding that students are expected to gain from a course covering measures of central tendency and measures of dispersion	**2**	**2**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO5-The course provide a comprehensive overview of the skills and understanding that students are	**1**	**2**	**1**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

expected to gain from a course covering correlation and regression, rank correlation, curve fitting, and various tests of significance.																

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO1 Understand the importance of algebraic properties with regard to working within various number systems.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1 Complex Variable (Differentiation) 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11,1.12	SL1.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO2 By the end of the course students are expected to understand the concept of a contour integral in the complex plane, concept of zeros of analytic functions and behavior of functions near essential singularities	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-2 Complex Variable – (Integration) 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10 2.11,2.12	SL2.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO3 The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course in elementary probability theory and random variables.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-3 Probability and Random 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11,3.12	SL3.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO4 The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course covering measures of central tendency and measures of dispersion .	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-4 Measures of Central Tendency and Measures of Dispersion 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12	SL4.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO5The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course covering correlation and regression, rank correlation, curve fitting, and various tests of significance	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-5 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	SL5.1

Semester-III

Course Code: BSC 106-AU

Course Title : Environmental Science (Audit)

Pre-requisite: To study this course, the student must have a knowledge about the environmental components, pollution, biodiversity and ecosystem at senior secondary, Class 12th level.

Rationale: Environmental awareness is today's need as pollution impact is highly increasing. Environmental legislation and Audit is the mechanism to enforce environment friendly techniques/methods to business and industries. And hence knowledge of environmental legislation and audit is an essential requirement for environment engineers. This course therefore aims to develop in students, knowledge of the legal concepts, procedures and techniques which have evolved. The course also provides knowledge of tools about the environmental audit. The course will also help students to understand and carry out the environmental auditing and life cycle assessment.

Course Outcomes:

BSC 106-AU**.1:**Gain an understanding of the fundamental of industrial pollution.
BSC 106-AU**.2:** To educate/ train about environmental laws and policies.
BSC 106-AU **3:** Implement critical thinking toward Environmental Management System
BSC 106-AU**.4:** Develop, Implement, maintain Environmental Audit for Organizations.
BSC 106-AU**.5:** For environmental protection, social equity and sustainable development

Scheme of Studies:

Code	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)	BSC 106-AU	Environmental Science (Audit)	2	0	1	1	4	0

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

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

Scheme of Assessment:
Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA + ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT +AT)		
PCC	BSC 106-AU	Environmental Science (Audit)	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.

BSC 106-AU 1: Gain an understanding of the fundamental of industrial pollution

Approximate Hours

Item	Appx Hrs
Cl	07
LI	0
SW	1
SL	2
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO1.1 Understand air pollution and its sources. **SO1.2**Know about gaseous and particulate pollutants. **SO1.3**Observe the sources of water pollution. **SO1.4**Learn about water quality parameter. **SO1.**5 Evaluate the effects of noise pollution.		**Unit-1 Industrial pollution and its mitigation** 1.1 Air Pollution: Sources, classification of air pollutants 1.2 Mitigation and control measures of Particulate matters and gaseous pollutants 1.3 Water Pollution: sources, classification 1.4 Water quality parameters, 1.5 Control measures of water pollution 1.6 Soil pollution and impacts, soil conservation, 1.7 Noise pollution: sources, effects and control measures.	1. Difference between pollution and pollutants. 2. Water quality standards.

SW-1 Suggested Sessional Work(SW):

a.Assignments:

I. Classify the air pollutants on different basis.

II. Describe control measures of noise pollution.

BSC 106-AU 2: To educate /train about environmental Laws and policies.

Approximate Hours

Item	AppX Hrs
Cl	6
LI	0
SW	1
SL	1
Total	08

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 Know about the environmental acts. **SO2.2** To learn about Water Pollution act. **SO2.3** To understand the air Pollution Act. **SO2.4** To discuss about Environmental protection act **SO2.**5 To lean about the waste management act.		Unit-2 **Environmental Law and Policy** 2.1 Highlights of the Environmental Acts, 2.2 Institutional arrangements for The water (Prevention & Control of pollution) Act 1974, 2.3 The Air (Prevention & Control of pollution) Act 1981 2.4 The Environmental Protection Act 1986, 2.5 The waste management Act 1996, 2.6 The National Green Tribunal Act 2010.	1.What is the difference between law and policies.

SW-2 Suggested Sessional Work(SW):

a.Assignments:

v. Mention the measure provisions of air pollution control act.

vi. Describe waste management act.

BSC 106-AU.3: Implement critical thinking toward Environmental Management System

Approximate Hours

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

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 Know about ISO 14000 & 14001 **SO3.2**Learn applications of EMS **SO3.3**Know the methods of EIA **SO3.4**Apply the methods of EIA **SO3.5** Discuss about sustainable development.		**Unit-3:Environmental Management System** 3.1 ISO 14000 - EMS as per ISO 14001– benefits and barriers of EMS 3.2 Concept of continual improvement and pollution prevention, 3.3 Applications of EMS, Environmental Management plan. 3.4 Introduction and Principle – purpose of EIA 3.5 Sustainable development and EIA 3.6 The EIA Process – methodologies and practice.	i. ISO Certification

SW-3 Suggested Sessional Work(SW):

a.Assignments:

i. Methods of EIA
ii. Applications of EMS
iii. Environmental Management Plan

BSC 106-AU.4: Develop, Implement, maintain Environmental Audit for Organizations.

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)
SO4.1 Define environmental auditing. **SO4.2**Know the Scopes of Environmental auditing. **SO4.3**learn the objectives of environmental auditing. **SO4.4**Apply the methods of Auditing. **SO4.5** Create the auditing reports.	c.	**Unit-4 :Environmental Audit-Scope and Requisites** 4.1 Introduction to Environmental Auditing, 4.2 Objectives and scope, Types, Basic structure of Environmental Auditing, General Audit Methodology 4.3 Elements of Audit Process:coverage- GOI notification on environmental audit- benefits to industry. 4.4 Reporting environmental audit findings- 4.5 Importance of environmental audit report to industry, public and the government.	i. Process / methods of environmental auditing in any industry.

SW-4 Suggested Sessional Work(SW):

a. Assignments:

1. Objectives, scope& Types of environmental auditing.

BSC 106-AU.5: For environmental protection, social equity and sustainable development

Item	Approx Hrs
Cl	6
LI	0
SW	1
SL	0
Total	7

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO5.1 Learn to prepare electricity consumption report of any institution. **SO5.2**know to prepare water consumption report. **SO5.3**apply survey skills of any institution. **SO5.4**Examine environmental related services. **SO5.**5 Acquire Skill to compile data& results for audit report.		**Unit 5: Hands on Exercise: Attempt any three** 5.1 Prepare an interpretive electricity consumption report of the organization/ institution over a five-year period (both actual or arbitrary data can be used). 5.2 Prepare an interpretive water consumption report of the organization/ institution over a five-year period (both actual or arbitrary data can be used). Also, identify the sources of wastewater discharge and its management, if any. 5.3Survey the campus and prepare a list of the plant/ animal (or both) diversity, highlighting its importance and threats faced. 5.4Prepare a comprehensive assessment report of Solid Waste Management at the organization/ institution highlighting compliance to Waste Management Acts, 2019. 5.5Examine various environment-related practices and activities of the organization/ institution that have impacted the neighboring communities and prepare a social audit questionnaire for studying the impact. 5.6Compile the data, results, and analysis of all previous practicals and prepare a detailed environmental audit report of your selected organization/ institution.	

SW-5 Suggested Sessional Work(SW):

a. Assignments:

Prepare an interpretive electricity consumption report of the organization/ institution over a five-year period (both actual or arbitrary data can be used).

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)
BSC 106-AU.1: Gain an understanding of the fundamental of industrial pollution	7	0	1	2	10
BSC 106-AU**.2:** To educate/ train about environmental laws and policies.	6	0	1	1	8
BSC 106-AU.3: Implement critical thinking toward Environmental Management System	6	0	1	1	8
BSC 106-AU**.4:**Develop, Implement, maintain and Audit Environmental Management systems for Organizations	5	0	1	1	7
BSC 106-AU**.**5: For environmental protection, social equity and sustainable development	6	0	1	0	7
Total Hours	30	0	5	5	40

Suggestion for End Semester Assessment

Suggested Specification Table(ForESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	**BSC106-AU**.1: Gain an understanding of the fundamental of industrial pollution	03	01	01	05
CO-2	**BSC106-AU..2:** To educate/ train about environmental laws and policies.	02	06	02	10
CO-3	**BSC106-AU**..3: Implement critical thinking toward Environmental Management System	03	07	05	15
CO-4	**BSC106-AU..4:** Develop, Implement, maintain and Audit Environmental Management systems for Organizations	-	10	05	15
CO-5	**BSC106-AU..**5: For environmental protection, social equity and	03	02	-	05

	sustainable development				
Total		11	26	13	50

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

The end of semester assessment for Environment Science (Audit)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 mining site
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
9. Brainstorming

Suggested Learning Resources:

(c) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Environmental Health and Safety Audits: A Compendium of Thoughts and Trends	Cahill, L.B	Bernan Press.	2017
2	Handbook of Energy Audits	Thuman, A., Niehus, T., Younger, W.J.		2012

Curriculum Development Team

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Semester-III

Course Code: MIN202

Course Title: Mine Development and Drilling Blasting

Pre-requisite: Student should have basic knowledge of shaft sinking, methods of shaft sinking, drilling and blasting parameters of mining and methods of tunnels making.

Rationale: The students studying should possess foundational understanding about Student should have basic knowledge of shaft sinking, methods of shaft sinking, drilling and blasting parameters of mining and methods of tunnels making. Additionally, students ought to acquire fundamental insights into various drilling machines technology, blast design parameters of open cast mining.

Course Outcomes:

MIN202.1: Understand the knowledge of prospecting, methods of exploration.

MIN202.2: Acquired the knowledge of different shaft sinking methods, working cycle of shaft sinking.

MIN202.3: Understanding of the special types of shafts sinking methods, safety in shaft sinking and statutory provisions as laid down under CMR, MMR issued by DGMS.

MIN202.4: Understanding of the knowledge of explosive properties, blast design parameters in open cast mining and types of different drilling machines.

MIN202.5: Understanding of the preparation of tunnels, Drivage techniques with blasting.

Scheme of Studies:

Code	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)	MIN202	Mine Development & Drilling Blasting	4	0	1	1	6	4

Legend:

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

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

Scheme of Assessment: Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks
			Class/Home Assignment 5 number 3 marks each(CA)	Class Test 2(2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class activity anyone (CAT)	Class Attendance(AT)	Total Marks CA+CT+SA+CAT+ AT)		
PCC	MIN 202	Mine Development and Drilling Blasting	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) upon the course's conclusion.

MIN202.1: Understand the knowledge of prospecting, methods of exploration.

Approximate Hours

Item	Appx Hrs
Cl	12
LI	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	**Laboratory Instruction(LI)**	**Classroom Instruction (CI)**	**Self-Learning(SL)**
SO1.1Definitions, prospecting, shaft, bore holes SO1.2 Methods of exploration SO1.3Borehole logging, deflection of boreholes SO1.4 Fishing tools and exploratory drilling SO1.5 Surface layout		**Unit-1.0General Introduction** 1.1 Definitions reconnaissance principles. 1.2 methods of prospecting. 1.3 Pit, shaft, trench and boreholes. 1.4 Methods of Exploration. 1.5 Selection of sites for boreholes.1.6 Surface layout of boring. 1.7 Details of equipment. 1.8 Borehole logging. 1.9 Maintenance of records. 1.10 Deflection of boreholes. 1.11 Difficulties in boring; Fishing tools and their uses. 1.12 Methods of exploratory drilling for oil; Interpretation of borehole	1. Borehole logging; Maintenance of records; Deflection of boreholes. 2. Difficulties in boring; Fishing tools and their uses.

SW-1Suggested Sessional Work(SW):

a. Assignments:

i. Exploration methods

MIN202.2**:** Acquired the knowledge of different shaft sinking methods, working cycle of shaft sinking.

Approximate Hours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning(SL)**
SO2.1 ToUnderstand the mine entries, location **SO2.2** To learn about preparatory work required of shaft sinking **SO2.3**Tounderstand theshaft sinking methods **SO2.4**To understand the sinking cycle **SO2.**5 To learn about the support system of shaft sinking		**Unit 2 Shaft Sinking I** 2.1 Shaft Sinking. 2.2 Mine Entries - Choice, location. 2.3 Size of mine entries. 2.4 Access to seated deposits by Adit/Drifts/Incline. 2.5 Selection - Location - Preparatory work required. 2.6 Sinking appliances, equipment and services. 2.7 Sinking methods and procedure. 2.8 Reaching up tothe rock head - Pre-sink. 2.9 Sinking through the rock. 2.10 Shaft Centering-Cycle (Drilling, Blasting,Lashing and 2.11 Mucking-Hoisting - Support or shaft lining. 2.12 Auxiliary operations – DewateringVentilation-Illumination.	i. Mine entries, location of mine ii. Methods of shaft sinking

SW-2Suggested Sessional Work(SW):

a. Assignments:

i. Shaft sinking methods

MIN202.3: Understanding of the special types of shafts sinking methods, safety in shaft sinking and statutory provisions as laid down under CMR, MMR issued by DGMS.

Approximate Hours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO3.1 Special methods of shaft sinking **SO3.2 C**ementation method **SO3.3** Drilling and boring **SO3.4** Safety features as per requirement of CMR **SO3.5**Freezing methods		**Unit-3: Shaft Sinking II** 3.1 Shaft Sinking – II. 3.2 Station construction and initial development. 3.3 Special methods of shaft sinking. 3.4 Piling System-Caisson Method. 3.5Sinking drumprocess-Forced drop. 3.6Shaft method -Pneumatic caisson method. 3.7 Special methods by temporaryor permanent isolation of water -Cementation. 3.8 Boring/Drilling-Cementation -Sinking and Walling. 3.9 The freezing process - Drilling and lining of boreholes-Formation and maintenance. 3.10 The ice column -Actual sinking operations - Thawing of ice wall. 3.11 Freezing – Shafts - Shaft drilling and boring - Shaft drilling Shaft boring. 3.12 Safety in sinking shafts &Statutory provisions as laid down under CMR, MMR & Circulars issued by DGMS.	i. Shaft sinking methods ii. Freezing methods and Safety provisions

SW-3Suggested Sessional Work (SW):

a. Assignments:

1. Special Shaft sinking methods

MIN202.4: Understanding of the knowledge of explosive properties, blast design parameters in open cast mining and types of different drilling machines.

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	2
Total	15

Approximate Hours

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction(CI)**	**Self-Learning(SL)**
SO4.1 Understand the drilling machine SO4.2 Explosive properties SO4.3 Blast design parameters SO4.4 Fragmentation SO4.5 Advances in Blasting		**Unit-4 Drilling and Blasting** 4.1 Drilling – Introduction selection-application-classification. 4.2 construction of few drill machines. 4.3 Drill bits – operation & maintenance etc. 4.4 Explosives & Accessories used in Mines. 4.5 Selection-Classification-Properties-Testing. 4.6 Underground Coal Mines. Permitted & non-permitted. 4.7 Explosives-Explosives used in Quarries. 4.8 Opencast Mines (details of selection, blast design. will be taught in Surface Mining). 4.9 Storage-Transport of explosives & accessories. 4.10 Theories of Blasting. 4.11 Environmental Impact due to Blasting. 4.12 Safety during Blasting – Advances in Blasting.	i. Blast design parameters in mining ii. Types of explosives

SW-4 Suggested Sessional Work(SW):

a. Assignments:

i. Blast design parameters

MIN202.5: Understanding of the preparation of tunnels, Drivage techniques with blasting.

Approximate Hours

Item	AppX Hrs
Cl	12
LI	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction(CI)**	**Self-Learning(SL)**
SO5.1 Conventional methods of tunnels **SO5.2** Over view of site investigation **SO5.3** Role of the techniques in blasting **SO5.4** Post blasting handling **SO5.**5 Support system		**Unit 5:Drifts/Drivage's & Tunnels** 5.1 Conventional Methods. 5.2 Introduction, Preparations for driving drivage's/tunnels. 5.3 Site investigations, Location of - Rocks and ground. 5.4 characterization-Size,shape, length. 5.5 Orientation (route) - function of drives. 5.6 Tunnels - Drivage techniques (fordrives and tunnels). 5.7 Drivage techniques with blasting (Pattern of holes - Blasting off the solid. 5.8 UG Gassy seams- Pattern of Holes-Charging and blasting the rounds - Placement of primer. 5.9 Stemming - Depth of round/hole - Charge density in cut-holes and rest of the face area – Smooth blasting). 5.10 Post Blast Handling - Muck disposal and handling (mucking and transportation). 5.11 Ventilation during drivage/ tunneling - Working cycle (including auxiliary operations). 5.12 Driving large sized drives/tunnels in tough rocks.	1. Methods of tunnels 2. Blasting techniques

SW-5 Suggested Sessional Work(SW):

a. Assignments:
Support system

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	SessionalWork (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
MIN202.1:Understand the knowledge of prospecting, methods of exploration.	12	0	1	2	15
MIN202.2:Acquired the knowledge of different shaft sinking methods, working cycle of shaft sinking.	12	0	1	2	15
MIN202.3: Understanding of the special types of shaft sinking methods, safety in shaft sinking and statutory provisions as laid down under CMR, MMR issued	12	0	1	2	15
MIN202.4: Understanding of the knowledge of explosive properties, blast design parameters in open cast mining and types of different drilling machines.	12	0	1	2	15
MIN202.5: Understanding of the preparation of tunnels and Drivage techniques with blasting.	12	0	1	2	15
Total Hours	60	0	5	10	75

Suggestion for End Semester Assessment

Suggested Specification Table (ForESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Understand the knowledge of prospecting, methods of exploration.	03	01	01	05
CO-2	Acquired the knowledge of different shaft sinking methods, working cycle of shaft sinking.	02	06	02	10
CO-3	Understanding of the special types of shafts sinking methods, safety in shaft sinking and statutory provisions as laid down under CMR, MMR issued by DGMS.	07	05	03	15
CO-4	Understanding of the knowledge of explosive properties, blast design parameters in open cast mining and types of different drilling machines.	03	03	04	10
CO-5	Understanding of the preparation of tunnels and Drivage techniques with blasting.	03	02	05	10
Total		14	23	13	50

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

The end of semester assessment for Basic Mining Engineering will be heldwithwrittenexaminationof50 marks.

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

Suggested Instructional/ Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,WhatsApp, Mobile,On-line sources)
9. Brainstorming

Suggested Learning Resources:

(a)Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Elements Of Mining Technology	D.J. Deshmukh	Denett & Co. Nagpur, N e w Delhi, Chennai P u n e	2016
2	Mining Competition Handbook (For GATE, Overman, Mining Sirdar and others competitive exams)	Dr. Sandeep Prasad	Orange Books Publication	1st and 2023
3	Das, S.K., Surface Mining Technology, Lovely Prakashan, Dhanbad			
4.	Kennedy, B.A.(Editor), 1990, Surface Mining, SME, USA, 2nd Edition.			

Web Link:

https://en.wikipedia.org/wiki/Drilling_and_blasting

https://core.ac.uk/download/pdf/53188886.pdf

https://nptel.ac.in/

Curriculum Development Team

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Cos, Pos and PSos Mapping

Program Title: B. Tech. Mining Engineering

Course Code: MIN202

Course Title: Mine Development Drilling and blasting

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO11	PO 12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability:	Ethics	Individual and team work:	Communication:	Project management And finance:	Life-long learning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of mining engineering.
CO1 : Understand the knowledge of prospecting, methods of exploration.	1	2	1	1	1	2	1	2	2	1	1	2	2	3	2	1
CO 2 : Acquired the knowledge of different shaft sinking methods, working cycle of shaft sinking.	1	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1
CO3 : Understanding of the special types of shaft sinking methods, safety in shaft sinking and statutory provisions as laid down under CMR, MMR issued by DGMS.	2	2	1	1	1	2	2	2	1	2	1	2	1	1	2	2

CO4:Understanding of the knowledge of explosive properties, blast design parameters in open cast mining and types of different drilling machines.	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO5:Understanding of the preparation of tunnels and Drivage techniques with blasting.	1	2	1	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map

Pos& PSOs No.	Cos No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO1,2, 4, 6,7,8,9,10, 12 PSO1,2,3,	CO1 : Understand the knowledge of prospecting, methods of exploration.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 General Introduction 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11,1.12	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 2 Acquired the knowledge of different shaft sinking methods, working cycle of shaft sinking.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2Shaft Sinking I 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9,2.10,2.11,2.12	SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3	CO3 Understanding of the special types of shaft sinking methods, safety in shaft sinking and statutory provisions as laid down under CMR, MMR issued by DGMS.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3:Shaft Sinking II 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11,3.12	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 4: Understanding of the knowledge of explosive properties, blast design parameters in open cast mining and types of different drilling machines.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4: Drilling and Blasting 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12	SL 4.1
PO1,2,3, 5,6 7,8,10,11,12 PSO1,2,3,4	CO 5: Understanding of the preparation of tunnels and Drivage techniques with blasting.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit5: Drifts / Drivage's and Tunnels 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11,5.12	SL 5.1

Semester III

Course Code: MIN203/MIN203-L

Course Title: Underground Coal Mining

Pre-Requisite: The student should have basic knowledge about the depositional pattern of coal as a mineral resource and broad classification of coal mining methods

Rationale: The student studying mining engineering should develop fundamental understanding about the scope and application of different methods of coal mining in specific geo-mining conditions. It encompasses the history of development of commercial coal mining and gradual changes in underground coal mining technologies in commensuration with the need of the nation in general.

Course Outcome

MIN203/MIN203-L:1.1 Will garner an insight into the present status of underground coal mining in India, its limitations from the technological as well as economical point of view and will develop a logical understanding defining the future trend

MIN203/MIN203-L:1.2Acquire the knowledge of the methods of access and egress to underground coal deposits with specific reference to vertical shaft sinking in consideration of their design, dimension &location optimization.

MIN203/MIN203-L:1.3Will develop complete knowledge and understanding of the design elements of Bord & Pillar (B&P) method of development in coal mines

MIN203/MIN203-L:1.4Will comprehend the technical challenges associated with the depillaring operation in underground coal mines and accordingly adopt methods of safe operation for extraction and reduction of coal pillars

MIN203/MIN203-L:1.5Will be able to identify and accordingly adopt such types of geo-mining conditions in underground coal mines where specific conditions exist to adopt special mining methods like partial extraction methods or other non-conventional methods.

Scheme of studies:

Code	Course code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total study Hours (CI+LI+SW+SL)	
Program Core (PCC)	MIN203/MIN203-L	Underground coal Mining	4	1	1	1	7	5

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

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

Scheme of Assessment: Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PR+ESA)
			Class/HomeAssignment5number3 marks each(CA)	Class Test 2(2 best outof 3) 10 marks each (CT)	Seminar one (SA)	Class activity anyone (CAT)	Class Attendance(AT)	Total Marks CA+CT+SA+CAT+AT)		
PCC	MIN 203	Underground coal Mining	15	20	5	5	5	50	50	100

Scheme of Assessment: Practical

CODE	Couse Code	Course Title	Scheme of Assessment (Marks)					
			Progressive Assessment (PRA)				End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 7 marks each (CA)	Viva	Class Attendance (AT)	Total Marks (CA+VV+AT)		
PCC	MIN203-L	Underground coal Mining	35	10	5	50	50	100

Course-Curriculum Detailing

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

MIN203/MIN203-L:1.1 Garnering an insight into the present status of underground coal mining in India, its limitations from the technological as well as economical point of view and will develop a logical understanding defining the future trend

Approximate hours

Item	Approx. Hrs.
Cl	9
LI	0
SW	2
SL	2
Total	13

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self-Learning (SL)
SO1.1- Garnering knowledge about history of commercial coal production in India SO1.2- Comprehension of the reasons behind imbalanced rapid growth of open cast coal mining in India compared to UG coal mining SO1.3- Analytical concept about the need to change the status of UG coal mining in India at present SO1.4- Understanding the need for setting new trend in UG coal mining in India from Techno-economical point of view SO1.5- Comprehension about the basic criteria for selection of improved mining methods for UG coal mining.		Unit 1: Present status & trend of UG coal mining. Classification and selection of mining methods. 1.1 Chronology of development of coal mining in India 1.2 Present status of UG coal mining in India 1.3 Necessity to change status quo of UG coal mining in India 1.4 Importance of setting new trend of UG coal mining in India 1.5 Classification of coal mining methods. 1.6 Coal mining methods and their applicability. 1.7 Continuous mining processes. 1.8 Cyclic mining processes 1.9 Basic criteria for selection of mining methods.	Study Area: (i)History of development of coal mining industry in India (ii) Present status and future perspective of coal mining in general and underground coal mining in particular

Suggested Sessional works: a. Assignments

(i) Analysis of the reasons for extremely rapid growth of open cast coal mining in India in contrast to practical stagnancy in underground coal mining

(ii) Need for striking a balance to between open cast and underground coal mining in India in present day context

b. **Mini Project**: - Strategies to improve Underground Coal Mining Technologies in India and its significance in National and Global context

MIN203/MIN203-L:1.2Acquire the knowledge of the methods of access and egress to underground coal deposits with specific reference to vertical shaft sinking in consideration of their design, dimension & location optimization.

Approximate hours

Item	Approximate Hours
Cl	15
LI	4
SW	2
SL	2
Total	23

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self-Learning (SL)
SO2.1- Complete understanding of the importance of deciding the methods of access and egress during mine planning SO2.2- Comprehension of the significance of vertical shaft sinking in present and future Indian UG coal mining SO2.3- Conceptualization of the design aspects of vertical shaft sinking SO2.4- Garnering technological knowledge about conventional and mechanized shaft sinking SO2.5- Identification of specific conditions for application of special methods of shaft sinking.	2.1- Drilling &blasting in vertical shaft sinking 2.2- Vertical shaft equipping	Unit 2- Access to underground coal deposits. Vertical shaft sinking technology. 2.1Different methods of access to underground coal deposits & their applicability 2.2 Different methods of access egress to underground coal deposits & their applicability 2.3 Basic factors affecting the selection of numbers, dimensions and locations of means of access and egress 2.4 Factors affecting the locations of means of access and egress 2.5 Significance of vertical shaft sinking as a method of access to deep coal deposits in Indian context 2.6Conventional Method of vertical shaft sinking 2.7 Need for mechanized shaft sinking 2.8 Different phases of mechanized shaft sinking 2.9 Installation phase 2.10 Operational phase of mechanized shaft sinking 2.11 Shaft fitting and equipping 2.12 Caisson method of shaft sinking 2.13 Piling method of shaft sinking 2.14 Freezing method shaft sinking 2.15 Other special methods of shaft sinking	Study Area: - (i)Access and egress planning for very large UG coal mines with high level of production and critical environmental conditions (ii) Method of shaft equipping and its technological aspects

Suggested Sessional Works: Assignments

(i) Designing Drilling & Blasting design in a 6m diameter vertical shaft during mechanized sinking

(ii) Time cycle study for mechanized shaft sinking

Mini Project: Significance of highly mechanized shaft sinking in designing upcoming coal mining projects in Indian context.

MIN203/MIN203-L:1.3Developing complete knowledge and understanding of the design elements of Bord & Pillar (B&P) method of development in coal mines

Approximate hours:

Item	Approximate Hours
Cl	14
LI	6
SW	2
SL	3
Total	25

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self-Learning (SL)
SO3.1- A student will understand the applicability of B&P method of mining in UG coal mines. SO3.2- Will develop the skill in designing the pillars based on long term pillar stability criteria SO3.3- Will comprehend the concept of panel development and design the panels in B&P system SO4.4- Will be able to plan ventilation, evacuation and support systems with conventional B&P mining system SO3.5- Will be able to plan production potential from an B&P development district	3.1- Designing of B&P working 3.2- Lay-out of B&P development district with SDL/ LHD 3.3- Guidelines for support plan & determining RMR of immediate roof	Unit 3- Bord & Pillar (B&P) development in UG coal mines 3.1Defining B&P method and its applicability. 3.2Suitable conditions of B&P workings 3.3 Advantages and disadvantages of B&P workings 3.4 Design elements of B&P workings in UG coal mines 3.5 Determination of abutment load on solid pillars 3.6 Strength calculation of solid pillars 3.7 Determination of pillar stability 3.8 Concept of panel development in B&P workings and its advantages 3.9 Standard layout of B&P development panels 3.10 Factors affecting size of panels and designing of panels 3.11 Ventilation and evacuation systems in B&P development districts 3.12Support system in B&P development districts 3.13 Drilling & Blasting in B&P workings. 3.14 Blasting off solids.	Study area:- (i)Variation in design elements of B&P method of mining like the use of rectangular pillars in room & pillar method from experience in USA (ii) different pillar stability formulas used in other countries (iii)Numerical and computer modeling methods for pillar designing

Suggested Sessional works:

(i) Determination of pillar stability in B&P system by numerical example

(ii) Designing a panel in B&P workings in consideration of multiple factors affecting the panel dimensions.

Topic for Mini Project- Scope of B&P workings in Indian coal mines and strategies for improvement in production and productivity.

MIN203/MIN203-L:1.4 Will comprehend the technical challenges associated with the depillaring operation in underground coal mines and accordingly adopt methods of safe operation for extraction and reduction of coal pillars.

Approximate hours

Item	Approximate Hours
Cl	11
LI	4
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
The student SO4.1- Will develop complete understanding about depillaring phase of UG coal mining SO4.2- Will be able to analyze the contents of CMR related to depillaring operation SO4.3- will comprehend the concepts of sequence of pillar extraction to deal with strata control challenges So4.4- Will learn about different methods of depillaring in different mining conditions SO4.5- Will be able to execute depillaring operation in real UG coal mining situations.	4.1- Designing depillaring by S&R with caving. Calculation of number of slices. 4.2- Determining production potential of a B&P working district.	Unit 4- Depillaring Operation in Conventional B&P Workings 4.1Defining depillaring operation as the 2nd phase of activity in mining operations 4.2Technical challenges associated with depillaring operation in UG coal mines 4.3Strata control challenges 4.4Provisions of CMR 4.5 Provisions in CMR related to spontaneous heating 4.6 Risks from outbreak of fire 4.7 Provisions in CMR related to environmental control. 4.8 Provisions in CMR related to isolation of panels. 4.9 Sequence of depillaring operation in a panel and line of extraction. 4.10 Depillaring by S&R with caving. 4.11 Depillaring by S&R method with stowing.	Study area:- (i)Strata movement in lower and upper main roof during depillaring and their impact on loading pattern on the supports

Suggested Sessional works:

(i) Design the pillar extraction procedure in a B&P development district at a depth of 300m from surface with gallery width 4.8m deploying LHD.

(ii) Make a comparative statement between the procedures of depillaring with caving and depillaring with stowing.

Topic for Mini Project- Anticipation and mitigation of challenges associated with conventional B&P depillaring in multi-seam conditions.

MIN203/MIN203-L:1.5 Will be able to identify and accordingly adopt such types of geo-mining conditions in underground coal mines where specific conditions exist to adopt special mining methods like partial extraction methods or other non-conventional methods.

Approximate hours

Item	Approximate Hours
Cl	11
LI	2
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self-Learning (SL)
The student SO5.1- Will understand the specific conditions requiring partial extraction of pillars SO5.2- Will be able to apply different partial extraction methods by selection of conditions SO5.3- Will learn thoroughly about cable bolting method in seam of thickness more than 3 to 8m SO5.4- Will comprehend the challenges of contiguous seam mining and its mining method SO5.5- Will comprehend the risks of mining operations in coal seams prone to bumps and apply the method for safe working in such seams.	5.1- Adoption of variable sequence of operation during extraction of contiguous coal seams	Unit 5- Partial Extraction of Coal Pillars. Mining under Special Conditions by B&P workings 5.1 Defining partial extraction method. 5.2 Conditions requiring partial extraction 5.3 Different methods of partial extraction. 5.4 Splitting of pillars 5.5 Wide stall method of partial extraction 5.6 Limited span or non-effective width method of partial extraction 5.7 Yielding pillar technique of strata control 5.8 Extraction of coal pillars more than 3m thick by cable bolting 5.9 Defining special mining conditions where special methods are required 5.10 Extraction of coal pillars in contiguous coal seams 5.11 Extraction of coal in seams prone to bumps	(i)Implication of limited span method on surface subsidence

Suggested Sessional works:

(i) Application of non-effective width method for subsidence control

(ii) Adoption of yield pillar technique in hard roof strata control

Topic for Mini Project- Comparative analysis of different partial mining methods and specific conditions for their application.

Brief of Hours suggested for the course outcome:

Course outcomes	Class Lectures (CL)	Laboratory Instructions (LI)	Sessional work (SW)	Self-Learning (SL)	Total Hour (CL+LI+SW +SL)
CO-1 Present status, limitations and future trend in Indian UG coal mining	9	0	2	2	13
CO-2 Access & Egress to UG coal mines. Shaft sinking	15	4	2	2	23
CO-3Design elements of B&P workings	14	6	2	2	24
CO-4 Depillaring operation in UG coal mining- Its challenges	11	4	2	3	20
CO-5 Special mining methods other than conventional mining methods	11	2	2	1	16
Total Hours	60	16	10	10	96

Suggestions for End semester Assessment:

Suggested Specification Table

COs	Unit Titles	Marks Distribution			Total; Marks
		R	U	A	
CO 1	Present status, limitations and future trend in Indian UG coal mining	3	3	1	7
CO 2	Access & Egress to UG coal mines. Shaft sinking	3	4	3	10
CO 3	Design elements of B&P workings	3	5	5	13
CO 4	Depillaring operation in UG coal mining- Its challenges	3	5	5	13
CO 5	Special mining methods other than conventional mining methods	2	3	2	7
	Total	14	20	16	50

Legend: R-Remember U-Understand A-Apply

The end of semester assessment for Underground coal mining technologies will be held with written examination of 50 marks

Suggested Instructional/ Implementation Strategies:

1. **Improved lectures**
2. Tutorial
3. Case studies
4. Group discussion
5. Role play
6. Visit to mines and mineral processing industries
7. Demonstration
8. Digital media application in teaching learning process and mass media
9. Brainstorming

Suggested Learning Resources

(a) Books:

Sl.No	Title	Author	Publisher	Edition & Year
1.	Elements of Mining Technology (Vol. 1)	D J Deshmukh	Denett & Co	2008
2	Principles and practice of modern coal mining	R D Singh	New Age International publisher	2019
3	Introduction to Mining Technology	Dr. G K Pradhan	AKS University	2016
4.	Modern Coal Mining Technology	Samir Kumar Das	Lovely Prakashan	2006

(b) Link

https://nap.nationalacademies.org/read/11977/chapter/15

https://archive.nptel.ac.in/Harddisk/Direct_Download.html

https://epathshala.nic.in/

https://swayam.gov.in/

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COs, POs & PSOs Mapping

Program Title: B. Tech .Mining Engineering
Course Code: MIN203/MIN203-L
Course Title: Underground Coal Mining

	Program Outcomes												**Program Specific Outcomes**			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
Course Outcome	Engg Know ledge	Prob Lem Ana-lysis	Des-ign/ Dev of Solu tion	Inv-esti gat ion of comple x proble ms	Mod ern tool usage	Eng Ineer & soc iety	Env Iron ment & Sus tai nab ility	Work Eth ics	Ind Ivi Dual &te-am Wo-rk	Commu nica tion	Pro Ject Mg mt & Fin ance	Life lo ng Lea ning	Dev. Analy tical skill for identi-fying mine prob-lems for solution s	Garnerin g know Ledge about economi c, env & soc ietal impacts of mining	Dev. Knowledg e for mine plan ing, operation & closure	Develop work ethics under mine statutes
CO1-Present status, limits & future trends in Indian UG coal mining	2	1	1	1	1	1	2	1	1	1	1	2	1	1	1	1
CO 2-Access & egress to UG mines-shaft sinking	2	1	1	1	2	1	1	1	3	2	3	2	1	1	2	2
CO 3- Design elements of B&P mining	3	2	3	1	2	1	2	1	3	3	2	2	2	1	3	1
CO 4- Depillaring operation in UG coal mines- its challenges	3	2	3	1	2	1	2	1	3	3	2	2	2	1	3	1
CO 5- Special mining methods other than conventional mining methods	3	2	2	3	2	1	2	2	3	3	3	2	2	2	3	2

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

POs & PSOs Number	Cos number & Title	SOs Number	Laboratory Instruction (LI)	Class Room Instructions (CI)	Self Learning (SL)
PO1,2,3,4,5,67,8,9, 10,11,12 PSO1,2,3,4	CO 1- Present status, limitations and future trend in Indian UG coal mining	SO 1.1 SO 1.2 SO 1.3 SO 1.4 SO 1.5	Nil	Unit 1- Present status & trend in UG coal mining. 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7	SL 1.1
PO1,2,3,4,5,67,8,9, 10,11,12	CO 2- Access & Egress to UG coal mines. Shaft sinking	SO2.1 SO 2.2 SO 2.3 SO 2.4 SO 2.5	2.1 2.2	Unit 2- Access to UG coal deposits. Vertical shaft sinking technology 2.1 to 2.10	SL2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 3- Design elements of B&P workings	SO 3.1` SO 3.2 SO 3.3 SO 3.4 SO 3.5	3.1 3.2 3.3	Unit 3- B&P development in UG coal mines 3.1 to 3.11	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 4- Depillaring operation in UG coal mining- Its challenges	SO 4.1 SO 4.2 SO 4.3 SO 4.4 SO 4.5	4.1 4.2	Unit 4- Depillaring operation in conventional B&P workings 4.1 to 4.8	SL4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 5- Special mining methods other than conventional mining methods	SO 5.1 SO 5.2 SO 5.3 SO 5.4 SO 5.5	5.1 5.2	Unit 5- Partial extraction of coal pillars. Mining under special conditions by B&P method 5.1 to 5.8	SL.5.1

Semester III

Course Code: **HSMC-301**

Course Title: Universal Human Values

Pre- requisite: Creating awareness among the students on a holistic perspective about life

Rationale: The purpose is to help develop a holistic perspective about life. A self-reflective methodology of teaching is adopted. It opens the space for the student to explore his/her role (value) in all aspects of living – as an individual, as a member of a family, as a part of the society and as an unit in nature. Through this process of self exploration, students are able to discover the values intrinsic in them.

Course Outcomes:

HSMC-301.1: To understanding Value Education

HSMC-301.II: Students will have the ability to learnabout Harmony in the Human Being**.**

HSMC-301.III: Student will be able to gain knowledge on Harmony in the Family and Society.

HSMC-301.IV: Understanding Harmony in the Nature/Existence.

HSMC-301.V: Student will able to understand about Implications of Holistic Understanding- A Look at Professional Ethics.

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours CI+LI+SW+SL	
HSMC	**HSMC-301**	Universal Human Values	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: Session Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

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

Scheme of Assessment:

Theory

`Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test2 (2 best out of 3) 10 marks each (CT)	Seminarr on anyone (SA)	Class Activity any one (CAT)	Class Attendance (A T)	Total Marks (CA+CT+ SA+CAT +AT)		
HSMC	HSMC-301	Engineering Graphics & Design	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.

HSMC-301.I Student will be able to Understand the Value Education

Approximate Hours

Item	Approximate Hours
CI	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 1.1. Understand Self-exploration as the Process for Value Education SO1.2. Understand Continuous Happiness and Prosperity – the Basic Human Aspirations SO 1.3. Understand Right Understanding SO1.4. Understand Relationship and Physical Facility SO 1.5. Understand Happiness and Prosperity – Current Scenario SO 1.6. Understand Method to Fulfill the Basic Human Aspirations		**Module-I Understanding Value Education** 1.2 Self-exploration as the Process for Value Education 1.2 Continuous Happiness and Prosperity – the Basic Human Aspirations 1.3 Right Understanding 1.4 Relationship and Physical Facility 1.5 Happiness and Prosperity 1.6 Current Scenario 1.7 Method to Fulfill the Basic 1.8 Human Aspirations 1.9 Numerical	Human values to become a good man

SW-1 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Continuous Happiness and Prosperity – the Basic Human Aspirations

b. **Mini Project:**
   ii. Relationship and Physical Facility

HSMC-301:2 Students will have the ability to apply the gained knowledge onHarmony in the Human Being

Approximate Hours

Item	Approximate Hours
CI	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 2.1. Understanding Human being as the Co-existence of the Self and the Body SO2.2. Understand the Distinguishing between the Needs of the Selfand Body SO 2.3. Understand the Body as an Instrument of the Self SO 2.4. Understanding Harmony in the Self SO 2.5. Understanding Harmony of the Self with the Body SO2.6. Understand Programme to ensure self-regulation and Health		**Module-II Harmony in the Human Being** 2.1. Human being as the Co-existence of the Self and the Body 2.2. Distinguishing between the Needs of the Selfand Body 2.3. Body as an Instrument of the Self 2.4 Harmony in the Self 2.5 Harmony of the Self with the Body 2.6 Programme to ensure self-regulation and Health 2.7 Example 2.8 Example 2 2.9 Example 3	**1.** Harmony in and among human being

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Harmony in the self

b. Mini Project:

ii. Body an an instrument

HSMC-301.III: Student will be able to understand Harmony in the Family and Society

Approximate Hours

Item	Approximate Hours
CI	**9**
LI	**0**
SW	**2**
SL	**1**
Total	**12**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 3.1. Understand Harmony in the Family – the Basic Unit of Human Interaction SO 3.2. Understand the Values in Human-to-Human Relationship SO 3.3. Understand the 'Trust' – the Foundational Value in Relationship SO 3.4. Understand the 'Respect' – as the Right Evaluation SO 3.5. Understanding Harmony in the Society SO 3.6. Understand the Vision for the Universal Human Order		**Module III. Harmony in the Family and Society** 3.1 Harmony in the Family – the Basic Unit of Human Interaction 3.2 Values in Human-to-Human Relationship 3.3 'Trust' – the Foundational Value in Relationship 3.4 'Respect' – as the Right Evaluation 3.5 Understanding Harmony in the Society 3.6 Vision for the Universal Human Order 3.7 Example 1 3.8 Example 2 3.9 Example 3	1. Harmony in the society

SW-3 Suggested Sessional Work (SW):

a. Assignments:

1. Respect the right evaluation

b. Mini Project:

1. Trust is the fundamental value of relationships

HSMC-301.IV: Student will be able to understand Harmony in the Nature/Existence

Approximate Hours

Item	Approximate Hours
CI	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 4.1. Understanding Harmony in the Nature, Interconnectedness SO 4.2. Understand self regulation and Mutual Fulfillment among 4 orders of Nature SO 4.3. Understand the Exploring Four Orders of Nature SO 4.4. Understand the Realizing Existence as Co-existence at All Levels SO 4.5. Understand the holistic Perceptions of Harmony in Existence SO 4.6. Understand the Exploring Co-Existence in Existence		**Module-IV Harmony in the Nature/Existence** 4.1 Harmony in the Nature, Interconnectedness 4.2 Self regulation and Mutual Fulfillment among 4 orders of Nature 4.3 Exploring Four Orders of Nature 4.4Realizing Existence as Co-existence at All Levels 4.5 The holistic Perceptions of Harmony in Existence 4.6The Exploring Co-Existence in Existence 4.7 Case study 4.8 Study 2 4.9 Case study 3	i. Harmony in the nature

SW-4 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Harmony in nature

b. **Mini Project:**
   i. Exploring 4 orders of nature

HSMC-301.V: Students will have the ability to apply the gained knowledge in Implications of Holistic Understanding- A Look at Professional Ethics

Approximate Hours

Item	Approximate Hours
CI	**9**
LI	**0**
SW	**2**
SL	**1**
Total	**12**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 5.1. Understand Natural acceptance of Human Values SO 5.2 Understand Definitiveness of (Ethical) Human Conduct SO5.3. Understand A Basis for Humanistic Education SO 5.4. Understand the Humanistic Constitution and Universal Human Order SO 5.5. Understand Competence in Professional Ethics SO 5.6. Understand Strategies for Transition towards value based Life and Profession		**Module V. Implications of Holistic Understanding- A Look at Professional Ethics** 5.1 Natural acceptance of Human Values 5.2.Definitiveness of (Ethical) Human Conduct 5.3 A Basis for Humanistic Education 5.4 Humanistic Constitution and Universal Human Order 5.5Competence in Professional Ethics 5.6 Strategies for Transition towards value based Life and Profession 5.7 Example 1 5.8 Example 2 5.9 Example 3	Holistic understanding of human values

SW-5 Suggested Sessional Work (SW):

- **a. Assignments:**
  - i. Human conduct
- **b. Mini Project:**
  - i. Humanistic constitution

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
UHV Module. I:Student will be able to understand The Value Education	**9**	**2**	**1**	**12**
UHV Module. II: Students will have the ability to apply the knowledge gained about Harmony in the Human Being	**9**	**2**	**1**	**12**
UHV Module. III: Student will be able to understandthe Harmony in the Family and Society	**9**	**2**	**1**	**12**
UHV Module. IV: Understand the Harmony in the Nature/Existence	**9**	**2**	**1**	**12**
UHV Module. V: Understand about the Implications of Holistic Understanding- A Look at Professional Ethics	**9**	**2**	**1**	**12**
Total	**45**	**10**	**5**	**60**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO 1	The Value Education	**2**	**5**	**1**	**8**
CO 2	Harmony in the Human Being	**2**	**6**	**2**	**8**
CO 3	Harmony in the Family and Society	**2**	**6**	**5**	**13**
CO 4	Harmony in the Nature/Existence	**2**	**4**	**4**	**10**
CO 5	Implications of Holistic Understanding- A Look at Professional Ethics	**2**	**5**	**2**	**9**
Total		**10**	**26**	**14**	**50**

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

The end of semester assessment for **Universal Human Values** will be held with written examination of 50 marks

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

Suggested Instructional/Implementation Strategies:

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

5. Role Play
6. Visit to Religious places, World Heritage Sites
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	*JeevanVidya: EkParichaya*	A Nagaraj	JeevanVidyaPrakashan, Amarkantak	1998
2	*Human Values*	A.N. Tripath	New Age Intl. Publishers, New Delhi,	2004
3	*Universal Human Values*		AICTE	2021

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COs, POs and PSOs Mapping

Program: B. Tech. Mining Engineering
Course Code : HSMC-301
Course Title: Universal Human Values

CourseOutcomes	Program Outcomes												Program Specific Outcome				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PS0 5
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct studies of difficult problems	Utilization of modern tools	Engineers and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-longlearning	Use fundamental knowledge of math, science, and engineering to comprehend, evaluate, and create computer Programmes in the fields of algorithms, multimedia, big data analytics, machine learning, artificial 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.
UHV Module. I: Student will be able to understand The Value Education	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1	2
UHV Module. II: Students will have the ability to apply the knowledge gained about Harmony in the Human Being	1	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1	3

UHV Module. III: Student will be able to understand the Harmony in the Family and Society	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**	**2**
UHV Module. IV: Understand the Harmony in the Nature/Existence	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**	**2**
UHV Module. V: Understand about the Implications of Holistic Understanding- A Look at Professional Ethics	**1**	**1**	**1**	**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)
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4,5	**UHV Module. I:**Student will be able to understand The Value Education	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5 SO1.6		Unit-1 **Understanding Value Education** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	SL 1.1
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4,5	**UHV Module. II:** Students will have the ability to apply the knowledge gained about Harmony in the Human Being	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5 SO2.6		Unit-2**Harmony in the Human Being** 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9	SL 2.1
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4,5	**UHV Module. III:** Student will be able to understandthe Harmony in the Family and Society	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5 SO3.6		Unit-3**Harmony in the Family and Society** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9	SL 3.1
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4,5	**UHV Module. IV:** Understand the Harmony in the Nature/Existence	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5 SO4.6		Unit-4**Harmony in the Nature/Existence** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	SL 4.1
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4,5	**UHV Module. V:** Understand about the Implications of Holistic Understanding- A Look at Professional Ethics	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5 SO5.6		Unit-5 **Implications of Holistic Understanding- A Look at Professional Ethics** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9	SL 5.1

Semester-III

Course Code: **ESC202/ ESC202-L**

Course Title: Engineering Mechanics

Pre- requisite: Student should have basic knowledge of mathematics and Physics up to higher secondary level.

Rationale: As a bridge between theory and application, engineering mechanics is used to formulate new ideas and theories, discover and interpret phenomena and develop experimental and computational tools.

Course Outcomes:

ESC202/ ESC202-L.1: Understanding of term Mechanics and its classification.

ESC202/ ESC202-L.2: Understanding Resolution and composition of force acting on the rigid body.
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ESC202/ ESC202-L.3: Compute the resultant of force for different system of force and study of different laws related to different force system.

ESC202/ ESC202-L.4: compute the different types of load acting on a different types of beam.

ESC202/ ESC202-L.5: Compute the centroid, second moment of area, center of gravity, moment of inertia and mass moment of inertia.

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits(C)
			CI	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
PCC	ESC202/ ESC202-L	Engineering Mechanics	4	2	1	1	8	5

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

Code	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)		
ESC	**ESC202/ ESC202-L**	Engineering Mechanics	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), culminatingin the overall achievement of Course Outcomes (COs) upon the course's conclusion.

ESC202/ ESC202-L.1: Understanding of term Mechanics and its classification.

Approximate Hours

Item	AppX Hrs
Cl	9
LI	4
SW	2
SL	1
Total	16

Session Outcomes (SOs)	**LaboratoryInstruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO1.1 Understanding of basic knowledge of term Mechanics. SO1.2 Understanding how objects move when forces are applied to them. Newton's laws lay the foundation for comprehending how forces interact with objects to cause motion. SO1.3 Describing motion without considering its causes. This includes concepts like velocity, acceleration, displacement, and time. SO1.4 Understanding the causes of motion, mainly through the study of forces. This involves concepts like friction, tension, gravitational forces, and how they affect objects.	1.1 Introduction to laboratory 1.2 Introduction to Tools and Equipments	**Unit-1.0 Introduction to Mechanics** 1.1 Introduction of term mechanics 1.2 classification of mechanics 1.3 static and dynamics 1.4 classification of dynamics 1.5 kinetic and kinematic 1.6 fundamental laws of mechanics 1.7 Gravitational law 1.8 Newton Laws 1.9 Numerical	**1.** Numerical problem related to classification of mechanics **2.** Numerical problem related to basic laws

SW-1 Suggested Sessional Work (SW):

a. Assignments:

1. Explain Newton 2nd law of motion and its application
2. Write the definition of basic term related to static and dynamic

ESC202/ ESC202-L.2: Resolution and composition of force acting on the rigid body.. Approximate Hours

Item	AppX Hrs
Cl	13
LI	12
SW	0
SL	1
Total	26

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO2.1 Ability to break down a single force into its horizontal and vertical components. This involves understanding trigonometric concepts like sine and cosine functions to determine the components of a force along different axes. SO2.2 Ability to determine the resultant of multiple forces acting on an object. This includes finding the net force and direction when multiple forces are applied simultaneously. SO2.3 Applying these concepts to real-world scenarios, such as analyzing the forces acting on structures, machines, or systems. This could involve calculating the forces involved in bridges, buildings, or mechanical devices SO4. Understanding how to add multiple vectors together using the Polygon Law. This involves arranging vectors head-to-tail to form a closed polygon, where the resultant vector is the vector closing the polygon from the starting point to the end point.	**2.1** Introduction to Laws of forces **2.2** Verification of Parallelogram law of forces 2.3 Verification of Triangle law of forces 2.4 Verification of Polygon law of forces 2.5 Introduction to Lami's theorem 2.6 To verify the lami's theorem	**Unit-2.0 Resolution and Composition of Forces** 2.1 Forces and its type 2.2 Pressure and Stress 2.3 Concept of free body diagram 2.4 Characteristics and Effects of a Force 2.5 System of Forces 2.6 Resolution of a Force 2.7 Composition of Forces, Resultant / Equilibrant Force, 2.8 Law of Parallelogram of Forces, 2.9. Law of Triangle of Forces, Polygon Law of Forces. 2.10 Lami's Theorem 2.11 Equilibrium of a Body Under Two / Three/More Than Three Forces 2.12. Law of Superposition of Forces. 2.13 Practice class	1. Numericals of resolution of forces

ESC202/ ESC202-L.3: Apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints.

Approximate Hours

Item	AppX Hrs
Cl	11
LI	4
SW	1
SL	2
Total	19

Session Outcomes (SOs)	**LaboratoryInstruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO3.1 Calculating the resultant force by summing up all the individual forces acting on an object. The resultant force represents the net effect of all forces combined. SO3.2 Identifying the point where the resultant force is applied on the object or structure. This may involve finding the moment or torque caused by the forces and locating the resultant force's line of action. So.3 Checking whether the system of forces is in equilibrium. If the resultant force is zero, the system is in equilibrium; otherwise, the object or structure will experience acceleration or movement in the direction of the resultant force.	3.1 Introduction to moment and couple 3.2 To verify the principle of moment using by bell crank lever	**Unit-3.0 System of forces** 3.1Introduction of system of forces 3.2 Moment of a force 3.3 Varignon'sTheorem 3.4 Resultant of Parallel Forces 3.5 Moment of a Couple 3.6 Resolution of Force into a Couple 3.7 Resultant of Coplanar,Non Con-Current Forces 3.8 Numericals on Moment 3.9 Numericals on Couple 3.10 Numericals on system of forces 3.11 Practice class	1. Explanation of nature of moment and its types 2. Numericals on resultant force

SW-3 Suggested Sessional Work (SW):

a. **Assignments:**

I. Classify system of forces

ESC202/ ESC202-L**.4:** Compute the different types of load acting on a different types of beam.

Approximate Hours

Item	AppX Hrs
Cl	13
LI	4
SW	1
SL	2
Total	20

Session Outcomes (SOs)	**LaboratoryInstruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO4.1 Calculating the forces and moments at support points. This includes determining the vertical and horizontal reactions, as well as any moments generated at these locations due to applied loads. SO4.2 Supported at both ends and can carry loads between the supports. They experience maximum bending moment at the center and zero shear at the ends. SO4.3 Fixed at one end and free at the other. They carry loads at the free end and experience maximum shear at the fixed end. SO 4.4 Assemblies of beams connected by joints, commonly used in bridges and roofs. They rely on the framework of triangles to distribute loads efficiently.	4.1 Introduction to Trusses 4.2 To calculate the forces in members of simple roof truss and find the percentage error between the observed and calculated values	Unit-4.0 **Beams and Trusses** 4.1 define beam and its type 4.2 Simply Supported Beam, Overhanging Beam, Cantilever Beam 4.3 Simply Supported Beam, Overhanging Beam, Cantilever Beam 4.4 concept of load 4.5 Load on the Beam or Frame 4.6 Load on the Beam or Frame 4.7 Calculation of support reaction and its type 4.8 Support reaction calculation in cantilever beam 4.9 Support reaction calculation in simple supported beam 4.10 Concept of truss 4.11 Analysis of truss by analytical method (Joint method) 4.12 Analysis of truss by analytical method (Section method) 4.13 Practice class	1. Numerical problem of support reaction calculation in cantilever beam and simply supported beam. 2. Numerical problem of truss analysis by joint method.

SW-4 Suggested Sessional Work (SW):

a. Assignments:

1. Classify Beams and Load acting on it.

2. Explain types of truss.

ESC202/ ESC202-L.5: Compute the centroid, second moment of area, center of gravity, moment of inertia and mass moment of inertia.

Approximate Hours

Item	AppX Hrs
Cl	14
LI	6
SW	1
SL	2
Total	23

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO5.1 Determining the point where the entire weight of an object or system appears to act. SO5.2 Quantifying an object's resistance to rotational motion around a specific axis.	5.1 Introduction to Moment of inertia 5.2 To determine the moment of inertia of a flywheel about its own axis of rotation 5.3 Viva practice	**Unit-5.0 Center of gravity and moment of inertia** 5.1 Concept of Centroid, Centre of Gravity. 5.2 Difference between Centroid, Centre of Gravity 5.3 Centroid of Triangle 5.4 Centroid of I section 5.5 Centroid of angle section 5.6 Centroid of channel section 5.7 Theorems ofMoment of Inertia 5.8 Radius of Gyration 5.9 Polar Moment of Inertia of Standard Sections 5.10 Moment of Inertia of Composite Section 5.11 Principal Moment of Inertia 5.12 Concept of mass moment of inertia 5.13 Mass moment of inertia of basic solid figures. 5.14 Practice class	1. Numerical problem related to center of gravity 2. Numerical of MI of T section

SW-5 Suggested Sessional Work (SW):

a. **Assignments:**

1.Find the CG and MI of Circle,semicircle,and Rectangle and Triangle.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Lab Lecture (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+LI+SW+SI)
ESC 207.1: Understanding of term Mechanics and its classification	9	4	1	**2**	16
ESC 207.2: Understanding Resolution and composition of force acting on the rigid body.	13	12	0	**1**	26
ESC 207.3: Compute the resultant of force or different system of force and study of different laws related to different force System.	11	4	1	2	18
ESC 207.4: compute the different types of load acting on a different types of beam.	13	4	1	2	20
ESC 207.5: Compute the centroid, second moment of area, center of gravity, moment of inertia and mass moment of inertia	14	6	1	**2**	23
Total Hours	60	30	4	9	103

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	ESC 207.1: Understanding of term Mechanics and its classification	03	01	01	05
CO-2	ESC 207.2: Understanding Resolution and composition of force acting on the rigid body.	02	06	02	10
CO-3	ESC 207.3: Compute the resultant of force for different system of force and study of different laws related to different force system.	03	07	05	15
CO-4	ESC 207.4: compute the different types of load acting on a different types of beam.	-	10	05	15
CO-5	ESC 207.5: Compute the centroid, second moment of area, center of gravity, moment of inertia and mass moment of inertia	03	02	-	05
Total		11	26	13	50

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

The end of semester assessment for Engineering mechanics will be held with writtenexamination 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 mining 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	Engineering Mechanics	Dr.R.K bansal	Laxmi Publication(p) ltd.	4rth and 2016
2	Engineering mechanics	R.K Rajpoot	Laxmi Publication(p) ltd.	3^{rd} and 2016
3	Engineering Mechanics: Statics & Dynamics	Russell C. Hibbeler	Pearson	14th Edition, 2015
4	*Engineering Mechanics*	*Timoshenko, and Young*	TMH	5^{th} 2017

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Cos, POs and PSOs Mapping

Course Title: B. Tech Mining Engineering

Course Code : ESC202/ ESC202-L

Course Title: Engineering Mechanics

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO 10	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability:	Ethics	Individual and team work:	Communication:	Project management and finance:	Life-long learning	Demonstrate a sound understanding and application of fundamental principles of mechanics, including Newton's laws, equilibrium, kinematics, and kinetics, to solve engineering problems	Analyze and evaluate various structural components and mechanical systems to determine their behavior under different loading conditions and environments	Apply engineering mechanics concepts to design and optimize mechanical systems, considering factors like strength, stability, and safety while meeting specified requirements and constraints	Develop problem-solving skills and critical thinking abilities to address real-world engineering challenges related to mechanics, including identifying, formulating, and solving problems using appropriate methodologies
CO1 : Understanding of term Mechanics and its classification	1	1	2	2	2	2	3	1	2	2	1	2	2	2	1	1

CO 2 : Understanding Resolution and composition of force acting on the rigid body.	**1**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**1**	**1**	**2**	**3**	**2**	**2**	**2**	**1**
CO3 : Compute the resultant of force for different system of force and study of different laws related to different force system.	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**1**	**1**	**2**	**1**	**2**	**2**	**1**	**2**	**2**
CO 4: compute the different types of load acting on a different types of beam.	**3**	**2**	**2**	**1**	**3**	**1**	**3**	**1**	**2**	**1**	**1**	**2**	**3**	**3**	**3**	**2**
CO 5: Compute the centroid, second moment of area, center of gravity, moment of inertia and mass moment of inertia	**1**	**2**	**2**	**1**	**1**	**1**	**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	CO1 : Understanding of term Mechanics and its classification	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1,1.2	Unit-1.0 Introduction to Mechanics 1.1,1.2,1.3,1.4,1.5,1.6,1.7	SL 1.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 2 : Understanding Resolution and composition of force acting on the rigid body.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1,2.2,2.3,2.4, 2.5,2.6	Unit-2 Resolution and Composition of Forces 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	SL 2.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	CO3 : Compute the resultant of force for different system of force and study of different laws related to different force system.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1,3.2,	Unit-3 : System of forces 3.1, 3.2,3.3,3.4,3.5,3.6,3.7,3.8	SL 3.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 4: compute the different types of load acting on a different types of beam.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1,4.2	Unit-4 : Beams and Trusses 4.1, 4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10	SL 4.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 5: Compute the centroid, second moment of area, center of gravity, moment of inertia and mass moment of inertia	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1,5.2	Unit 5: Center of gravity and moment of inertia 5.1,5.2,5.3,5.4,5.5	SL 5.1

Semester-IV

Course Code: **MIN204/MIN204-L**

Course Title: Mining Geology-II

Pre-requisite: Student should have basic knowledge of scope and purpose of geology, Rocks, Minerals, various methods of age determination of rock and minerals.

Rationale: The students studying Mining Engineering should possess foundational understanding about principles of Stratigraphy mineral resource distribution. They must have knowledge of economic value of minerals. They should be able to prospect the minerals through various methods.

Course Outcomes:

MIN204/MIN204-L:1.1 Describe physiographic division of India and geological time scale.

MIN204/MIN204-L:1.2 Analyse process of ore formation of economic Mineral deposits.

MIN204/MIN204-L:1.3 Demonstrate metallic and non-metallic deposits, their origin and occurrence.

MIN204/MIN204-L:1.4 Explain physical properties, processes of occurrence of coal, petroleum and fossil.

MIN204/MIN204-L:1.5 Evaluate geophysical prospecting methods, application of remote sensing and GIS.

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours(CI+LI+SW+SL)	
Program Core (PCC)	MIN204/MIN204-L	Mining Geology-II	4	2	1	1	8	5

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

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

Scheme of Assessment: Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessme	Total Marks (PR+ESA)
			Class/HomeAssignment5number 3 marks each (CA)	Class Test 2(2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class activity anyone (CAT)	Class Attendance (AT)	Total Marks CA+CT+SA+CAT+AT)		
PCC	MIN204	Mining Geology-II	15	20	5	5	5	50	50	100

Scheme of Assessment: Practical

Code	Couse Code	Course Title	Scheme of Assessment (Marks)					
			Progressive Assessment (PRA)				End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/Home Assignment 5 number 7 marks each (CA)	Viva	Class Attendance (AT)	Total Marks (CA+VV+ AT)		
BSC	MIN204-L	Mining Geology-I-Lab	35	10	5	50	50	100

Course-Curriculum Detailing

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

MIN204/MIN204-L:1.1 Describe physiographic division of India and geological time scale.

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	4
SW	2
SL	2
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1. Describe the Geological time-scale. **SO1.2**Demonstrate Physiographic Division of India. **SO1.3**Interpret Cuddapah System. **SO1.4**Explain Vindhya System. **SO1.5**Describe Gondwana super group.	1.1 To determine the rank of coal on the basis of banded constituents. 1.2 To determine the specific gravity of metallic minerals.	**Unit1:**Stratigraphy 1.1 Objectives of Stratigraphy 1.2 Litho stratigraphy 1.3 Chrono stratigraphy 1.4Geological time-scale 1.5 Physiographic Division of India 1.6Cuddapah System 1.7Vindhya System 1.8Gondwana super group 1.9Deccan traps 1.10 Fossil: Definition 1.11 Mode of occurrence 1.12 Two fossils morphology etc.	1. Mineral resource distribution. 2. Criteria for Stratigraphy classification.

SW-1 Suggested Sessional Work(SW):

i. Assignments:
Explain principles of Stratigraphy.

ii Mini Project:
Flow diagram of geological time scale.

MIN204/MIN204-L:1.2 Analyse process of ore formation of economic mine

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	4
SW	2
SL	2
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1 Describe Elements of economic geology. **SO2.2**Explain Process of ore formation of economic Mineral deposits with examples **SO2.3**AnalyseStudy of Metalliferous deposits of India-, Fe, Cu, Mg, Al, Au, Pb, & Zn. **SO2.4** Relate Metallogentic/ Mineralogenetic provinces of India. **SO2.5**Evaluate Petroleum Geology.	2.1 To determine the specific gravity of non-metallic minerals. 2.2 Identification of hand specimen of metallic minerals like Cu, Pb, Zn, Mn, Fe, Al.	**Unit-2:**Economic Geology 2.1Elements of economic geology 2.2 Formation of ore minerals 2.3 Definition of forms of Ore ,Gangue 2.4Process of ore formation of economic Mineral deposits with examples. 2.5Study of Metalliferous deposits of India-, Fe, Cu 2.6Study of Metalliferous deposits of India-Mg 2.7 Study of Metalliferous deposits of India-Al, Au 2.8Study of Metalliferous deposits of India-Pb, & Zn. 2.9 Metallogenticprovinces of India. 2.10Mineralogenetic provinces of India. 2.11Petroleum Geology. 2.12 Tutorials	iProcess of ore formation of economic Mineral deposits ii Petroleum Geology.

SW-2 Suggested Sessional Work(SW):

a. Assignments

i. Discuss the process of ore formation of economic minerals.

ii. Write notes on Mn, Cu, Fe.

b. Mini Project

Show economic minerals zones in India map.

MIN204/MIN204-L:1.3Demonstrate metallic and non-metallic deposits, their origin and occurrence.

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	4
SW	2
SL	2
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO3.1 Explain Metallic and Non-metallic deposits. **SO3.2**Evaluate about graphite, copper, zinc, lead, gold. **SO3.3** Discuss about iron, manganese, radioactive minerals, asbestos, mica, and gemstone-origin. **SO3.4**Analyse Mode of occurrence and distribution in India. **SO3.5** Assess Origin and occurrence of industrial minerals- ceramic, refractory, abrasive, glass and paint industry.	3.1 Identification of hand specimen of non-metallic minerals like Limestone, Dolomite, Gypsum, Mica etc. 3.2 To study Stratigraphy & geological map of Post Cambrian.	**Unit-3: Economic** Indian Mineral Deposits 3.1 Metallic deposits 3.2 Non-metallic deposits 3.3 Study of graphite, copper. 3.4 Study of zinc, lead, gold. 3.5 Study of iron, manganese. 3.6 Radioactive minerals. 3.7 Study of asbestos, mica. 3.8 Gemstone-origin 3.9Mode of occurrence and distribution in India 3.10Origin and occurrence of industrial minerals- ceramic, refractory 3.11Origin and occurrence of industrial minerals-glass and paint industry. 3.12 Tutorials	i. Study of iron, manganese, radioactive minerals, asbestos, mica. ii. Origin and occurrence of industrial minerals-ceramic.

SW-3 Suggested Sessional Work(SW):

a. Assignments:

i. Discuss about iron, manganese, and radioactive minerals, asbestos.

ii. Origin and occurrence of industrial minerals- ceramic.

b. Mini Project:

Prepare a report of economic minerals in India.

MIN204/MIN204-L:1.4 Explain physical properties, processes of occurrence of coal, petroleum and fossil.

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	4
SW	2
SL	2
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4.1 Discuss about Origin. **SO4.2** Relate the Physical properties. **SO4.3** Evaluate the Processes. **SO4.4** Demonstrate Occurrence of coal and its types. **SO4.5**Evaluate Fossil fuel distribution in sedimentary basins of India.	4.1 To study Stratigraphy & geological map of Pre Cambrian. 4.2 Reserve estimation of given ore deposit data.	**Unit-4:**Coal and Petroleum Geology 4.1Origin of coal 4.2In situ Theory 4.3Drift Theory 4.4 Type Coal and Grade 4.5 Chemical constituents 4.6 Physical properties of coal 4.7 Processes of coal formation 4.8 Petroleum deposits 4.9 State the distribution of Oil fields in India 4.10 Fossil fuel distribution in 4.11 Sedimentary basins of India. 4.12 Tutorials	i. Occurrence of coal and its types ii. Fossil fuel distribution in sedimentary basins of India

SW-4 **Suggested Sessional Work (SW):**

a. Assignments:

i. Discuss about Origin.
ii. Evaluate Fossil fuel distribution in sedimentary basins of India.

b. Other Activities (Specify):

Power Point Presentation of coal formation.

MIN204/MIN204-L:1.4 Evaluate geophysical prospecting methods, application of remote sensing and GIS.

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	4
SW	2
SL	1
Total	19

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO5.1 Describe Geophysical prospecting methods. **SO5.2** Apply Seismic electrical, magnetic and gravity methods of mineral. Prospecting. **SO5.3**AnalyseIntroduction to aerial and satellite remote sensing. **SO5.4**Evaluate Application of remote sensing in geological mapping and mineral exploration. **SO5.5** Judge Application of GIS in geological mapping and mineral exploration.	5.1 Identification of natural gem stones. 5.2 Identification of artificial gem stones.	**Unit 5:** Geophysics, Remote Sensing and GIS 5.1 Objectives: Guide lines for location of mineral deposits. 5.2 Prospecting method s principles. 5.3 Geophysical prospecting methods 5.4 Seismic electrical. 5.5 Resistivity Methods. 5.6 Magnetic Method 5.7 Gravity methods 5.8 Remote sensing 5.9 Aerial and satellite. 5.10Application of remote sensing in geological mapping 5.11 Application of remote sensing in mineral exploration 5.12Application of GIS in geological mapping and mineral exploration	1. Application of remote sensing in geological mapping.

SW-5 Suggested Sessional Work(SW):

a. Assignments:

i. Seismic electrical, magnetic and gravity methods of mineral.

b. Mini project:

1. **Ore study**

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)
CO-1 Describe physiographic division of India and geological time scale.	12	4	2	2	20
CO-2 Analyse process of ore formation of economic Mineral deposits.	12	4	2	2	20
CO-3 Demonstratemetallic and non-metallic deposits, their origin and occurrence.	12	4	2	2	20
CO-4 Explain physical properties, processes of occurrence of coal, petroleum and fossil fuels.	12	4	2	2	20
CO-5 Evaluate geophysical prospecting methods, application of remote sensing and GIS.	12	4	2	1	19
Total Hours	60	20	10	9	99

Suggestion for End Semester Assessment

Suggested Specification Table(For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Stratigraphy	03	01	01	05
CO-2	Economic Geology	02	06	02	10
CO-3	Types of Cement Manufactured in India	03	07	05	15
CO-4	Economic Indian Mineral Deposits	-	10	05	15
CO-5	Geophysics, Remote Sensing and GIS	03	02	-	05
Total		11	26	13	50

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

The end of semester assessment for Mining Geology-II will be held with written examination of 50 marks

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

Suggested Instructional/Implementation Strategies:

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

Suggested Learning Resources:

(a) **Books**:

S. No.	Title	Author	Publisher	Edition &Year
1	Introduction to Geology	G.B. Mahapatra	CBS Publishers And Distributors Pvt Ltd	2017
2	A Text Book of Geology	P.K. Mukherjee	World press	2013
3	Engineering And General Geology	Parbin Singh	Katson Educational Series	2013

(b) **Web link**:

https://geology.com/

https://archive.nptel.ac.in/Harddisk/Direct_Download.html

https://epathshala.nic.in/

https://swayam.gov.in/

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<u>**Cos, Pos and PSOs Mapping**</u>

Program Title: B. Tech. Mining Engineering

Course Code: MIN204/MIN204-L

Course Title: Mining Geology-II

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2	PSO3	PSO4
	Engineering Knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool usage	The engineer and society	Environment and sustainability:	Ethics	Individual and teamwork:	Communication:	Project management And finance:	Life-long learning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of mining engineering.
CO-1 Describe physiographic division of India and geological time scale.	1	2	1	1	1	2	1	2	2	1	1	2	2	3	2	1
CO-2 Analyse process of ore formation of economic Mineral deposits.	1	1	2	2	1	2	3	2	1	1	2	2	2	1	2	1
CO-3 Demonstratemetallic and non-metallic deposits, their origin and occurrence of rocks and minerals	1	1	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO-4 Explain physical properties, processes of occurrence of coal, petroleum and fossil fuels.of Minerals.	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO-5 Evaluate geophysical prospecting methods, application of remote sensing and GIS.	1	2	1	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction	Classroom Instruction (CI)	Self-Learning (SL)
PO1,2,3,4,5,67,8,9,10, 11,12 PSO1,2,3,4	CO-1 Describe physiographic division of India and geological time scale.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1 1.2	Unit-1.0 Stratigraphy 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10, 1.11,1.12	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO- 2 Analyse process of ore formation of economic Mineral deposits.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1 2.2	Unit-2 Economic Geology 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9,2.10, 2.11,2.12	SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-3 Demonstrate metallic and non-metallic deposits, their origin and occurrence.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1 3.2	Unit-3 : Economic Indian Mineral 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10, 3.11,3.12	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-4 Explain physical properties, processes of occurrence of coal, petroleum and fossil fuels.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1 4.2	Unit-4: Coal and Petroleum Geology 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10, 4.11,4.12	SL 4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO -5 Evaluate geophysical prospecting methods, application of remote sensing and GIS.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1 5.2	Unit5: Geophysics, Remote Sensing and GIS 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11,5.12	SL 5.1

Semester-IV

Course Code: **PEC-MIN01/PEC-MIN01-L**

Course Title: Mine surveying

Pre-requisite: Student should have basic knowledge of measurements and unit of measurement.

Rationale: The students studying mining technology must possess a foundational understanding about surveying, especially Mine surveying. Mine surveying is necessary to run any mine safely. The students ought to know the fundamentals of mine surveying and its method. Additionally, students ought to acquire the advancements of surveying.

Course Outcomes

PEC-MIN01/PEC-MIN01-L: 01 Understand the mine surveying and basic requirements of mine surveying.

PEC-MIN01/PEC-MIN01-L: 02: Learn the different types of measurement, like linear and angular horizontal and vertical techniques

PEC-MIN01/PEC-MIN01-L:03 To know the magnetism and declination

PEC-MIN01/PEC-MIN01-L:04 To know the leveling methods and calculation

PEC-MIN01/PEC-MIN01-L: 05: To know the curve setting.

Scheme of Studies:

Course core	**Course Code**	**Course Title**	**Scheme of studies(Hours/Week)**					**Total Credits**
			Cl	**LI**	**SW**	**SL**	**Total Study Hours(CI+LI+SW+SL)**	**(C)**
Program Core (PCC)	**PEC-MIN01/PEC-MIN01-L**	Mine Surveying	4	2	1	1	8	5

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

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

SW: 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

Code	Course Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class 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)
PCC	PEC-MIN01/PEC-MIN01-L	Mine Surveying	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) upon the course's conclusion.

PEC-MIN01/PEC-MIN01-L: 1Acquire knowledge of Linear Measurement and Angular Measurement and Theodolite. They also learn about Area &volume.

Approximate Hours

Item	**AppxHr**
CI	**12**
LI	**6**
SW	**2**
SL	**2**
Total	**22**

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO 1.1Understand the mine surveying and basic requirements of mine surveying. SO1.2 Know the types of ranging for linear measurement. SO 1.3 Know about instrument SO 1.4 Know the setting of instruments for survey . So 1.5 Know the calculation of area by different method	1.1To Study the Theodolite and 1.2 adjustment in Theodolite 1.3 Linear measurement by direct ranging	Unit-1.0 Linear Measurement and Angular Measurement (Theodolite)/ Area &volume 1.1 Introduction types and classification of Surveying. 1.2 ,Linear measurement Ranging and types of ranging 1.3 Parts of Theodolite 1.4 Terms used LIKE, Face left face right swinging etc. 1.5 Temporary adjustments permanent adjustment 1.6 Ranging and types 1.7 , horizontal angle, vertical angle, bearings 1.8 Area & volume measurement of area and volume by trapezoidal and Simpson formula . Calculation of area by mid ordinate and average ordinate rule. 1.9Types of cross section and 1.10 areas 1.11 numerical 1.12 problems	1.Solve some examples for volume calculation by 2. trapezoidal rule and Simpson's rule

SW1:- Suggested Sessional works (SW)

1) **Types of Theodolite**
2) **Types of leveling Instrument**

b. Mini Project:

Introduction with Labeled diagram of venire Theodolite

PEC-MIN01/PEC-MIN01-L:2 Acquire knowledge of bearing and traversing and be able to calculate the coordinates.

Approximate Hours

Item	AppxHr
CI	12
LI	2
SW	2
SL	2
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
2.1 Understand the bearing and angle. 2.2 Know the traversing and purpose of traversing. 2.3 Know the method of calculating coordinates. 2.4 Know the calculation of area by coordinate method.	2.1 Determination of bearing by Theodolite /compass	**Unit - II Bearing & Traversing** 2.1 - Bearing & type of bearing of lines. 2.2Traversing – continuous Azimuth, double fore sight methods 2.3Purpose of traversing, first, second and third order traverse, 2.4 computation of bearings of traverses 2.5closed and open traverse. Included and direct angles, Latitude, Departures 2.6checks-corrections of the traverse Bowditch rule and transit rule 2.7. problems on rectangular coordinates – calculation of areas. 2.8 Numerical Based on Bearing 2.9 problems 2.10 problems 1 2.11 problems 2 2.12 problems 3	1. Solve the minimum two examples of calculating the coordinate. 2. One example of calculation area by coordinates

SW2: - Suggested Sessional works (SW)

a. **Assignments:**

1) **Plotting of a closed traverse in suitable scale.**

b. **Mini Project:**

Make a polytonally closed traverse and calculate the area by coordinate method.

PEC-MIN01/PEC-MIN01-L:3 Acquire knowledge of Compass Survey & Tachometry survey.

Approximate Hours

Item	AppxHr
CI	12
LI	4
SW	**2**
SL	1
Total	**19**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
3.1 To know the compass and its setting 3.2 To know the magnetism 3.3 To know about magnetic declination 3.4 To know about Tacheometry 3.5 To know the distance calculation by Tacheometry	. 3.1To Determine the distance from tachometry 3.2 Determine the tachometry constant in field.	**Unit – III Compass Survey** & **Tachometry** 3.1 Compass; Surveyor's Compass; E & W ARE transposed. 3.2, Calculation of Included Angle; Local Attraction 3.3 Theory of Magnetism; Dip of Magnet needle. 3.4 Magnetic Declination. Calculation of local attraction 3.5, Introduction of Tachometry 3.6 Tachometry measurements 3.7 Numerical Based on Tacheometry 3.8 Numerical Based on Compass 3.9 problems 3.10 problems 1 3.11 problems 2 3.12 problems 2	1.Some examples for calculation of local attraction and included angle.

SW: - Suggested Sessional works (SW)

a. Assignments

1) Distance from tachometry method and check by tape.

b. Mini Project:

Chain study

PEC-MIN01/PEC-MIN01-L: 4:.Know about leveling and leveling Instrument

Approximate Hours

Item	AppxHr
CI	12
LI	4
SW	1
SL	**2**
Total	**19**

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
4.1 Know about levelling and level instruments. 4.2 Able to set the levelling instruments. 4.3Find out the level difference between two station. 4.4 Able to make profile levelling and make profile of the ground	4.1 Levelling of a ground and calculation by HImethod. 4.2 Levelling of a ground and calculation by Rise and fall method.	**Unit - IV levelling and levelling Instrument.** **4.1** levelling Instrument; Types and Constructional details of Dumpy Level, Auto Level. 4.2 Definition of important term used in levelling. 4.3 Temporary and Permanent Adjustments. 4,4 Introduction and Different Method ofLevelling. 4.5 H I method of levelling numerical 4.6 Rise and fall method of levelling. 4.7 Reciprocal Levelling; Longitudinal Sections. 4.8 Methods Of booking and reduction of levels. 4.9 Checks of calculation of levelling 4.10Plumbing measurement of depth of shaft. 4.11 numerical 4.12 problem	1.Compare the method of levelling with example. 2. Solve the minimum two examples of HI and Rise and fall method

SW: - Suggested Sessional works (SW)

a. **Assignments**

1) Reciprocal leveling and make a section on suitable scale.

PEC-MIN01/PEC-MIN01-L . 5 Know about Curve Dip and strike.

Approximate Hours

Item	**AppxHr.**
CI	12
LI	4
SW	1
SL	**2**
Total	**19**

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
5.1 Know about the curve and use of curve. 5.2 Be able to draw a curve on a road. 5.3 Know the full dip and apparent dip of seam. 5.4 Find out full dip of a seam by bore holes data.	5.1 Find out the full dip by apparent dips by plotting. 5.2 Curve by offsets method	**Unit – V Curve and Dip strike** 5.1 Curve and its type 5.2 setting of curves by offset method. 5.3 setting of curves by angular method **5.4** Dip strike and related problems **5,5** Determining the true and apparent dip and strike from bore hole data, **5.6** fault and throw **5.7** Determining the throw of fault. **5.8**Determining length of drift to cross the fault, 5.9, Finding out the bearings and dip of various mine working. 5.10 Problems 5.11 Problems 1 5.12 Problems 2	1. Determine the full dip by construction method and check by calculation. 2. Solve some examples regarding setting of curve

SW5: - Suggested Sessional works (SW)

a. **Assignments**

1) With the help of three bore hole data calculate the full dip check by construction.

Suggested Learning Resources:

Suggested books:-
(a)Book

S. No.	Title	Author	Publisher	Edition /year
1	**A text book of surveying**	**S.K.Duggal**	**TMH**	**NA**
2	**Surveying Vol I**	**S.K.Duggal**	**MAC GRAW HILL**	**FOURTH**
3	**SURVEYING**	**B.C.Punamia**	**NA**	**Vol I &II**

(b) Web link

https://nptel.ac.in/courses/105107122

https://epathshala.nic.in/

https://swayam.gov.in/

Curriculum Development Team

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2) Prof G C Mishra, Director Cement Technology, AKS University, Satna
3) Prof G. K. Pradhan, Dean, Faculty of Engineering Technology, AKS University, Satna.

Course Curriculum Map :-

Course Outcomes	Class Lecture (Cl)	**Laboratory Instruction (LI)**	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
Acquire knowledge of Linear Measurement and Angular Measurement and Theodolite . They also learn about Area &volume**.**	12	6	2	2	22
Acquire knowledge of bearing and traversing and be able to calculate the coordinates.	12	2	2	2	18
:Acquire knowledge of Compass Survey & Tachometry survey .	12	4	2	1	19
Know about levelling and levelling Instrument	12	4	1	2	19
Know about Curve Dip and strike.	12	4	1	2	19
Total Hours	60	20	8	9	97

Suggestion for End Semester Assessment

Suggested Specification Table(For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Linear Measurement and Angular Measurement (Theodolite)/ Area &volume	03	01	01	05
CO-2	Bearing and Traversing	02	06	02	10
CO-3	Compass Survey & Tachometry	03	07	05	15
CO-4	levelling and levelling Instrument.	-	10	05	15
CO-5	Curve and Dip	03	02	-	05
Total		11	26	13	50

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

The end of semester assessment for Mine Surveying 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 Mining industry
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
9. Brainstorming

Suggested Learning Resources:

(c) **Books**:

S. No.	Title	Author	Publisher	Edition& Year
1	Surface Mining Technology	Das, S.K	Lovely Prakashan, Dhanbad	2, 1988
2	Introduction to Mining Technology, Vol. I & II	Pradhan, G.K	Mintech Publication, Bhubaneswar(An AKS University Initiative).	2020

(a) **Web link**:

https://geology.com/

https://archive.nptel.ac.in/Harddisk/Direct_Download.html

https://epathshala.nic.in/

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Cos, Pos and PSOs Mapping

Program Title: B. Tech. Mining Engineering
Course Code: PEC-MIN01/PEC-MIN01-L
Course Title: Mine Surveying

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conducting vestigations ofcomplex problems	Modern toolusage	The engineer and society	Environment and sustain ability:	Ethics	Individual andteamwork:	Communication:	Project management andfinance:	Life-longlearning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of mining engineering.
CO1:Acquire knowledge of Linear Measurement and Angular measurement	1	2	1	1	1	2	1	2	2	1	1	2	2	3	2	1
CO 2. Acquire knowledge of bearing and traversing and be able to calculate the coordinates. survey	1	1	2	2	1	2	3	2	1	1	2	2	2	1	2	1
CO3Acquire knowledge of Compass Survey &Tachometry	1	1	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO 4: 1 Know about levelling and levelling Instrument	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO5: Know about Curve Dip and strike.	1	2	1	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend: 1–Low,2–Medium,3–Hig

Course Curriculum Map

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (L I)	Classroom Instruction (CI)	SELF LEARNING
PO 1,2,3,4,5,6 7,8,9,10,11,1 2,13,14,15 PSO 1,2, 3, 4, 5	1. Acquire knowledge of Linear Measurement and Angular Measurement and Theodolite . They also learn about Area &volume 1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1,1.2,1.3	1. Acquire knowledge of Linear Measurement and Angular Measurement and Theodolite . They also learn about Area &volume 1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11,1.12	SL 1.1
PO 1,2,3,4,5,6 7,8,9,10,11,1 2,13,14 PSO 1,2, 3, 4,	CO2: - Acquire knowledge of bearing and traversing and be able to calculate the coordinates. survey	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5,	2.1	2. Acquire knowledge of bearing and traversing and be able to calculate the coordinates. survey .: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10,2.11,2.12	SL 2.1
PO 1,2,3,4,5,6 7,8,9,10,11,1 2 ,13,14 PSO 1,2, 3, 4, 5	CO3:- 3.1 Acquire knowledge of Compass Survey & Tachometry	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1,3.2	3.Acquire knowledge of Compass Survey & Tachometry 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11,3.12	SL 3.1
PO 1,2,3,4,5,6 7,8,9,10,11,1 2,13,14,15,1 6,17 PSO 1,2, 3, 4, 5	CO4. 4.1 Know about levelling and levelling Instrument	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1,4.2	4. Know about levelling and levelling Instrument 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12	SL 4.1
PO 1,2,3,4,5,6 7,8,9,10,11,1 2,13,14,15,1 6 PSO 1,2, 3, 4, 5	**CO** 5 5.1 Know about Curve Dip and strike.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1, 5.2	5. Know about Curve Dip and strike. 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11,5.12	SL 5.1

Semester IV

Course Code: MIN 205
Course Title: Advanced Underground Coal Mining

Pre-Requisite: The student should have acquired adequate knowledge and skill to implement conventional underground mining methods and analytical skill to comprehend the need for improved state of the art underground mining technologies

Rationale: The student studying mining engineering should develop fundamental understanding about the scope and application of different methods of coal mining in specific geo-mining conditions. It also implies the understanding for the necessity to improve in production and productivity levels in underground coal mines through higher level of mechanization and by using state of the art underground mining technologies. The course also should enable the students to deal with the challenges associated with thick seam mining in comparatively deeper deposits.

Course Outcomes:

The student

- **MIN 205**.1- Will comprehend the role of Mass Production Technologies (MPTs) in underground coal mining in general and their application in Indian underground coal mines in particular for radical transformation of techno-economical parameters of UG coal mines at national level
- **MIN 205**.2- Will be acquainted with Continuous Miner Technology, one of the world acclaimed MPTs applicable with B&P method of mining with complete understanding of its configuration, panel design and operational pre-requisites
- **MIN 205**.3- Will garner knowledge about the geo-technical challenges associated with mechanized depillaring with Continuous Miner technology and dealing with such challenges for their practical application in mines successfully
- **MIN 205**.4- Will be acquainted with the Powered Support Longwall Technology as the safest, most productive and techno-economically most acclaimed globally accepted underground mining technology along with its equipment configuration and scope of application. The student will also develop the skill to select the powered supports based on geo-technical data and analysis of load concentration on the working area.
- **MIN 205**.5- Will be able to comprehend the challenges associated with thick seam mining, its different methods in variable mining conditions and analytically resolve their applicability challenges.

Scheme of studies:

Code	Course code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Totaql study Hours (CI+LI+SW+SL)	
Program Core (PCC)	**MIN 205**	Advanced Underground coal Mining	4	0	1	1	5	4

Legend:

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

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

Scheme of Assessment: Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks
			Class/HomeAssignment5number 3 marks each(CA)	Class Test 2(2 best outof 3) 10 marks each (CT)	Seminar one (SA)	Class activity anyone (CAT)	Class Attendance(AT)	Total Marks CA+CT+SA+CAT+AT)		
PCC	**MIN 205**	**Advanced Underground Coal Mining**	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) upon the course's conclusion.

MIN 205.1:- Comprehension of the role of Mass Production Technologies (MPTs) in underground coal mining in general and their application in Indian underground coal mines in particular for radical transformation of techno-economical parameters of UG coal mines at national level

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	12
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	15

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO1.1- Student will comprehend the need for adoption of MPTs in Indian UG coal mines SO1.2- Will learn about the MPTs adopted at present in global scale SO1.3- Will identify the applicability criteria for different types of MPT SO1.4- Will be able to comprehend the prospects and constraints of MPTs in Indian coal mines SO1.5- Will be acquainted with the broad based strategies by coal industry in large scale implementation of MPTs.		Unit1- Introduction to Mechanization & Mass Production Technologies in UG coal mining 1.1-Concept of mass production technology (MPT) in UG coal mining 1.2-Articulated need for MPT in Indian UG coal mines 1.3-Types of MPTs 1.4 their applications 1.5-Focus areas for deployment of 1.6 MPT in Indian UG coal mines their selection criteria 1.7- Prospects of adopting MPTs in Indian UG coal mines 1.8 Constraints in the path of adopting MPTs in large scale in Indian UG coal mines 1.9- Roadmap by Ministry of coal 1.10 coal mining industry to mitigate the constraints 1.11 Numerical 1.12 Problems	Study area:- (I)Global experience of the use of MPTS in UG coal mines

Suggested Sessional works: a. Assignments

(i) Scope of improvement in production and productivity in UG coal mines in India by Mass Production Technologies

b. **Topic of Mini Project-** An analysis into the Techno-economic transformation in Indian UG coal mining industry through introduction of MPTs.

MIN 205.2:-Acquaintance with Continuous Miner Technology, one of the world acclaimed MPTs applicable with B&P method of mining with complete understanding of its configuration, panel design and operational pre-requisites

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	12
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	15

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO2.1- Acquaintance of Continuous Miner Technology as a MPT for B&P method of mining SO2.2- Garnering knowledge about the equipment configuration of the technology and function of each component SO2.3- Comprehend the optimum layout for CM development district SO2.4- Understanding the Operational details for CM technology SO2.5- Ability to analyze the operational cycle in a CM district to identify scope of improvement		Unit2- Introduction to Continuous Miner Technology 2.1- Scope and limitation of CM technology in Indian UG mines 2.2- Configuration of CM equipment set & function of each machine of the set 2.3- Typical layout of a CM development district 2.4- Sequence of operation in a CM development district 2.5- Time study for the operations in a CM development district 2.6- Standard Operational Procedure (SOP) for a CM development district under Safety Management Plan 2.7- Ventilation system in a CM development district 2.8- Production potential from a CM district 2.9 Case study 2.10 Study Mine 1 2.11 Study 2 2.12 Mine study 3	Study area:- (i)Experience in different leading coal producing nations regarding use of Continuous Miner Technology

Suggested Sessional works:

A. A**ssignments**

(i) Analysis of the design elements of a development district with Continuous Miner technology

(ii) Analytical time study to determine production potential from a Continuous Miner development district

b.Topic of Mini Project- Preparing a feasibility report for introduction of Continuous Miner Technology in coal seam

MIN 205.3:- Garnering knowledge about the geo-technical challenges associated with mechanized depillaring with Continuous Miner technology and dealing with such challenges for their practical application in mines successfully

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	10
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	13

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO3.1- Comprehending the problems of mechanized depillaring and analytical comparison with conventional depillaring problems SO3.2- Developing the knowledge about different methods of depillaring by CM technology and their scope of application SO3.3- Analytically understanding the importance of NEVID method of depillaring with CM in existing UG coal mines in India SO3.4- Comprehending the basic criteria for Successful mechanized depillaring operation with CM technology SO3.5- Developing skill to design strata control monitoring plan with CM in operational mines.		Unit 3: Mechanized Depillaring with Continuous Miner (CM) Technology 3.1- Challenges of mechanized depillaring 3.2- Depillaring methods with CM technology. Split and Fender method 3.3- Nevid method of extraction of coal pillars 3.4- Importance of application of Nevid method in Indian UG coal mines 3.5- Criteria to make CM based mechanized depillaring successful 3.6- Irregular shaped heightened ribs/snooks 3.7- Roof bolt based breaker line supports (RBBLS) 3.8- Warning limits of roof sagging & monitoring by auto-warning tell-tales. Determination of COD 3.9- Different geo-technical parameters for mechanized depillaring with CM 3.10- Strata Control Monitoring Plan (SCAMP) in a CM depillaring district	Study area:- (i)Thorough study about the general problems of mechanized depillaring

Suggested Sessional works: **a. Assignments**

(i) Preparing a comparative statement between Split & Fender method of mechanized depillaring and Nevid method of depillaring

(ii) Parameters for successful mechanized depillaring with CM technology

b.Topic of Mini Project- Planning for mitigation of challenges of mechanized depillaring with Continuous Miner Technology in Indian geo-mining conditions.

MIN 205.4:-Acquaintance with the Powered Support Longwall Technology as the safest, most productive and techno-economically most acclaimed globally accepted underground mining technology along with its equipment configuration and scope of application. The student will also develop the skill to select the powered supports based on geo-technical data and analysis of load concentration on the working area.

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	14
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	17

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO4.1- Comprehension of the PSLW technology as a world acclaimed UG coal mining method SO4.2- Analysis of the scope for PSLW technology in UG coal mines in India from the present and futuristic point of view SO4.3- In depth understanding of the types of PSLW mining, their fields of application and operational cycles. SO4.4- Acquiring in depth knowledge about the strata behavior during Longwall mining and its application in determining the capacity of the powered supports SO4.5- Generation of analyzing skill to identify the factors that affect the performance of PSLW equipment in mines and preparation of mitigation plans.		Unit 4- Powered Support Longwall mining technology 4.1- Basic features, applicability & general geo-mining conditions suitable for PSLW technology 4.2- Scope of PSLW technology in Indian UG coal mining 4.3- Equipment configuration of PSLW set 4.4- Types and specifications of powered supports 4.5- Basic specifications for other components of PSLW set 4.6- Layout of PSLW district- Its development by Road Headers and other machines 4.7- Retreating and Advancing Longwall- their applications 4.8- Operational cycle in retreating Longwall with caving 4.9- Operational cycle of advancing Longwall 4.10- Strata control in Longwall operation- selection of supports 4.11- Concept of main and periodic fall at a Longwall face 4.12- Longwall face move 4.13- Production potential from a PSLW district 4.14- Factors affecting the performance of Longwall mining in India’	Study Area- (i)Analysis of the experience of PSLW mining in India so far for its success and failures

Suggested sessional works: **a. Assignments**

(i) Determination of support capacity for a Powered Support Longwall district

(ii) Calculation of production potentiality from a PSLW district based on operational time study.

b.Topic of Mini Project- An analysis of the different factors affecting the performance of PSLW technology in Indian mines and their mitigation planning.

MIN 205.5:-Comprehension of the challenges associated with thick seam mining, its different methods in variable mining conditions and analytically resolve their applicability challenges.

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	12
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	15

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO5.1-In depth understanding of the problems of thick seam mining SO5.2- Acquiring knowledge about various methods of thick seam mining with application SO5.3- Application of PSLW technology in thick seams in different conditions SO5.4- Comprehension about the limitations of B&P method in thick seam mining		Unit 5- Mining in Thick Coal Seams 5.1- Defining thick seams. 5.2 Mining in thick coal seams 5.3problems of thick seam mining 5.4- Classification of methods of mining in thick coal seams 5.5- Mining in thick coal seams with PSLW technology 5.6- Thick seam extraction in two lifts by B&P method with bottom section stowing 5.7top section caving 5.8- Extraction of very thick coal seam in sections by B&P method with full stowing 5.9- An analysis of the performances of different methods of thick seam mining. 5.10 Tutorials 5.11 Problems 5.12 Numerical	Area of study- (i)National as well as Global experience of thick seam coal mining

Suggested Sessional works: **a. Assignments**

(i) Analysis of the problems associated with thick seam coal mining
(ii) Comparison between application of Longwall method and B&P method in extraction of thick coal seams

b.Topic of Mini Project- Scope of thick seam coal mining in India with a wholistic approach to mitigate its problems for more efficient coal extraction.

Brief of Hours suggested for the course outcome:

Course outcomes	Class Lectures (CL)	Laboratory Instructions (LI)	Sessional work (SW)	Self Learning (SL)	Total Hour (CL+LI+SW+SL)
MIN 205.1-Comprehension of role of Mass Production Technology and its application in Indian UG coal mines	12	0	2	1	15
MIN 205.2-Acquiantance with Continuous Miner (CM) technology & its application in Indian UG coal mines	12	0	2	1	15
MIN 205.3-Comprehension of the challenges of mechanized depillaring with CM technology	10	0	2	1	13
MIN 205.4-Acquiance with Powered Support Longwall (PSLW) technology and its scopes and challenges in Indian UG coal mines	14	0	2	1	17
MIN 205.5-Thick seam mining challenges and application of various methods in variable mining conditions	12	0	2	1	15
Total Hours	60	0	10	5	75

Suggestions for End semester Assessment:

Suggested Specification Table

COs	Unit Titles	Marks Distribution			Total; Marks
		R	U	A	
CO 1	Comprehension of role of Mass Production Technology and its application in Indian UG coal mines	3	3	1	7
CO 2	Acquiantance with Continuous Miner (CM) technology & its application in Indian UG coal mines	3	4	3	10
CO 3	Comprehension of the challenges of mechanized depillaring with CM technology	3	5	5	13
CO 4	Acquiance with Powered Support Longwall (PSLW) technology and its scopes and challenges in Indian UG coal mines	3	5	5	13
CO 5	Thick seam mining challenges and application of various methods in variable mining conditions	2	3	2	7
	Total	14	20	16	50

Legend: R-Remember U-Understand A-Apply

The end of semester assessment for Underground coal mining technologies will be held with written examination of 50 marks

Suggested Instructional/ Implementation Strategies:

1. **Improved lectures**
2. Tutorial
3. Case studies
4. Group discussion
5. Role play
6. Visit to mines and mineral processing industries
7. Demonstration
8. Digital media application in teaching learning process and mass media
9. Brainstorming

Suggested Learning Resources

Sl. No	Title	Author	Publisher	Edition & Year
1.	Introduction to Mine Technology	D J Deshmukh	Lovely Prakashan	2010

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COs, POs & PSO Mapping:-

Program Title: B. Tech (Mining Engineering)
Course Code: MIN 205
Course Title: Advanced Underground Coal Mining

	Program Outcomes												Program Specific Outcomes			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
Course Outcome	Engg Know ledge	Prob Lem Ana-lysis	Des-ign/ Dev of Solu tion	Inv-esti gat ion of complex problems	Mod ern tool usage	Eng Ineer& soc iety	Env Ironment& Sus tai nab ility	Work Eth ics	Ind Ivi Dual & te-am Wo-rk	Commu nica tion	Pro Ject Mgmt & Fin ance	Life lo ng Lea ning	Dev. Analy tical skill for identi-fying mine prob-lems for solutions	Garnering know Ledge about economic, env & soc ietal impacts of mining	Dev. Knowledge for mine plan ing, operation & closure	Develop work ethics under mine statutes
CO1-Comprehension of role of MPT and application in Indian UG coal mines	2	1	1	1	1	1	2	1	1	1	1	2	1	1	1	1
CO 2-Acquiantance with CM technology & its application in Indian UG coal mines	2	1	1	1	2	1	1	1	3	2	3	2	1	1	2	2
CO 3-Comprehension of the challenges of mechanized depillaring with CM	3	2	3	1	2	1	2	1	3	3	2	2	2	1	3	1
CO 4- Acquaintance with PSLW technology & its scopes and challenges in Indian UG coal mines	3	2	3	1	2	1	2	1	3	3	2	2	2	1	3	1
CO 5- Thick seam mining challenges & their application in variable mining conditions	3	2	2	3	2	1	2	2	3	3	3	2	2	2	3	2

Legend: 1: Low 2: Medium 3: High

Course Curriculum Map:

POs & PSOs Number	Cos number & Title	SOs Number	Laboratory Instruction (LI)	Class Room Instructions (CI)	Self Learning (SL)
PO: 1,2,3,4,5,6,7,8,9,10, 11,12 PSO: 1,2,3,4	CO 1- Comprehension of role of MPT and application in Indian UG coal mines	SO 1.1 SO 1.2 SO 1.3 SO 1.4 SO 1.5		Unit 1- Present status & trend in UG coal mining. 1.1,1.2,1.3,1.4,1.5,1.6, 1.7,1.8,1.9,1.0,1.11,1. 12	SL 1.1
PO: 1,2,3,4,5,6,7,8,9,10, 11,12 PSO: 1,2,3,4	CO 2- Acquiantance with CM technology & its application in Indian UG coal	SO2.1 SO 2.2 SO 2.3 SO 2.4 SO 2.5		Unit 2- Access to UG coal deposits. Vertical shaft sinking technology 2.1,2.2,2.3,2.4,2.5,2.6, 2.7,2.8,2.9,2.10,2.11,2 .12	SL 2.1
PO: 1,2,3,4,5,6,7,8,9,10, 11,12 PSO: 1,2,3,4	CO 3- Comprehension of the challenges of mechanized depillaring with CM	SO 3.1` SO 3.2 SO 3.3 SO 3.4 SO 3.5		Unit 3- B&P development in UG coal mines 3.1,3.2,3.3,3.4,3.5,3.6, 3.7,3.8,3.9,3.10	SL 3.1
PO: 1,2,3,4,5,6,7,8,9,10, 11,12 PSO: 1,2,3,4	CO 4- Acquaintance with PSLW technology & its scopes and challenges in Indian UG coal mines	SO 4.1 SO 4.2 SO 4.3 SO 4.4 SO 4.5		Unit 4- Depillaring operation in conventional B&P workings 4.1,4.2,4.3,4.4,4.5,4.6, 4.7,4.8,4.9,4.10,4.11,4 .12,4.13,4.14	SL 4.1
PO: 1,2,3,4,5,6,7,8,9,10, 11,12 PSO: 1,2,3,4	CO 5- Thick seam mining challenges & their application in variable mining conditions	SO 5.1 SO 5.2 SO 5.3 SO 5.4 SO 5.5		Unit 5- Partial extraction of coal pillars. Mining under special conditions by B&P method 5.1	SL 5.1

				,5.2,5.3,5.4,5.5,5.6,5.7 ,5.8,5.9,5.10,5.115.12	

Semester-IV

Course Code: **MIN206/MIN206-L**

Course Title: Surface Mining

Pre-requisite: Student should have basic knowledge of scope and purpose of mining and its methods.

Rationale: The students studying any Engineering should possess fundamental understanding about mining methods in India. They should have some idea about principle and techniques related to Mining methods.

Course Outcomes:

MIN206/MIN206-L:1.1Explain the terminologies, classification and opening of surface mining.

MIN206/MIN206-L:1.2Explain the Planning of surface mines, excavation sequence.

MIN206/MIN206-L:1.3DescribeDrilling mechanism, selection of drills for coal and other formations.

MIN206/MIN206-L:1.4 Explain Methods of excavation & transportation.

MIN206/MIN206-L:1.5Evaluate application and selection of Special methods of mining.

Scheme of Studies:

Code	**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)	MIN206/ MIN206-L	Surface Mining	4	2	1	1	8	5

Legend: **CI:** Classroom Instruction(Includesdifferentinstructionalstrategiesi.e.Lecture(L)andTutorial (T)and others),

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

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

SL: Self Learning,

C: Credits.

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

Scheme of Assessment:

Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment(PRA)						**End Semester Assessment (ESA)**	**Total Marks**
			Class/HomeAssignment5number 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)		(PRA+ ESA)
PCC	MIN206/ MIN206-L	Surface Mining	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). Asthecourseprogresses,studentsshouldshowcasetheirmasteryofSessionOutcomes(SOs),culminatingintheoverallachievementof Course Outcomes (COs) upon the course's conclusion.

MIN206/MIN206-L:1.1 Explain the terminologies, classification and opening of surface mining.

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	4
SW	2
SL	1
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1. Describe the Application and limitations of surface mining. **SO1.2**Demonstrate Surface Mine Design Basic Parameters. **SO1.3**Interpret Annual production and life of mine. **SO1.4**Explain Cut-off grade; Stripping ratio Opening of Benches. **SO1.5**Describe Factors influencing in location of mine openings.	1.1 Drawing of schematic diagram showing different types of surface mining methods adopted in Coal, Lignite and non-coal mineral mining. 1.2 Designing various layouts for hilly deposits of vein and bedded formation.	**Unit-1:Introduction**1.1 Application and limitations of surface mining, 1.2Classification 1.3Surface Mine Design Basic Parameters 1.4 Size of mine area; Pit depth 1.5Annual production and life of mine 1.6 Bench height, width and slope, Pit slope. 1.7Cut-off grade; Stripping ratio 1.8 Opening of Benches. 1.9 Factors influencing in location of mine openings1.10 Opening of deposits, Trench, Ramp. 1.11 Width and slope of entry trenches 1.12 Driving of entry and opening trenches; Formation of benches.	1.Surface Mine Design Basic Parameters.

SW-1 Suggested Sessional Work (SW):

a.Assignments:

Explain Factors influencing in location of mine openings.

b.Mini Project: Draw layout of Benches

MIN206/MIN206-L.2: Explain the Planning of surface mines, excavation sequence.

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	4
SW	1
SL	1
Total	18

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO2.1 Describe Bench design. **SO2.2**Explain Mine scheduling, production scheduling. **SO2.**Discuss Overburden/waste removal– Equipment selection. **SO2.4**Explain Selection and application of rippers. **SO2.5**Explain Casting methods, Disposal of OB/waste material.	2.1 Designing various types of layouts for deposits below the general ground level. 2.2 Designing of various types of layouts for placer deposits.	**Unit-2:Surface Mine Planning** 2.1Bench design (bench formation, height, width, slope) 2.2 factors influencing in equipment selection 2.3Mine scheduling, production scheduling 2.4 Operation scheduling. 2.5Overburden/waste removal 2.6 Equipment selection 2.7 Bench parameter selection. 2.8Selection and application of rippers, shovels, draglines, shovel-dragline combination 2.9 Bucket wheel excavators. 2.510 Casting methods 2.11 Disposal of OB/waste material 2.12 Dump design.	i. Mine scheduling.

SW-2 Suggested Sessional Work(SW):

aAssignments:

a. Discuss Casting methods, Disposal of OB/waste material.

MIN206/MIN206-L.3: Describe Drilling mechanism, selection of drills for coal and other formations.

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	4
SW	2
SL	1
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 Explain Drilling mechanism, selection of drills for coal and other formations. **SO3.2**DescribeDust control, bit selection and bit life improvement. **SO3.3** Discuss Explosives &Blasting in surface mines. **SO3.4** Analyse Environmental impact of surface mine blasting and how to control. **SO3.5**Assess Computer assisted blasting and instrumentation in blast assessment.	3.1 Designing a deposit by opencast mining, which has been partially excavated by underground mining. 3.2 Performance and choice of drilling equipment in surface mine working.	**Unit-3 :Drilling/Blast hole drilling** 3.1 Drilling mechanism, selection of drills for coal and other formations 3.2Dust control 3.3 Bit selection and bit life improvement etc. 3.4Explosives & Blasting in surface mines 3.5 Explosives and Blasting accessories used in surface mines. 3.6Blasting Theory and Blast Design 3.7 Blast performance assessment, problems in blasting. 3.8Environmental impact of surface mine blasting and how to control 3.9 Surface mine blasting safety & Accident analyses. 3.10 Computer assisted blasting 3.11Instrumentation in blast assessment. 3.12 Special techniques of Blasting in hot holes, protecting slopes etc.	1.Study of Dust control, bit selection and bit life improvement.

SW-3 Suggested Sessional Work (SW):

a.Assignments:

i. Discuss Environmental impact of surface mine blasting and how to control.

b.Mini Project: Special techniques of Blasting

MIN206/MIN206-L.4: Explain the distribution of non-metallic mineral resources in India.

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	4
SW	2
SL	2
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO4.1 Discuss about Factors influencing Selection and application of shovel-dumper combination. **SO4.2**Explain Types of transport system – their selection. **SO4.3**Evaluate Computerized truck dispatch system. **SO4.4**Demonstrate Haul Road design and maintenance. **SO4.5**Various surface mine layout study.	4.1 Designing the blast hole charging, taking into consideration various parameters. 4.2 Measurement of blasting vibrations with Blastmate series III equipment and its analysis.	**Unit-4:Methods of excavation & transportation** 4.1Factors influencing Selection and application of shovel-dumper combination. 4.2 Draglines, surface miner 4.3 Bucket wheel excavator 4.4Types of transport system 4.5 Transport selection. 4.6 Computerized truck dispatch system. 4.7 Haul Road design 4.8 Haul Road maintenance, etc. 4.9Various surface mine layout study. 4.10Types of layouts in surface mines 4.11Layout problems 4.12 Solutions for six different layouts.	1) Bucket wheel excavator 2) Various surface mine layout study.

SW-4 Suggested Sessional Work (SW):

a.Assignments:

i. Discuss Types of transport system – their selection.

b.Mini Project:

Surface mine layout

MIN206/MIN206-L.5: Evaluate application and selection of Special methods of mining.

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	4
SW	2
SL	2
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO5.1 Describe Mining of coal from over developed galleries. **SO5.2** Explain Placer mining, hydraulicking, dredging, leaching. **SO5.3** Describe Steep angle conveying system. **SO5.4**Discuss In-pit crushing and conveying. **SO5.5**Explain Mine production support systems.	5.1Design of mine lighting and study/ measurement of their illumination level. 5.2 Dragline bench layout.	**Unit 5: Application and selection of Special methods of mining** 5.1 Mining of coal from over developed galleries 5.2 Placer mining 5.3Hydraulicking 5.4 Dredging, leaching. 5.5 Steep angle conveying system 5.6High angle conveying system. 5.7 In-pit crushing and conveying. 5.8 High wall mining 5.9 Mine production support systems 5.10 Mine lighting 5.11 Dust control, drainage, slope management 5.12 Manpower management in mines.	1. Dredging, leaching. 2.In-pit crushing and conveying.

SW-5Suggested Sessional Work (SW):

a.Assignments:

i. Describe In-pit crushing and conveying

b.Mini Project: Dust control

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)
MIN206/MIN206-L.1: Explain the terminologies, classification and opening of surface mining.	12	4	2	1	19
MIN206/MIN206-L.2: Explain the Planning of surface mines, excavation sequence.	12	4	1	1	18
MIN206/MIN206-L.3: Describe Drilling mechanism, selection of drills for coal and other formations.	12	4	2	1	19
MIN206/MIN206-L.4: Explain Methods of excavation & transportation.	12	4	2	2	20
MIN206/MIN206-L.5: Evaluate application and selection of Special methods of mining.	12	4	2	2	20
Total Hours	60	20	9	7	96

Suggestion for End Semester Assessment

Suggested Specification Table(For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Application	03	01	01	05
CO-2	Surface Mine Planning	02	06	02	10
CO-3	Drilling/Blast hole drilling	03	07	05	15
CO-4	Methods of excavation and transportation	-	10	05	15
CO-5	Application and selection of Special methods of mining	03	02	-	05
Total		11	26	13	50

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

The end of semester assessment for surface 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 Mining Industry
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter ,Whatsapp,Mobile,Onlinesources)
9. Brainstorming

Suggested Learning Resources:

(d) **Books**:

S. No.	Title	Author	Publisher	Edition& Year
1	Surface Mining Technology	Das, S.K	Lovely Prakashan, Dhanbad	2, 1988
2	Introduction to Mining Technology, Vol. I & II	Pradhan, G.K	Mintech Publication, Bhubaneswar(An AKS University Initiative).	2020
3	Explosives & Blasting Techniques	Pradhan, G.K	Mintech Publication, Bhubaneswar(An AKS University Initiative).	2020

(b) **Web link**:

https://geology.com/

https://archive.nptel.ac.in/Harddisk/Direct_Download.html

https://epathshala.nic.in/

https://swayam.gov.in/

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Cos ,Pos and PSOs Mapping

Program Title: B. Tech. Mining Engineering
Course Code: MIN206/MIN206-L.1
Course Title: Surface Mining

Course Outcomes	Program Outcomes												Program Specific Outcome			
	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 investigations of complex problems	Modern Tool usage	The engineer and society	Environment and sustainability:	Ethics	Individual and teamwork:	Communication:	Project management And finance:	Life-long learning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of mining engineering.
CO-1 Explain the terminologies, classification and opening of surface mining.	1	2	1	1	1	2	1	2	2	1	1	2	2	3	2	1
CO-2 Explain the Planning of surface mines, excavation sequence. India.	1	1	2	2	1	2	3	2	1	1	2	2	2	1	2	1
CO-3 Describe Drilling mechanism, selection of drills for coal and other formations.	1	1	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO-4Explain Methods of excavation & transportation.	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO-5 Evaluate application and selection of Special methods of mining.	1	2	1	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,67, 8,9,10,11,12 PSO1,2,3,4	CO-1 Explain the terminologies, classification and opening of surface mining.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1,1.2	Unit-1.0 Application 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11,1.12	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-2 Explain the Planning of surface mines, excavation sequence.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1,2.2	Unit-2 Surface Mine Planning 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9,2.10,2.11,2.12	SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-3DescribeDrilling mechanism, selection of drills for coal and other formations.	SO3 .1 SO3 .2 SO3.3 SO3.4 SO3.5	3.1,3.2	Unit-3 : Drilling/Blast hole drilling 3.1,3.2,3.3,3.4,3.5,,3.6,3.7,3.8,3.9,3.10,3.11,3.12	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-4 Explain Methods of excavation & transportation.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1,4.2	Unit-4: Methods of excavation and transportation 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12	SL 4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO -5 Evaluate application and selection of Special methods of mining.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1,5.2	Unit5: Application and selection of Special methods of mining 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11,5.12	SL 5.1

Semester-IV

Course Code:	**ESC 204/ESC 204-L**
Course Title:	STRENGTH OF MATERIALS
Pre-requisite:	Students must have knowledge of Calculus, linear algebra, physics (classical mechanics), differential equations, materials science basics, and mechanics of materials concepts.
Rationale:	The study of Mechanics of Deformable Bodies is crucial for understanding structural behavior, enabling design, analysis, and optimization in engineering applications.

Course Outcomes:

ESC 204/ESC 204-L.1 Apply elasticity principles to analyze and design structures, understanding stress-strain relationships, deformations, and temperature effects for practical engineering solutions."

ESC 204/ESC 204-L.2 Analyze plane stresses using principal stresses, Mohr's circle, and transformations. Understand plain strain, principal strains, and combined loading in structures and pressure vessels.

ESC 204/ESC 204-L.3 Develop shear force and bending moment diagrams for beams, understanding loading rate relationships and identifying maximum moments and contraflexure points.

ESC 204/ESC 204-L.4 Derive flexural and shear formulas, analyze stress distribution, calculate slope and deflection using double integration method for standard cases.

ESC 204/ESC 204-L.5 Analyze strain energy in axial loads, bending, torsion, determine torsion stresses, and study buckling of columns using Euler's and Rankine's formulas.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
(Professional course category)PCC	**ESC 204/ESC 204-L**	STRENGTH OF MATERIALS	4	2	1	1	8	5

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

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

Scheme of Assessment: Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA+ ESA)
			Class/HomeAssignment5number 3marks each (CA)	ClassTest2 (2bes tout Of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity anyone (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+ CAT+AT)		
PCC	ESC 204/ESC 204-L	STRENGTH OF MATERIALS	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.

ESC 204/ESC 204-L.1: Apply elasticity principles to analyze and design structures, understanding stress-strain relationships, deformations, and temperature effects for practical engineering solutions."

Approximate Hours

Item	AppXHrs
Cl	11
LI	6
SW	1
SL	1
Total	19

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 Define stress, strain, elastic constants, and material behavior principles. SO1.2 Interpret stress-strain diagrams for ductile and brittle materials, ensuring safety factors. SO1.3 Evaluate stresses and strains in determinate, indeterminate, homogeneous, and composite bars. SO1.4 Analyze temperature-induced stresses in simple structural members. SO1.5 Understand and apply interrelations between various elastic constants.	1.1 To study the universal testing machine. 1.2 To perform the Tensile test of Mild Steel on U.T.M and to draw stress – strain Curve. 1.3 To determine strength of wood on U.T.M (i) Along the grain (ii)Across the grain	1.1 Introduction 1.2 Stresses and strain, Hooke's law 1.3 Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity 1.4 Modulus of Rigidity, Bulk Modulus. Interrelation between elastic constants, 1.5 Stress-strain diagram for ductile and brittle materials, factor of safety 1.6 Stresses and strains in determinate and indeterminate bars under self weight 1.7 Stresses and strains in determinate and indeterminate under concentrated loads. 1.8 Stresses and strains in homogeneous and composite bars under self weight. 1.9 Stresses and strains in homogeneous and composite bars under concentrated loads. 1.10 Temperature stresses in simple members. 1.11 Tutorial 1	1. Explore the components and interpretation of stress-strain diagrams, including elastic deformation, yield point, ultimate strength, and fracture point.

SW-1Suggested Sessional Work (SW):

a. Assignments:

1. Explain the concept of modulus of elasticity and how it relates to Hooke's Law in the context of engineering materials. Provide a real-life example to illustrate the practical application of these concepts.

ESC 204/ESC 204-L.2: Analyze plane stresses using principal stresses, Mohr's circle, and transformations. Understand plain strain, principal strains, and combined loading in structures and pressure vessels.

Approximate Hours

Item	AppXHrs
Cl	13
LI	6
SW	1
SL	1
Total	21

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1 Apply Mohr's circle to analyze principal stresses and maximum shear stresses. **SO2.2** Understand Mohr's circle for plain strain, principal strains, and maximum shear strain. **SO2.3** Evaluate components under bending, torsion, and axial loads. **SO2.4** Analyze stresses in thin-walled pressure vessels. **SO2.5** Integrate knowledge to solve complex stress and strain scenarios.	2.1 To observe Flexural Behavior of Timber specimen and to determine it's strength under transverse loading on U.T.M. 2.2 To study the Impact Testing Machine and test specimen of Izod and Charpy. 2.3 To determine Izod and Charpy Value of the given mild steel specimen.	2.1 Principal stresses and strain 2.2 Transformation of plane stresses, Principal stresses 2.3Maximum shear stresses, 2.4 Numerical solving 2.5 Mohr's circle for plane stresses 2.6 Numerical solving 2.7 Plain strain and its Mohr's circle representation 2.8 Principal strains, 2.9 Maximum shear strain. 2.10 Combined Loading: Components subjected to bending, torsion & axial loads. 2.11 Analysis of thin pressure vessels. 2.12 Numerical solving 2.13 Tutorial 1	1. Learn how to apply Mohr's circle to transform stresses from one coordinate system to another, particularly focusing on plane stress conditions.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

a) Explain the concept of Mohr's circle for plane stresses.

ESC 204/ESC 204-L.3: Develop shear force and bending moment diagrams for beams, understanding loading rate relationships and identifying maximum moments and contra flexure points.

Approximate Hours

Item	AppXHrs
Cl	10
LI	6
SW	1
SL	1
Total	18

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO3.1 Construct shear force and bending moment diagrams for various loads. **SO3.2** Understand the connection between loading rates, shear force, and bending moments. **SO3.3** Identify and calculate maximum bending moments in statically determinate beams. **SO3.4** Determine positions of points of contraflexure in beam structures.	3.1 To study the Fatigue Testing Machine and to discuss the procedure to find out endurance limit of given material. 3.2 To study the Spring Testing Machine. 3.3 To determine modulus of rigidity for the material of open and closed Coiled Helical Spring Subjected to Axial Load by spring testing machine.	3.1 Types of Beam 3.2 Shear force and bending moment 3.3 Shear force and bending moment diagrams for statically determinate beam due to concentrated load 3.4 Shear force and bending moment diagrams for statically determinate beam due to uniformly distributed load 3.5 Shear force and bending moment diagrams for statically determinate beam due to uniformly varying load 3.6 Shear force and bending moment diagrams for statically determinate beam due to couple 3.7 Relationship between rate of loading, shear force and bending moment. 3.8 Maximum bending moment and position of points of contra flexure 3.9 Tutorial 1 3.10 Tutorial 2	1. Enhance problem-solving skills by solving numerical exercises related to the analysis of beams and the construction of shear force and bending moment diagrams.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Explain how shear force and bending moment are related to the internal forces and moments experienced by a beam

ESC 204/ESC 204-L.4: Derive flexural and shear formulas, analyze stress distribution, calculate slope and deflection using double integration method for standard cases.

Approximate Hours

Item	AppXHrs
Cl	13
LI	6
SW	1
SL	1
Total	21

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4.1 Derive flexural formula, stress distribution, moment of resistance. SO4.2 Derive distribution formula, analyze common sections. SO4.3 Relate bending moment, analyze determinate beams using integration. SO4.4 Calculate second moment for various cross sections, stress diagrams. SO4.5 Explore shear stresses, connections between flange and web.	4.1 . To study the Torsion Testing Machine 4.2 To determine ultimate shear stress and modulus of rigidity under Torsion. 4.3 To study the Cupping Test Machine and to determine Erichsen value of Mild Steel sheet.	**UNIT-4.0** 4.1 Theory of simple bending, assumptions 4.2 Derivation of flexural formula 4.3 Second moment of area of common cross sections (rectangular, I,T,C) with respect to centroidal and parallel axes 4.4Bending stress distribution diagrams, 4.5 moment of resistance and section modulus. 4.6 Shear stresses: Concept, derivation of shear stress distribution formula, 4.7 shear stress distribution diagrams for common symmetrical sections, 4.8 maximum and average shears stresses, 4.9 shear connection between flange and web. 4.10 Slope and deflection of beams: Relation between bending moment and slope 4.11 Slope and deflection of determinate beams, 4.12 Double integration method (Macaulay's method), 4.13 Derivation of formula for slope and deflection for standard cases.	1. Explore the concepts of maximum and average shear stresses and their significance in beam design.

SW-4Suggested Sessional Work (SW):

a. Assignments:

i. Sketch the bending stress distribution diagram for a beam subjected to a uniformly distributed

ESC 204/ESC 204-L.5 Analyze strain energy in axial loads, bending, torsion, determine torsion stresses, and study buckling of columns using Euler's and Rankine's formulas.

Item	AppXHrs
Cl	13
LI	6
SW	1
SL	1
Total	21

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO5.1 Analyze gradual, sudden, and impact scenarios. SO5.2 Examine stresses, strains, and deformations in determinate shafts. SO5.3 Derive Euler's formula, evaluate safe loads, consider end conditions. SO5.4 Investigate torsion, bending, and axial force interactions. SO5.5 Understand energy aspects in bending, torsion.	5.1 To study the Rockwell Hardness Testing Machine and to determine the Rockwell Hardness of the given material. 5.2 To study the Brinell Hardness Machine and to determine the Brinell hardness of the given material. 5.3 . To study the Vickers Hardness Machine and to conduct a test on the machine.	5.1Strain energy: Strain energy due to gradual load 5.2 Strain energy due to sudden load 5.3 Strain energy due to impact load, 5.4 Strain energy due to bending and torsion. 5.5 Torsion: Stresses, strain and deformations in determinate shafts of solid and hollow, 5.6 homogeneous and composite circular cross section subjected to twisting moment, 5.7 derivation of torsion equation, 5.8 stresses due to combined torsion, bending and axial force on shafts. 5.9 Buckling of columns: Concept of buckling of columns, 5.10 derivation of Euler's formula for buckling load for column with hinged ends, 5.11 Concept of equivalent length for various end conditions, 5.12 limitations of Euler's formula, 5.13 Rankine's formula, safe load on columns.	1. Understand the concept of buckling in columns and its implications for structural stability.

SW-5Suggested Sessional Work (SW):

a. Assignments:

1. Discuss the stresses induced in structural elements subjected to combined loading, including torsion, bending, and axial forces.

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)
CO1: Apply elasticity principles to analyze and design structures, understanding stress-strain relationships, deformations, and temperature effects for practical engineering solutions."	11	6	1	1	19
CO2: Analyze plane stresses using principal stresses, Mohr's circle, and transformations. Understand plain strain, principal strains, and combined loading in structures and pressure vessels.	13	**6**	1	1	21
CO3: Develop shear force and bending moment diagrams for beams, understanding loading rate relationships and identifying maximum moments and contraflexure points.	10	6	1	1	18
CO4: Derive flexural and shear formulas, analyze stress distribution, calculate slope and deflection using double integration method for standard cases.	13	6	1	1	21
CO5: Analyze strain energy in axial loads, bending, torsion, determine torsion stresses, and study buckling of columns using Euler's and Rankine's formulas.	13	**6**	1	1	21
Total Hours	60	**30**	5	5	100

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Simple stresses and strains	03	01	01	05
CO-2	Principal stresses and strains	02	06	02	10
CO-3	Shear Force and Bending Moment Diagrams	03	07	05	15
CO-4	Stresses in Machine Elements, Slope and deflection of beams	-	10	05	15
CO-5	Strain energy and Buckling of columns:	03	02	-	05
Total		11	26	13	50

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

The end of semester assessment for Mechatronics it 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 mining industry
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog , Face book, Twitter, Whats-app, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a)Books:

S. No.	Title	Author	Publisher
1	Strength of Materials	Gere &Timoshenko	CBS Publication
2	Strength of Materials	Ramamurtham	Dhanpat Rai Publication.
3	Strength of Material	S.S. Rattan	Tata McGraw Hill Publication Co. Ltd.
4	Strength of Materials- 3rd Edition	G. H. Ryder	Macmillan Pub, India
5	Strength of Material	Beer and Johnston	CBS Publication
6	Introduction to Mechanics of Solids	E.P. Popov	Prentice Hall Publication
7	Introduction to Mechanics of Solids	Singer and Pytel	Harper and row Publication.
8	Strength of Material	B.K. Sarkar	Tata McGraw Hill New Delhi

(b) Link https://nptel.ac.in/

Curriculum Development Team

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Cos, Pos and PSOs Mapping

Course Title: B. Tech. Mining Engineering
Course Code: ESC 204/ESC 204-L
Course Title: STRENGTH OF MATERIALS

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problemanalysis	Design/developmentof solutions	Conduct investigationsof complex problems	Modern tool usage	Theengineerandsociety	Environment and sustainability:	Ethics	Individualandteamwork:	Communication:	Projectmanagement and finance:	Life-longlearning	Mechanical System Design and Analysis	Manufacturing Processes and Automation	Computational Modeling and Simulation.	Product Innovation and Development
CO 1: Apply elasticity principles to analyze and design structures, understanding stress-strain relationships, deformations, and temperature effects for practical engineering solutions."	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1
CO 2: Analyze plane stresses using principal stresses, Mohr's circle, and transformations. Understand plain strain, principal strains, and combined loading in structures and pressure vessels.	1	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1
CO 3: Develop shear force and bending moment	2	2	1	1	1	2	2	2	1	2	1	2	1	1	2	2

diagrams for beams, understanding loading rate relationships and identifying maximum moments and contraflexure points.																
CO 4: Derive flexural and shear formulas, analyze stress distribution, calculate slope and deflection using double integration method for standard cases.	3	2	2	2	3	2	3	2	2	1	2	3	3	3	3	2
CO 5: Analyze strain energy in axial loads, bending, torsion, determine torsion stresses, and study buckling of columns using Euler's and Rankine's formulas.	1	1	1	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3– High

Course Curriculum Map:

Pos &PSOs No.	Cos No. &Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO 1: Apply elasticity principles to analyze and design structures, understanding stress-strain relationships, deformations, and temperature effects for practical engineering solutions."	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1 1.2 1.3	Unit-1.0 Simple stresses and strains 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11	SL 1.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO 2: Analyze plane stresses using principal stresses, Mohr's circle, and transformations. Understand plain strain, principal strains, and combined loading in structures and pressure vessels.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1 2.2 2.3	Unit-2.0 Principal stresses and strains 2.1,2.2,2.3,2.4,2.5,2.6,2.7, 2.8,2.9,2.10,2.11,2.12,2.13	SL 2.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO 3: Develop shear force and bending moment diagrams for beams, understanding loading rate relationships and identifying maximum moments and contra flexure points.	SO3.1 SO3.2 SO3.3 SO3.4	3.1 3.2 3.3	Unit-3.0 : Shear Force and Bending Moment Diagrams 3.1, 3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10	SL 3.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO 4: Derive flexural and shear formulas, analyze stress distribution, calculate slope and deflection using double integration method for standard cases.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1 4.2 4.3	Unit-4.0 : Stresses in Machine Elements, Slope and deflection of beams 4.1, 4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12,4.13	SL 4.1
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	CO 5: Analyze strain energy in axial loads, bending, torsion, determine torsion stresses, and study buckling of columns using Euler's and Rankine's formulas.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1 5.2 5.3	Unit 5.0 Strain energy and Buckling of columns: 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	SL 5.1

Semester-IV

Course Code: **ESC201, ESC201-L**

Course Title : **Basic Electronics Engineering**

Pre-requisite: Student should have knowledge of fundamental principles of analog electronics.

Rationale: In current scenario the diode, transistors, op-amp is extensively used in various electronic circuits. Such systems are required to design and maintain by engineer. Therefore, the goal of this course is for students to become competent to understand design and maintenance of such type of systems.

Course Outcomes:

ESC201, ESC201-L.1: Understanding of the concept of semiconductor materials, pn junction junction diodes and BJT and its types.
ESC201, ESC201-L.2: : Understanding of Operational amplifier its construction working and its different types.
ESC201, ESC201-L.3: Explain the principle, construction and working of different timing circuits and oscillator with its types.

ESC201, ESC201-L 4: Explain the basic concepts of digital electronics, Boolean algebra, logic gates and different logic circuits

ESC201, ESC201-L.5: Explain the principle of Electronics Communication System its types and different modulation techniques

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Hours(CI+LI+SW+SL)	
ESC	ESC201, ESC201-L	Basic Electronics Engineering	4	2	1	1	8	5

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

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

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

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
ESC	ESC201	Basic Electronics Engineering	15	20	5	5	5	50	50	100

Practical

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)					Total Marks (PRA+ESA)
			Progressive Assessment (PRA)				End Semester Assessment(ESA)	
			Class/Home Assignment 5 number 7 marks each (LA)	VIVA(VV)	Class Attendance (TA)	Total Marks (LA+VV+ TA)		
ESC	ESC201-L	Basic Electronics Engineering	35	10	5	50	50	100

Course-Curriculum Detailing:

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

ESC201, ESC201-L.1: Understanding of the concept of semiconductor materials, pn junction junction diodes and BJT and its types

Approximate Hours

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

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Understand the concept of semiconductor material **SO1.2**Understand the concept of PN junction diode and its characteristics **SO1.3**Understand the concept of BJT and its working **SO1.4** understand the different type of BJT and characteristics	1. Study of PN junction diode . 2. Study of half wave and full wave rectifier. 3. study of CB CE CC of BJT.	**Devices and Applications** 1.1 Introduction to semiconductor 1.2 Introduction to P-N Junction Diode and V-I characteristics, 1.3 Half wave and Full-wave rectifiers,capacitor filter. 1.4 Tutorial-1 1.5Zener diode and its characteristics,Zener diode as voltage regulator. 1.6 Regulated power supply IC based on 78XX and 79XX series, 1.7 Introduction to BJT,its input-output and transfer characteristics, 1.8 Tutorial-2 1.9 BJT as a single stage CE amplifier, frequency response and bandwidth. 1.10 Tutorial-3	1. Semiconductor and its types 2. Concept of PN junction

SW-1 Suggested Sessional Work(SW):

c. **Assignments:**

i. Explain forward biasing and reverse biasing of PN junction.
ii. Describe the application of rectifier.

ESC201, ESC201-L.2:: Understanding of Operational amplifier its construction working and its different types.

Approximate Hours

Item	ApproxHrs
CI	11
LI	6
SW	1
SL	1
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self- Learning (SL)
SO2.1 Understanding of operational amplifier **SO2.2**Learn the working of OP-AMP as open loop and feedback circuit **SO2.3**Understandthe construction and working of OP-AMP as inverting non inverting amplifier **SO2.4** Understand the different application of OP-AMP	1. study of operational amplifier as summing and differencial 2. study of OP-AMP as integrator and differentiator 3. Study of OP-AMP as inverting and non inverting amplifier.	**Unit-2:Operational amplifier and its applications** 2.1 Introduction to operational amplifiers, 2.2 Op-amp input modes and parameters, 2.3 Op-amp in open loop configuration, op-amp with negative feedback, 2.4 Tutorial-1 2.5 study of practical op-amp IC 741, 2.6 inverting and noninverting amplifier 2.7 applications: summing and difference amplifier, 2.8 unity gain buffer, comparator, 2.9 Tutorial-2 2.10 integrator and differentiator. 2.11 Tutorial-3	1. Concept of BJT as an amplifier 2. Concept of feedback circuit 3. Operation Of integrators and differentiators

SW-2 Suggested Sessional Work(SW):

c. Assignments:

i. Theoretical Assignment related to different types of OP-AMP

ii. Explain the working principle of OP-AMP as inverting and Non inverting OP-AMP

b. Mini Project:

i. Draw a Poster of different operations of OP-AMP

ESC201, ESC201-L.3:Explain the principle, construction and working of different timing circuits and oscillator with its types.

Approximate Hours

Item	ApproxHrs
CI	11
LI	6
SW	1
SL	1
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
SO3.1 To study of timing circuits and their types **SO3.2** To understand the Design and Characteristic of Timingcircuit **SO3.3** To learn about the Oscillator **SO3.4**To understand the Design and Characteristic of oscillator and its types.	1. study of Astable multi vibrator 2.study of R-C phase shift oscillator 3. study of Wein bridge oscillator	**Unit-3Timing Circuits and Oscillators** 3.1 RC-timing circuits, 3.2 Introduction to IC 555 3.3 IC 555 and its applications 3.4 IC 555astable ,IC 555 mono-stable 3.5 Tutorial-1 3.6 multi-vibrators, 3.7 Introduction of oscillators and positive Feedback oscillators 3.8 Tutorial-2 3.9 Barkhausen's criteria for oscillation, 3.10 R-C phase shift and Wein bridge oscillator. 3.11 Tutorial-3	1. Significance of timing circuits

SW-3Suggested Sessional Work(SW):

a. Assignments:

i. Make a poster of IC 555 timer

ii. Explain different types of oscillators

ESC201, ESC201-L.4: Explain the basic concepts of digital electronics, Boolean algebra, logic gates and different logic circuits

Approximate Hours

Item	**ApproxHrs**
CI	15
LI	6
SW	1
SL	1
Total	23

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self- Learning (SL)**
SO4.1 Understand the building Blocks of digital electronics **SO4.2** Understand the building Blocks of Boolean algebra **SO4.3**Understand the concepts of logic gates and circuits **SO4.4**Understand the applications of logic gates and circuits	4.1.study of Microprocessor . 4.2. Study of Microcontroller 4.3.Identification of different logic gates.	**Unit-4 :Digital Electronics Fundamentals** 4.1 Difference between analog and digital signals, 4.2 Boolean algebra, 4.3 examples of Boolean algebra 4.4 Tutorial-1 4.5 Basic and Universal Gates, Symbols, Truth tables, logic expressions, 4.6 Logic simplification using K- map, 4.7 Logic ICs, 4.8 half and full adder,half and full subtractor 4.9, Tutorial-2 4.10 multiplexers, de-multiplexers, 4.11 flip-flops and its types 4.12 shift registers, counters, 4.13Tutorial-3 4.14 Block diagram of microprocessor and their applications. 4.15 microcontroller and their applications.	1. Difference between analog electronics and digital electronics 2. Difference between logic gates and logic circuits

SW-4Suggested Sessional Work (SW):

a. **Assignments:**

i. Theoretical Assignments Based on Different types logic gates and circuits
ii. Numerical Problems Based on Boolean algebra

ESC201, ESC201-L.5:: Explain the principle of Electronics communication System its types and different modulation techniques

Approximate Hours

Item	ApproxHrs
CI	13
LI	6
SW	1
SL	1
Total	21

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning (SL)
SO5.1 Discussion about the communication system and its types **SO5.2**Understand the concept of modulation techniques **SO5.3**Understand the Building blocks of communication system **SO5.4**Study of different types of modulation techniques, .	5.1.Study of Amplitude Modulation. 5.2. study of Frequency modulation 5.3.Study of AM and FM modulators	**Unit 5: Electronic Communication Systems** **5**.1intoduction of communication system 5.2 block diagram of communication system 5.3 The elements of communication system,IEEE frequency spectrum 5.4 Tutorial-1 5.5 Transmission media: wired and wireless, 5.6 Introduction of Modulation 5.7 need of modulation,types of modulation 5.8 Tutorial-2 5.9 Introduction to AM 5.10 Introduction FM modulation schemes, 5.11 Mobile communication systems,cellular concepts 5.12 Tutorial-3 5.13 block diagram of GSM system.	1. Basic Structure and operation of communication system 2. Types of communication system

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. Theoretical Assignment based on Different types of communication system

ii. Explain different types of modulation techniques.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Lab Instruction(LI)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (CI+SW+Sl)
ESC201, ESC201-L.1: Understanding of the concept of semiconductor materials, pn junction junction diodes and BJT and its types	10	6	1	1	18
ESC201, ESC201-L.2: **:**Understanding of Operational amplifier its construction working and its different types.	11	6	1	1	19
ESC201, ESC201-L.3: Explain the principle, construction and working of different timing circuits and oscillator with its types.	11	6	1	1	19
ESC201, ESC201-L.4: Explain the basic concepts of digital electronics, Boolean algebra, logic gates and different logic circuits	15	6	1	1	23
ESC201, ESC201-L.5: Explain the principle of Electronics communication System its types and different modulation techniques	13	6	1	1	21
Total Hours	60	30	5	5	100

Suggestion for End Semester Assessment

Suggested Specification Table(For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Semiconductor Devices and Applications	04	03	01	8
CO-2	Operational amplifier and its applications	06	03	02	11
CO-3	Timing Circuits and Oscillators	04	03	01	8
CO-4	Digital Electronics Fundamentals	05	04	02	11
CO-5	Electronic Communication Systems	04	04	04	12
Total		23	17	10	50

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

The end of semester assessment for Process calculation will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared byt he 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. Group Discussion
4. Practical Design Demonstration
5. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
6. Brainstorming

Suggested Learning Resources:

(a)Books:

S.No.	Title	Author	Publisher	Edition &Year
1	Integrated Electronics	MillmanandHalkias	McGrawHill	2017
2	Electronics Devices and Circuits	R.BoylestedandL. Nashelsky	PrenticeHallIndia	2009
3	Electronics Devices and Circuits	MillmanandHalkias	TMHEdition	2017

4	AnalogElectronics	MalcolmGoodge	TMHEdition	1990
5	Communication Electronics: Principles	Frenzel,	Tata Mc Graw Hill,	2001
6	Lecturenoteprovided by Deptt.ofElectricalEngineering,AKSUniversity,Satna.			

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COs, POs and PSOs Mapping

Program Title: B. Tech Mining Engineering   Course Code: ESC201 / ESC201-L   Course Title: Basic Electronics Engineering

CourseOutcomes	Program Outcomes												Program Specific Outcome			
	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 investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Understanding of the concept of semiconductor materials, pn junction junction diodes and BJT and its types	3	3	2	2	3	2	1	1	2	1	1	2	2	2	2	3
CO-2: Understanding of Operational amplifier its construction working and its different types.	2	3	3	2	1	2	1	1	1	1	2	2	2	2	2	2
CO-3 Explain the principle, construction and working of different timing circuits and oscillator with its types.	3	3	2	1	1	2	1	2	1	2	2	2	1	2	2	3
CO-4: Explain the basic concepts of digital electronics, Boolean algebra,	3	2	2	2	3	2	1	2	2	1	2	2	3	3	3	1

logic gates and different logic circuits																
CO-5: Explain the principle of Electronics Communication System its types and different modulation techniques	**2**	**3**	**3**	**1**	**1**	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**3**	**1**	**3**

Legend:1–Low,2–Medium,3–High

Course Curriculum Map: Basic Electronics Engineering

POs & PSOs No.	Cos No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO-1:** Understanding of the concept of semiconductor materials, pn junction junction diodes and BJT and its types	SO1.1 SO1.2 SO1.3 SO1.4	1.1,1.2,1.3	**UNIT-1:Semiconductor Devices and Applications** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO-2:** Understanding of Operational amplifier its construction working and its	SO2.1 SO2.2 SO2.3 SO2.4	2.1,2.2,2.3	**UNIT-2:Operational amplifier and its applications** 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9,2.10,2.11	SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO-3:** Explain the principle, construction and working of different timing circuits and oscillator with its types.	SO3.1 SO3.2 SO3.3 SO3.4	3.1,3.2,3.3	**Unit-3:Timing Circuits and Oscillators** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO-4:**Explain the basic concepts of digital electronics, Boolean algebra, logic gates and different logic circuits .	SO4.1 SO4.2 SO4.3 SO4.4	4.1,4.2,4.3	**UNIT-4:Digital Electronics Fundamentals** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12,4.13,4.14,4.15	SL 4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO-5:** Explain the principle of Electronics Communication System its types and different modulation techniques	SO5.1 SO5.2 SO5.3 SO5.4	5.1,5.2,5.3	**UNIT-5:Electronic Communication Systems** 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	SL 5.1

Semester V

Course Code: **MIN301/ MIN301-L**

Course Title: **Mining Machinery-I**

Pre-Requisite: The student should have basic knowledge about the fundamentals of physics, mathematics and theoretical mechanics.

Rationale: The student studying mining engineering should develop fundamental understanding about the scope and application of theoretical mechanics in constructional, operational and designing of mining machines and equipment. Comprehension of the use of different power sources in mine like electrical, pneumatic and hydraulic powers is needed for rational deployment in mining conditions. The course Mining Machinery I encompasses all these aspects in a balanced manner.

Course Outcome:
The student

MIN301/ MIN301-L.1- will garner an insight into the theoretical aspects of basic mechanics and its application in mechanical transmission of power

MIN301/ MIN301-L.2- Understanding the principles of compressor machines along with acquiring the knowledge of the generation, storage and distribution of compressed air power and its energy efficient use in mining conditions.

MIN301/ MIN301-L.3-Will develop complete knowledge and understanding of the design elements of Drill machines for Underground and opencast mining conditions as well as for deep exploratory boreholes.

MIN301/ MIN301-L.4 -Will comprehend the technical aspects associated with the use of hydraulic power at very high pressures. Will also be able to distinguish between open centre and closed centre hydraulic circuits with the scope of their specific application in mining industry

MIN301/ MIN301-L.5- Will garner an understanding about the need for adopting specific types of specifications of Heavy Earth Moving Machinery (HEMM) in opencast mines which will give a complete understanding about the different operational mechanisms of HEMM reflecting on their efficiency and performance.

Scheme of studies:

Code	Course code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total study Hours (CI+LI+SW+SL)	
Program Core (PCC)	MIN301/ MIN301-L	Mine Machinery-I	4	2	1	1	8	5

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

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

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

SL: Self Learning,
C:Credits.

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

Scheme of Assessment:
Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+AT)		
PCC	MIN301/ MIN301-L	Mine Machinery -I	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

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

MIN301/ MIN301-L.1:- Theoretical aspects of basic mechanics & its application for Mechanical transmission of power

Approximate hours

Item	Appx Hrs
Class room Instructions (CI)	13
Laboratory Instructions (LI)	6
Sessional work (SW)	2
Self Learning	1
Total	22

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO1.1-Recapitulation of the fundamental knowledge of basic mechanics SO1.2- Conceptual skill development for linking the basics of mechanics with machine operation SO1.3-Knowledge of principles applied in simple machines SO1.4-Principles of transmission of mechanical power SO1.5-Application of transmission of mechanical power in machine design and operation	1.1- Banking on the curves 1. 2-Determining Brake HP of engines or motors LI 3- Torque converter	Unit 1- Basics of Mechanics. Mechanical Transmission of Power: 1.1-Basic quantities & their units in SI system for applied mechanics 1.2-Speed, velocity & acceleration, Equations of linear and angular motions 1.3-Centripetal and centrifugal forces 1.4-Moment of force. Couple 1.5-Work done by force and torque 1.6-Power and energy. Relation between Kinetic and potential energy. Conversion of energy 1.7-Moment of Inertia. Radius of Gyration 1.8-Simple machines and their types 1.9-Pulleys. Wheels and axles. Differential wheels and axles 1.10- Mechanical transmission of power- Shafts & shaft couplings 1.11- Clutches- their functions and different designs 1.12-Toothed gear wheels. Simple & compound trains of gear wheels 1.13- Belt drives for transmission of mechanical power	Study area: (i)Applied mechanics in machine designing

Suggested Sessional works: a. Assignments:

(i) Explaining in detail the structural elements, principle of operation and advantages of fluid coupling mentioning its applicability in mining industry

(ii) Explaining in detail about wheel and axle mechanism for multiplication of force and application of differential principle in improving the velocity ratio

b. Topic of Mini Project- Scope of application of Applied Mechanics in machine designing.

MIN301/ MIN301-L.2:- Understanding principles of compressor machines, generation, storage and distribution of Compressed air

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	13
Laboratory Instructions (LI)	6
Sessional work (SW)	2
Self Learning	1
Total	22

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO2.1-A complete understanding of the principles of operation of compressors based on their designs SO2.2-Garnering knowledge about applicability of various types of compressors in different conditions SO2.3-Comprehension of the ideal conditions and actual mode of operation of compressors SO2.4-Aquiring concept of the generation and distribution system of compressed air in mines SO2.5- Developing concept for energy efficient generation and consumption of compressed air energy in practice	I .1.-Layout of compressed air generation and distribution system in a mine I .2-Assessment of actual compressor capacity I .3- Modulation of compressors for energy efficient utilization	Unit 2: Compressors and compressed air power 2.1-Compressors- Types, 2.2-Gas laws. Inferences from combined gas law 2.3-Positive displacement compressors- their types and characteristics 2.4-Roto=dynamic compressors. Operation of single and multi-stage roto-dynamic compressors 2.5-Specific heat of gas. Isothermal and Adiabatic compression 2.6-Compressor capacity. Factors affecting energy efficiency of compressors 2.7-Energy efficiency in multi-stage compression compared to single stage compression 2.8-Leakage quantification in a compressed air system 2.9 configuration 2.10 and application 2.11 numerical 2.12 problem 2.13 Problems 1	Study area: (i)Strength and weakness of compressed air power in comparison to electrical and hydraulic power

Suggested Sessional works: a. Assignments:

(i) Explaining in detail the structural elements, principle of operation for positive displacement and Roto-dynamic compressors and main differences between these two types

b. Topic of Mini Project-Increasing Scope for application of Compressed air power in Mining Tunneling & Underground Space Technology.

MIN301/ MIN301-L.3:- Design elements of drilling machines for UG, OC and exploratory drilling

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	9
Laboratory Instructions (LI)	6
Sessional work (SW)	2
Self Learning	1
Total	18

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO3.1- Acquiring basic knowledge about the principles of drilling mechanism SO3.2-Comprehension about linking between specific geo-mining conditions and selection of drilling methods SO3.3- Application of energy efficient drilling methods SO3.4-Ability to design motor power for drilling machines in consideration of multiple factors affecting drilling operations SO4.5- Concept of automation of drilling process	I 1- Different types of drilling accessories and their application I 2- Construction & operation of Jack hammer drills I 3- Effect of environmental conditions and determination of motor power for drilling machine	Unit 3:- Drilling system and equipment 3.1-Systems of rock drilling. Application of different rock drilling methods 3.2-Percussion drilling- its basic features 3.3-Rotary drilling-its principle. Rotary percussion drilling 3.4-UG drilling machines- Jumbo, Simba and electrical coal drills 3.5-Cable-tool percussion method of drilling- Rotary percussive drills 3.6-Down the Hole (DTH) drills and reasons for their high efficiency. 3.7-Rock drilling and Augur drilling 3.8-Diamond core drilling- its basic application 3.9-Types of Diamond drills- their features	Study area: (i)Advanced methods of drilling in specific conditions for mechanical as well as other methods of drilling

Suggested Sessional works: a. Assignments:

(i) Define the basic principles of percussion and Rotary drilling. Make a comparative statement between percussion and rotary drilling

(ii) Explain in detail how the DTH drilling has revolutionized the drilling industry?

b. Topic of Mini Project- Case study

MIN301/ MIN301-L.4:- Comprehending hydraulic power and ita application in mining industry

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	12
Laboratory Instructions (LI)	2
Sessional work (SW)	2
Self Learning	1
Total	17

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO4.1-Comprehension of hydraulic power SO4.2-Application of hydraulic power in force multiplication SO4.3-Comprehension of different circuits of hydraulics SO4.4-Aquiring knowledge about modes of application of hydraulic circuits and its accessories SO4.5-Comprehension of the applicability of hydraulics in mining machines	I .1- General lay-out of Hydraulic circuit in a Powered Support Longwall Face	Unit 4:- Hydraulics and hydraulic circuits 4.1-Basics of hydraulics. Pascal's law and continuity equation 4.2-Bernouilli's Principle. 4.3 Force 4.4 torque multiplication 4.5-Application of the principle of force multiplication 4.6-Volumetric ratio for a hydraulic lift 4.7-Open centre hydraulic circuit 4.8- Closed centre hydraulic circuit 4.9-Application of hydraulic power in mining industry 4.10 Case study 4.11 Numerical; 4.12 Problems	Study area: (i)Details of hydraulic circuits and their application in mining machines

Suggested sessional works: a. Assignments:

(i) Explain how the principle of force and torque multiplication in hydraulic system can be utilized in machine designs

(ii) Make a comparative statement between open centre and closed centre hydraulic circuits.

b. Topic of Mini Project-Role of hydraulic power in mining industry

MIN301/ MIN301-L.5:- Understanding Constructional features & operational details of HEMM

Approx. Hours

Item	Approximate Hours
Class room Instructions (CI)	13
Laboratory Instructions (LI)	4
Sessional work (SW)	2
Self Learning	1
Total	20

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO5.1-Comprehension of the basic features for HEMM SO5.2-Application of different HEMM in different geo-mining conditions SO5.3-Understanding the versatility of hydraulic excavators SO5.4-Comprehension of machines used in cyclic and continuous modes of operation in surface mines SO5.5-Determination of production potentiality of various HEMM	1- Determination of production potentiality of Bucket Wheel Excavator 2- Determination of bucket capacity of a Bucket wheel excavator	Unit 5- Heavy Earth Moving Machinery and their constructional features 5.1- Classification of Mining Machinery 5.2 their application 5.3-Characteristics of Surface Mining Machinery 5.4-Different types of machines used in quarry's 5.5d surface mines 5.6 Electric rope shovel 5.7 its constructional details 5.8-Hydraulic shovels 5.9 their specific features 5.10-Constructional detail of Draglines 5.11-Surface Miners 5.12 their specifications 5.13-Bucket Wheel Excavators and their constructional elements	Learning area: (i)Ergonomics in designing HEMM

Suggested Sessional works: a. Assignments:

(i) Selection criteria for HEMM in surface mines depending on geo-mining condition of the mine and mine capacity

(ii) Make a comparative statement between Rope shovel and Hydraulic shovel

b. Topic of Mini Project- Methods to improve environmental sustainability in surface mines and Role of HEMM

Brief of Hours suggested for the course outcome:

Course outcomes	Class Lectures (CL)	Laboratory Instructions (LI)	Sessional work (SW)	Self Learning (SL)	Total Hour (CL+LI+SW+ SL)
MIN301/ MIN301-L.1- Theoretical aspects of basic mechanics and its application in mechanical transmission of power	13	6	2	1	22
MIN301/ MIN301-L.2- Understanding principles of compressors and generation, storage and distribution of compressed air	13	6	2	1	22
MIN301/ MIN301-L.3- Design elements of drill machines for UG, OC and exploratory drilling	9	6	2	1	18
MIN301/ MIN301-L.4- Comprehending hydraulic power and its application in mining industry	12	2	2	1	17
MIN301/ MIN301-L.5- Comprehending constructional features and operational details of HEMM	13	4	2	1	20
Total Hours	60	24	10	5	99

Suggestions for End semester Assessment:

Suggested Specification Table

COs	Unit Titles	Marks Distribution			Total; Marks
		R	U	A	
CO 1	Theoretical aspects of basic mechanics and its application in mechanical transmission of power	3	3	1	7
CO 2	Understanding principles of compressors and generation, storage and distribution of compressed air	3	4	3	10
CO 3	Design elements of drill machines for UG, OC and exploratory drilling	3	5	5	13

CO 4	Comprehending hydraulic power and its application in mining industry	3	5	5	13
CO 5	Comprehending constructional features and operational details of HEMM	2	3	2	7
	Total	14	20	16	50

Legend: R-Remember U-Understand A-Apply

The end of semester assessment for Underground coal mining technologies will be held with written examination of 50 marks

Suggested Instructional/ Implementation Strategies:

1. **Improved lectures**
2. Tutorial
3. Case studies
4. Group discussion
5. Role play
6. Visit to mining industries
7. Demonstration
8. Digital media application in teaching learning process and mass media
9. Brainstorming

Suggested Learning Resources

Sl.No	Title	Author	Publisher	Edition & Year
1.	Elements of Mining Technology	D J Deshmukh	Lovely Prakashan	2018

Link

https://nptel.ac.in/

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COs, POs & PSO Mapping

Program Title: B. Tech (Mining Engineering)
Course Code: MIN301/ MIN301-L
Course Title: Mining Machinery-I

	Program Outcomes												Program Specific Outcomes			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
Course Outcome	Engg Know ledge	Prob Lem Ana-lysis	Des-ign/ Dev of Solu tion	Inv-esti gat ion of complex problems	Mod ern tool usage	Eng Ineer & soc iety	Env Ironment & Sus tai nab ility	Work Eth ics	Ind Ivi Dual & te-am Wo-rk	Commu nica tion	Pro Ject Mgmt & Fin ance	Life lo ng Lea ning	Dev. Analy tical skill for identi-fying mine prob-lems for solutions	Garnering know Ledge about economic, env & soc ietal impacts of mining	Dev. Knowledge for mine plan ing, operation & closure	Develop work ethics under mine statutes
CO1- Theoretical aspects of basic mechanics and its application in mechanical transmission of power	2	1	1	1	1	1	2	1	1	1	1	2	1	1	1	1
CO2- Understanding principles of compressors and generation, storage and distribution of compressed air	2	1	1	1	2	1	1	-	3	2	3	2	1	1	2	2
CO 3- Design elements of drill machines for UG, OC and exploratory drilling	3	2	3	1	2	1	2	1	3	3	2	2	2	1	3	1
CO 4- Comprehending hydraulic power and its	3	2	3	1	2	1	2	1	3	3	2	2	2	1	3	1

application in mining industry																
CO 5- Comprehending constructional features and operational details of HEMM	3	2	2	3	2	1	2	2	3	3	3	2	2	2	3	2

Legend 1: Low 2: Medium 3: High

Course Curriculum Map:

POs & PSOs Number	COs number & Title	SOs Number	Laboratory Instruction (LI)	Class Room Instructions (CI)	Self Learning (SL)
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 1- Theoretical aspects of basic mechanics and its application in mechanical transmission of power	SO 1.1 SO 1.2 SO 1.3 SO 1.4 SO 1.5	1.1 1.2 1.3	Unit 1- Basics of mechanics. Mechanical transmission of power 1.1 ,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.11,1.12,1.13	SL 1.1
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 2- Understanding principles of compressors and generation, storage and distribution of compressed air	SO2.1 SO 2.2 SO 2.3 SO 2.4 SO 2.5	2.1 2.2 2.3	Unit 2- Compressors and compressed air power 2.1 ,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9,2.10,2.11,2.12,2.13	SL 2.1
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 3- Design elements of drill machines for UG, OC and exploratory drilling	SO 3.1` SO 3.2 SO 3.3 SO 3.4 SO 3.5	3.1 3.2 3.3	Unit 3- Drilling system and equipment 3.1 ,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9	SL 3.1
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 4- Comprehending hydraulic power and its application in mining industry	SO 4.1 SO 4.2 SO 4.3 SO 4.4 SO 4.5	4.1	Unit 4- Hydraulics and hydraulic circuits 4.1 ,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12,	SL 4.1
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 5- Comprehending constructional features and operational details of HEMM	SO 5.1 SO 5.2 SO 5.3 SO 5.4 SO 5.5	5.1	Unit 5- HEMM & their constructional features 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	SL 5.1

Semester V

Course Code: MIN302/ MIN302-L

Course Title: Mine Ventilation & Environment-I

Pre-requisite: Students should possess fundamental knowledge of key aspects of underground mining.

Rationale: The students studying Mining engineering should possess fundamental knowledge of key aspects of underground mining, the different gases present in the mine air and the mine environment affected by mine gases, dust, temperature and their mitigation efforts necessary to comply with the statute.

Course Outcomes:

MIN302/ MIN302-L.1: Explain the necessity of ventilation in Coal and Metal mines.

MIN302/ MIN302-L.2: Explain air flow system

MIN302/ MIN302-L.3: Determine the effects of natural ventilation

MIN302/ MIN302-L.4: Illustrate about Mechanical ventilation

MIN302/ MIN302-L.5: Assess mine ventilation devices. Explain the necessity of ventilation in Coal and Metal mines

Scheme of Studies:

Code	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)	MIN302/ MIN302-L	Mine Ventilation & Environment-I	4	2	1	1	8	5

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

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

SW: 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

Code	Course Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment(PRA)						**End Semester Assessment**	**Total Marks**
			Class/Home Assignment5 number 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)
PCC	MIN302 / MIN302 -L	Mine Ventilation & Environment-I	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

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

MIN302/ MIN302-L.1: Explain the necessity of ventilation in Coal and Metal mines.

Approximate Hours

Item	AppXHrs
Cl	11
LI	4
SW	2
SL	1
Total	18

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 Identify why ventilation is necessary in underground. **SO1.2**Understand Mine Gases: Occurrence, properties, detection, measurement and monitoring; **SO1.3**Prescribe Methane layering; Methane drainage SO1.**4**Examine Influence of mine gases in general mine environment **SO1.**5 Evaluate the means of control of heat and humidity in mines. .	1.1 Different gases found in coal mines, metal mines and their permitted limits as per the mining regulations. Effect of these gases when found in excess. 1.2 Various types of Methanometer used in mines and their selection criteria.	Unit-1.0 Introduction to underground ventilation 1.1 Why ventilation is required in underground Coal and Metal mines 1.2 Mine Gases and their occurrence 1.3 Properties and detection of gases 1.4 Measurement and monitoring 1.5 Methane layering; Methane drainage 1.6 Influence of mine gases in general mine environment. 1.7 Sources of Heat and Humidity 1.8 Effect and control of heat and humidity in mines 1.9 Conditions of comfort 1.10 Cooling power of mine air 1.11 Mine air conditioning.	1. Physiological effects of heat and humidity

SW-1Suggested Sessional Work (SW):

a. Assignments:

i. Statutory provisions of mine air quality.

b. Mini Project:

i. Accidents due to inhalation of noxious fumes in mines.

MIN302/ MIN302-L.2: Explain air flow system

Approximate Hours

Item	ApproxHrs
Cl	12
LI	4
SW	2
SL	1
Total	19

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1 Explain statutory provisions of Standards of ventilation; **SO2.2**Recognize Laminar and turbulent flow **SO2.3**Explain Pressure losses due to friction and shock resistances; **SO2.4** Examine air quantity requirements. **SO2.**5 Assess Central and boundary ventilation	2.1 Measurement of relative humidity with the help of various types of hygrometer 2.2 Various air circuits with resistance in series and parallel.	Unit-2 Air Flow in Mine Workings 2.1 Standards of ventilation; 2.2 Reynold's number 2.3 Laminar and turbulent flow. 2.4 Pressure losses due to friction and shock resistances 2.5 Pressure across the mine 2.6Equivalent orifice of the mine; 2.7 Resistances in series and parallel; 2.8Air quantity requirements; 2.9 Leakages; 2.10 Homotropal and Antitropal ventilation 2.11 Central and boundary ventilation. 2.12 Network analysis.	i. Advisory provisions of statute regarding standard of ventilation

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Ventilation network

ii. Equivalent orifice numerical.

b. Mini Project:

Detailing the ventilation network of any underground mine.

MIN302/ MIN302-L.3: Determine the effects of natural ventilation

Approximate Hours

Item	AppXHrs
Cl	11
LI	4
SW	2
SL	1
Total	18

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO3.1Recall types of ventilation. **SO3.2** Determine natural ventilation pressure **O3.3prepare and interpret ventilation plans** **SO3.4Calculate air quantity** **SO3.**5 Analyze characteristic curves	3.1 Calculation for the installation of main ventilation fan and its reversal arrangement. 3.2 Designing auxiliary ventilation system and their comparative performance.	Unit-3:Natural Ventilation: 3.1 Mechanism of natural ventilation 3.2 Estimation and measurement of natural ventilation pressure 3.3 Characteristic curves 3.4 Ventilation survey and its purpose 3.5 Ventilation survey and instruments and procedure 3.6 Ventilation survey tabulation and calculation. 3.7 Numerical 1 3.8 Numerical 2 3.9 Numerical 3 3.10 Numerical 4 3.11 Numerical 5	**i.** Natural ventilation effects

SW-3Suggested Sessional Work(SW):

a. Assignments:

i) Describe the effects of natural ventilation.

ii) Procedure of ventilation survey

b. Mini Project:

Interpretation of ventilation plan

MIN302/ MIN302-L.4: Illustrate about Mechanical ventilation

Approximate Hours

Item	AppXHrs
Cl	15
LI	4
SW	2
SL	1
Total	22

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4.1Explainmechanical ventilation SO4.2Discuss centrifugal and axial flow fan SO4.3 Describe series and parallel operation of fans. SO4.4 Review forcing and exhaust fans. SO4.5 Develop rescue and recovery work in connection with fire, explosion. SO4.5 Illustrate auxiliary ventilation.	4.1Measurement of air velocity with the help of anemometer, velometer etc, measurement of temperature, pressure etc. 4.2 Ventilation survey problem.	**Unit-4:** Mechanical ventilation 4.1 Centrifugal fans 4.2 Axial flow fans 4.3Construction, pressure developed by fans 4.4 Characteristic curves, 4.5 series and parallel operations of fans 4.6 Installations and testing of fans 4.7 Forcing and exhaust fans 4.8 Fan drifts and evasees 4.9 Reversal of air flow 4.10 Longitudinal air curtains and brattices 4.11 Forcing and exhausting ventilation system 4.12 Auxiliary fans- types and construction 4.13 Characteristics and location. 4.14 Air ducts 4.15 Risk of re-circulation.	i. Auxiliary ventilation

SW-4Suggested Sessional Work(SW):

a. Assignments:

i. Discuss the necessity of installation in series and parallel

ii. Describe the facilities necessary for reversal.

b. Mini Project:

i. Determine the necessity of reversal of air flow.

MIN302/ MIN302-L.5: Assess mine ventilation devices. Explain the necessity of ventilation in Coal and Metal mines

Approximate Hours

Item	AppXHrs
Cl	11
LI	4
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Recall different ventilation devices. **SO5.2**Stopping, doors, air locks **SO5.3**air crossings and regulators **SO5.4**Regulators and boosters for the regulation of air flow. **SO5.**5Construction, location and installation of ventilation devices	5.1 Auxiliary fan numerical. 5.2 Networking numerical.	**Unit5:Ventilation Devices** 5.1 Stopping, doors, air locks 5.2 Stopping, doors, air locks 5.3 Regulators and boosters for the regulation of air flow 5.4 Construction, location and installation 5.5 effect on the air flow in the panel and the entire mine; 5.6 effect on the air flow in the panel and the entire mine; 5.7 Risk of re-circulation; 5.8 Controlled recirculation for ventilating extensive mine workings 5.9 Mine Dust – sources, prevention 5.10 control, standard of dustiness 5.11 dust survey and measurement.	1. Stopping, doors, air locks

SW-5Suggested Sessional Work (SW):

a. Assignments:

Precautionary measures of ventilation devices required as per statute.
Categorization of ventilation devices

b. Mini Project:
Statutory provisions of dust in mines.

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)
MIN302/ MIN302-L.1: Explain the necessity of ventilation in Coal and Metal mines.	11	4	2	1	18
MIN302/ MIN302-L 8.2:Explain air flow system.	12	4	2	1	19
MIN302/ MIN302-L.3: Determine the effects of natural ventilation	11	4	2	1	18
MIN302/ MIN302-L.4: Illustrate about Mechanical ventilation	15	4	2	1	22
MIN302/ MIN302-L.5: Assess mine ventilation devices	11	4	2	1	18
Total Hours	60	20	10	5	95

Suggestion for End Semester Assessment

Suggested Specification Table (ForESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Explain the necessity of ventilation in Coal and Metal mines.	03	01	01	05
CO-2	Explain air flow system	02	06	02	10
CO-3	Determine the effects of natural ventilation	03	07	05	15
CO-4	Illustrate about mechanical ventilation	03	07	05	15
CO-5	Assess mine ventilation devices	03	02	-	05
Total		14	23	13	50

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

The end of semester assessment for Mine Ventilation and Environment –I will be held with written examination of 50 marks.

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

Suggested Instructional/Implementation Strategies:

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

Suggested Learning Resources:

(a)Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Subsurface Ventilation Engineering	Malcolm J Mcpherson	Chapman and Hall	1993
2	Mine Disasters and Mine Rescue	M A Ramlu	The Orient Blackswan	2018
3	Mine Environment and ventilation	G B Misra	Oxford University Press	1998
4	Coal Mines Regulations 2017			

(a) Web link:

https://archive.nptel.ac.in/Harddisk/Direct_Download.html

https://epathshala.nic.in/

https://swayam.gov.in/

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Cos, Pos and PSOs Mapping

Program Title: B. Tech. Mining Engineering

Course Code: MIN302/ MIN302-L

Course Title: Mine Ventilation & Environment-I

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/developmentof solutions	Conductinvestigations ofcomplex problems	Modern toolusage	Theengineerand society	Environment and sustainability:	Ethics	Individualand teamwork:	Communication:	Projectmanagement andfinance:	Life-long learning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of mining engineering.
CO1: Explain the necessity of ventilation in Coal and Metal mines.	1	2	1	1	1	2	1	2	2	1	1	2	2	3	2	1
CO 2 Explain air flow system	1	1	2	2	1	2	3	2	1	1	2	2	2	1	2	1

CO3Determine the effects of natural ventilation	1	1	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO 4:Illustrate about mechanical ventilation	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO5:Assess mine ventilation devices	1	2	1	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning (SL)
PO1,2,3,4,5,67 ,8,9,10,11,12 PSO1,2,3,4	CO1 :. Explain the necessity of ventilation in Coal and Metal mines.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1,1.2	Unit-1.0Introduction to mine ventilation 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 2 Explainair flow system	SO2.1 SO2.2 SO2.3 SO2.4 SO25	2.1,2.2	Unit-2 Mine air flow 2.1,2.2,2.3,2.4,2.5,2.6,2.7, 2.8, 2.9, 2.10, 2.11, 2.12	SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO3Determine the effects of natural ventilation	SO3.1S O3.2 SO3.3 SO3.4 SO3.5	3.1,3.2	Unit-3 :Natural ventilation 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO 4:** Illustrate about Mechanical ventilation	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1,4.2	Unit-4:Mechanical ventilation 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8, 4.9,4.10, 4.11,4.12,4.13,4.14,4.15	SL 4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 5: Assess mine ventilation devices	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1, 5.2	Unit5:Ventilation devices 5.1,5.2,5.3,5.4,5.5, 5.6, 5.7,5.8,5.9,5.10,5.11	SL 5.1

Semester-V

Course Code: **ESC303/ESC303-L**

Course Title : **FLUID MECHANICS**

Pre-requisite: Students are expected to know the fundamentals of engineering mechanics, resolving of forces, Statics, Dynamics and flow kinematics.

Rationale: Fluid mechanics and hydraulics are core to engineering, offering vital insights into liquid and gas behavior for efficient system design across industries like power generation, aerospace, and infrastructure. Understanding fluid dynamics drives innovation, impacting energy, transportation, and environmental sectors globally, with applications reaching into fields like medicine and meteorology.

Course Outcomes:

ESC303/ESC303-L.1: Grasp fluid properties (density, viscosity, surface tension) and understand static principles (pressure laws, buoyancy).
ESC303/ESC303-L.2: Analyze fluid motion using Lagrangian/Eulerian methods, study flow lines and particle acceleration.
ESC303/ESC303-L.3: Apply Euler's/Bernoulli's equations, understand Venturimeter, Orifice meter, and implications of momentum equations.
ESC303/ESC303-L.4: Differentiate between laminar/turbulent flow, study pipe flow, energy losses, configurations, and pipe phenomena.
ESC303/ESC303-L.5: Master boundary layer theory, friction factors, and separation control, plus dimensional analysis methods and model laws in fluid dynamics.

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours(CI+LI+SW+SL)	
Program Core (PCC)	ME203	Fluid Mechanics	4	2	1	1	8	5

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

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

SW: 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

Code	Course Code	Course Title	**Scheme of Assessment(Marks)**							
			Progressive Assessment(PRA)						**End Semester Assessment**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	**(ESA)**	(PRA+ESA)
PCC	ESC303/ ESC303-L	Fluid Mechanics	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.

ESC303/ESC303-L.1 Grasp fluid properties (density, viscosity, surface tension) and understand static principles (pressure laws, buoyancy).

Approximate Hours

Item	AppX Hrs
Cl	13
LI	04
SW	01
SL	01
Total	19

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO1.1 Understand fluid characteristics like density, viscosity, and surface tension. SO1.2 Master pressure laws, buoyancy, and equilibrium in liquids. SO1.3 Apply fluid knowledge to solve real-world engineering challenges. SO1.4 Develop problem-solving skills in fluid statics scenarios. SO1.5 Use fluid principles for efficient system design across industries.	1.1 Determination of Metacentric Height of Flat bottomed pantoon. 1.2 Study of Pressure Gauge	1.1 Introduction to fluid mechanics 1.2 Properties of fluid: Mass density, Weight density. Specific volume, Specific gravity, Viscosity, Surface tension. 1.3 Numericals on properties of fluid. 1.4 Capillarity, Vapour pressure, Compressibility and bulk modulus. 1.5 Newtonian and non-Newtonian fluids. 1.6 Fluid statics: Pressure, Pascal's law 1.7 Hydrostatic law, 1.8 Pressure measurement 1.9Hydrostatic force on submerged plane 1.10 Hydrostatic force on curved surface 1.11 Buoyancy 1.12 Floatation, Liquid in relative equilibrium. 1.13 Tutorial 1	1. Solve a set of practice problems related to hydrostatic law to reinforce your probelm solving skills.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Explore and differentiate between Newtonian and non-Newtonian fluids. Provide real-world examples of each type and explain how their behavior diverges from conventional Newtonian fluid dynamics.

ii. Discuss the concept of pressure measurement in fluid systems. Explain at least three different methods of measuring fluid pressure and compare their advantages and limitations.

ESC303/ESC303-L.2: Analyze fluid motion using Lagrangian/Eulerian methods, study flow lines and particle acceleration.

Approximate Hours

Item	AppX Hrs
Cl	13
LI	06
SW	01
SL	01
Total	21

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO2.1 Understand Lagrangian/Eulerian approaches, various flow types, and characteristics of flow lines. **SO2.2** Grasp continuity equations, fluid particle motion, accelerations, rotational flow, vorticity, and circulation. **SO2.3** Apply knowledge to create and analyze flow nets, understanding their utility in fluid systems. **SO2.4** Explore vortex dynamics and its significance in fluid systems.	2.1 Determination of performance characteristics of centrifugal pump. 2.2 Determination of performance characteristics of Pelton wheel. 2.3 Study of different types of fluid flows	2.1Fluid Kinematics: Description of fluid motion, Lagrangian and Eulerian approach, 2.2Type of fluid flow, 2.3 Type of flow lines-path line, Streak line, Stream line, Stream tube 2.4 Continuity equation 2.5 Acceleration of a fluid particle 2.6 Motion of fluid particle along curved path 2.7 Normal and tangential acceleration 2.8 Rotational flow, Rotation 2.9 Vorticity, Circulation, 2.8 Stream and potential function, 2.10 Flow net, Its characteristics and utilities 2.11 Vortex motion. 2.12 Numerical On Vortex Motion. 2.13 Tutorial 1	1. Watch YouTube videos on Lagrangian and eulerian approach

SW-2 Suggested Sessional Work (SW):

a. **Assignments: a)** Explain the differences between the Lagrangian and Eulerian approaches in describing fluid motion. Provide examples to illustrate situations where each approach is more applicable and why.
b) Define laminar, turbulent, and transitional flow. Compare and contrast these types of flow, highlighting their characteristics and the factors influencing their occurrence. Provide real-world examples for each type of flow.

ESC303/ESC303-L.3: Apply Euler's/Bernoulli's equations, understand Venturimeter, Orifice meter, and implications of momentum equations.

Approximate Hours

Item	AppX Hrs
Cl	11
LI	08
SW	1
SL	1
Total	21

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO3.1 Grasp Euler's and Bernoulli's equations and their practical applications in fluid dynamics. SO3.2 Explore Venturimeter, Orifice meter, Nozzle, and Pitot tube functionalities in measuring fluid flow. SO3.3 Apply impulse momentum and momentum of momentum equations for fluid behavior analysis. SO3.4 Understand kinetic energy and momentum correction factors in fluid systems' energy analysis. SO3.5 Apply Reynold's transport theorem to understand property transport in flowing fluids.	3.1 Verification of Bernoulli's Theorem experimentally. 3.2 Determination of coefficient of Discharge of venturimeter. 3.3 To determine hydraulic Coefficients Cd, Cv and Cc of an Orifice. 3.4 Study of Reynolds transport theorem	3.1 Fluid dynamics: Euler's Equation 3.2 Bernoulli's equation and its practical application, 3.3 Venturimeter 3.4 Orifice meter 3.5 Nozzle 3.5 Pitot tube 3.6 Impulse momentum equation 3.7 Momentum of Momentum equation 3.8 Kinetic energy 3.9 Momentum correction factor. 3.10 Reynold's transport theorem 3.11 Tutorial 1.	1. Choose a real life example and demonstrate how Bernoulli's Equation can be applied to analyze the fluid mechanics.

SW-3 Suggested Sessional Work (SW):

a. Assignments: 1. Derive and explain the impulse momentum equation for a control volume. Discuss its significance in analyzing fluid flow problems and provide examples demonstrating its application.

ESC303/ESC303-L.4: Differentiate between laminar/turbulent flow, study pipe flow, energy losses, configurations, and pipe phenomena

Approximate Hours

Item	AppX Hrs
Cl	11
LI	08
SW	2
SL	1
Total	22

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4:1 Understanding flow transitions from Reynold's experiment to viscous fluid behavior in pipes. SO4:2 Exploring shear stress and pressure gradient in Couette flow for parallel plate systems SO4:3 Grasping energy loss in pipes, hydraulic gradient, and optimizing pipe configurations. SO4:4 Applying equivalent pipe power transmission and managing water hammer effects in pipes.	4.1 To determine the minor head loss coefficient of different pipe fittings. 4.2 Determine the Renyold's no in different flow conditions. 4.3 Determination of Coefficient of Discharge of Rectangular and Triangular Notch. 4.4 Study of fluid flow through pipes	4.1 Laminar & Turbulent flow: Reynold's experiment 4.2 F low of viscous fluids in circular pipe 4.3 Shear stress & velocity distribution for turbulent. 4.4 Shear stress and pressure gradient between two parallel plates 4.5 Couette flow 4.6 Flow through pipes: Loss of energy in pipes 4.7 Hydraulic gradient and total energy line 4.8 Pipe in series and parallel. 4.9 Equivalent pipe power transmission through pipe 4.10 Water hammer in pipes. 4.11 Tutorial 1	1. Explore the phenomenon of cavitation in fluid flow. Investigate the condition under which cavitation occurs, its effects on pipes and equipment, and methods to prevent or mitigate cavitation.

SW-4 Suggested Sessional Work (SW):

a. Assignments: i) Describe the characteristics of turbulent flow concerning shear stress and velocity distribution in a pipe. Compare and contrast these characteristics with those of laminar flow. Provide explanations supported by equations and graphical representations

b. **Mini Project:** i) Study the behavior of pipe configurations in series and parallel, measuring flow rates and pressure differences.

b) Simulate and analyze the occurrence and effects of water hammer in the pipe network.

ESC303/ESC303-L.5: Master boundary layer theory, friction factors, and separation control, plus dimensional analysis methods and model laws in fluid dynamics.

Approximate Hours

Item	AppX Hrs
Cl	12
LI	04
SW	01
SL	2
Total	19

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO5.1 Use Darcy-Weisbach and Moody's diagram for internal flow friction calculations. SO5.2 Differentiate laminar and turbulent layers, explore growth, and solutions for momentum layers. SO5.3 Solve equations, grasp momentum principles, and separation factors. SO5.4 Use Rayleigh's and Buckingham's methods for fluid behavior using dimensionless numbers. SO5.5 Explain Reynold's, Fraude's, Euler's, Weber's, and Mach's laws in predicting varied fluid behaviors.	5.1 Determination of Friction Factor ‘f’ for G.I pipes. 5.2 Study of Boundary Layer theory	5.1 Internal flows: Friction factor, Darcy- Weisbach friction factor 5.2 Moody's diagram 5.3 Boundary Layer theory 5.4 Boundary layer equation 5.5 Laminar and turbulent boundary layer and its growth over flat plat. 5.6 Momentum boundary layer and its solutions, separation of boundary layer and its control. 5.7 Dimensional analysis: Methods of dimensional analysis, Rayleigh's method 5.8 Buckingham's theorem, Limitations 5.9 Model analysis, Dimensionless number and their significance 5.10 Model laws, Reynolds model law, 5.11Fraude's model law, Euler's model law, Weber's model law, Mach's Model law. 5.12 Tutorial 1	1. Investigate methods to control and prevent boundary layer separation. 2. Investigate the limitations of dimensional analysis.

SW-5 Suggested Sessional Work (SW):

a. Assignments: i) Discuss real-world applications where understanding friction factors and boundary layer theory is crucial.

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)
ESC303/ESC303-L.1: Grasp fluid properties (density, viscosity, surface tension) and understand static principles (pressure laws, buoyancy).	13	4	1	1	19
ESC303/ESC303-L.2 : Analyze fluid motion using Lagrangian/Eulerian methods, study flow lines and particle acceleration.	13	6	1	1	21
ESC303/ESC303-L.3: Apply Euler's/Bernoulli's equations, understand Venturimeter, Orifice meter, and implications of momentum equations.	11	8	1	1	21
ESC303/ESC303-L.4: Differentiate between laminar/turbulent flow, study pipe flow, energy losses, configurations, and pipe phenomena.	11	8	2	1	22
ESC303/ESC303-L.5: Master boundary layer theory, friction factors, and separation control, plus dimensional analysis methods and model laws in fluid dynamics.	12	4	1	2	19
Total Hours	60	30	6	6	102

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Properties of Fluid and Fluid Statics	03	01	01	05
CO-2	Fluid Kinematics	02	06	02	10
CO-3	Fluid Dynamics	02	07	06	15
CO-4	Laminar and Turbulent Flow and Flow through Pipes	02	07	06	15
CO-5	Internal Flows and Dimensional Analysis	01	02	02	05
Total		10	23	17	50

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

The end of semester assessment for Process calculation 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. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
8. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition&Year
1	Fluid Mechanics & Hydraulic Machines	S.S. Rattan	Khanna Book Publishing	2019
2	Introduction to Fluid Mechanics,	P.J. Pritchard, A.T. McDonald and R.W. Fox	Wiley India	2012
3	“Fluid Mechanics	F.M. White	Tata McGraw Hill	2011
4	“Introduction to Fluid Mechanics and Fluid Machines	S. K. Som, G. Biswas and S. Chakraborty	Tata McGraw Hill	2017
5	A Textbook of Fluid Mechanics and Hydraulic Machines	R. K. Bansal	Laxmi Publication	2005
6	Mechanics of Fluids	Shames	McGraw Hill Book Co. New Delhi	1988

(b) Link https://nptel.ac.in/

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Cos, POs and PSOs Mapping

Course Title: B. Tech Mining Engineering

Course Code : ESC303/ESC303-L

Course Title: FLUID MECHANICS

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability:	Ethics	Individual and team work:	Communication:	Project management and finance:	Life-long learning	Mechanical System Design and Analysis	Manufacturing Processes and Automation	Computational Modeling and Simulation.	Product Innovation and Development
ESC303/ESC303-L.1: Grasp fluid properties (density, viscosity, surface tension) and understand static principles (pressure laws, buoyancy).	3	2	3	1	1	1	1	1	3	2	1	3	2	2	2	2
ESC303/ESC303-L.2 : Analyze fluid motion using Lagrangian/Eulerian methods, study flow lines and particle acceleration.	3	2	2	1	1	2	1	2	2	1	2	3	2	2	2	1

ESC303/ESC303-L.3: Apply Euler's/Bernoulli's equations, understand Venturimeter, Orifice meter, and implications of momentum equations.	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**1**	**1**	**2**	**1**	**2**	**2**	**1**	**2**	**2**
ESC303/ESC303-L.4: Differentiate between laminar/turbulent flow, study pipe flow, energy losses, configurations, and pipe phenomena.	**3**	**2**	**2**	**1**	**3**	**1**	**3**	**1**	**2**	**1**	**1**	**2**	**3**	**3**	**3**	**2**
ESC303/ESC303-L.5: Master boundary layer theory, friction factors, and separation control, plus dimensional analysis methods and model laws in fluid dynamics.	**2**	**2**	**2**	**1**	**1**	**1**	**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	ME 203.1 Grasp fluid properties (density, viscosity, surface tension) and understand static principles (pressure laws, buoyancy).	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1 1.2	Unit-1.0 Properties of Fluid and Fluid Statics 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 in page number 4 to 11
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	ME 203.2 Analyze fluid motion using Lagrangian/Eulerian methods, study flow lines and particle acceleration.	SO2.1 SO2.2 SO2.3 SO2.4	2.1 2.2 2.3	Unit-2 Fluid Kinematics 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10,2.11,2.12,2.13	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	ME 203.3: Apply Euler's/Bernoulli's equations, understand Venturimeter, Orifice meter, and implications of momentum equations.	SO3.1SO3.2 SO3.3SO3.4 SO3.5	3.1 3.2 3.3 3.4	Unit-3 : Fluid Dynamics 3.1, 3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	ME 203.4: Differentiate between laminar/turbulent flow, study pipe flow, energy losses, configurations, and pipe phenomena.	SO4.1 SO4.2 SO4.3 SO4.4	4.1 4.2 4.3 4.4	Unit-4 :laminar and turbulent flow and flow through pipes 4.1, 4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	ME 203.5: Master boundary layer theory, friction factors, and separation control, plus dimensional analysis methods and model laws in fluid dynamics.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1 5.2	Unit 5: Internal flows and dimensional analysis 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11,5.12	

Semester V

Course Code: MIN304/ MIN304-L

Course Title : ROCK MECHANICS & STRATA CONTROL

Pre-requisite: Student should have basic knowledge of Rocks, Minerals, stress & strain

Rationale: The students studying rock mechanic should possess foundational understanding about behavior of rock under stress and strain and geology of rock mass and intact rock. . This will help in understanding and design of support system, monitoring slope stability, designing blasting pattern, suitable equipment to cope existing condition of mine .etc. Additionally, students will learn to test the rock specimen in laboratory..

Course Outcomes:

MIN304/ MIN304-L.**1:** Classify and interpret different types stresses in rock- mass.
MIN304/ MIN304-L.**2:** Acquire the knowledge of geological investigation of rock mass, classification, identification and survey of joints.
MIN304/ MIN304-L.**3:** Analyse and classify the rock behavior from laboratory testing and find out RMR, RQD, Q-system from the given data.
MIN304/ MIN304-L.**4:** Apply RMR to design support system of mine. Install instruments to assess the in situ stresses.
MIN304/ MIN304-L.**5:** Use different theories of rock failures, dynamic properties of rock mass in analyzing slope stability of waste dump.

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours(CI+LI+SW +SL)	
Program mining engineering	MIN304/ MIN304-L	ROCK MECHANICS & STRATA CONTROL	4	2	1	1	8	5

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

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

Scheme of Assessment:

Theory

Code	Course Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT +AT)		(PRA+ ESA)
RM	MIN304/ MIN304-L	ROCK MECHANICS & STRATA CONTROL	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.

MIN304/ MIN304-L :1 Understand the use of rock mechanics in mining engineering

Approximate Hours

Item	App Hrs
Cl	11
LI	4
SW	2
SL	1
Total	18

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 Classify and interpret different types stresses in rock mass . **SO1.2** Acquire the knowledge principal stress and its application. . **SO1.3** Analyse and determine the hardness of rock mass. **SO1.4** Apply to find out tensile stress of rock mass. **SO1.5 :** Use different mechanical properties of intact rock and rock mass .	1. Preparation of of core samples as per ISRM standards 2. Determination of compressive strength and point load index of given rock samples .	**Unit-1.0** role and status of roc k mechanics in mining engineering 1.1 Role and status of rock mechanics in mining engineering 1.2 Definitions& terms used in Rock Mechanics. 1.3 Stresses and Strains. 1.4 Stresses in two and three dimensions t. 1.5 : Stresses in two and three dimensions; Stress tensors, principal stresses , stress invariants 1.6.Displacements and strains 1.7 Stress-Strainrelations; 1.8. Equilibrium and compatibility equations. 1.9 Numerical 1.10 Problem 1 1.11Problem 2	1. Properties of stress and stress tensor Type's stresses, principal stress, strain etc. Details of Q-Barton's system Targezi ,s system CMRMR

SW-1 Suggested Sessional Work(SW):

a. Assignments:

i. Q-Barton's system, determination of RMR from given data ,

b. Mini-Project:

i. Prepare PPT for rock mass classification

MIN304/ MIN304-L **:2 Acquire knowledge of different types of stresses in rock mass**

Approximate Hours

Item	App. Hrs
Cl	11
LI	4
SW	2
SL	1
Total	18

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1 To apply joint and its effect in mining **SO2.2**To interpret classification of rock mass. **SO2.3**To represent joint in stereonet system. **SO2.4**To indentify and surveys the joints. **SO2.**5 To use the knowledge in determination of RMR.	1. Measurement of Schmidt rebound hardness and its application 2. Determination of slake durability index of given rock samples .	**Unit -2.0** Geological Investigation of Rock mass: 2.1 Classification of rock mass 2.2 Identification and survey of joints 2.3 Basic geological description of rock mass; 2.4 Graphical representation of joint systems 2.5 Stereo nets types 2.6 Stereo net projections 2.7 Stereo net projection and plotting 2.8Geophysical investigation of rock mass.. 2.9Impact of discontinuities on rock engineering projects. 2.10.Orientation ,spacing , persistence,, roughness 2.11Wall strength ,aperture ,filling ,	1. Classification of rock mass.

SW-2 Suggested Sessional Work(SW):

a. Assignments:

ii. Physical, Chemical and Mineralogical properties of Cement Grade Limestone

iii. Chemical properties of Clay, Laterite, Bauxite , Irion ore and Gypsum

b. Mini Project:

Marking of major limestone belts in India map

MIN304/ MIN304-L.**3:** Gain an understanding of the various types of cement manufactured in India and their utilization in infrastructure development**.**

Approximate Hours

Item	App .Hrs
Cl	14
LI	4
SW	2
SL	1
Total	21

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO3.1 Determine RQD from given data. **SO3.2** Find out Q-Barton from given data. **SO3.3** Interpret porosity and its effect on the strength of rock. **SO3.4** Determine slake durability of rock mass. **SO3.**5 To calculate RMR from given field data	1. . Determination of elastic properties of given rock samples 2. Determination of tensile strength of given rock samples by Brazilian test	Unit -3.0 Rock mass classification 3.1 RQD, RSR 3.2 RMR, 3.3 Q-system Rock Indices 3.4 Specific gravity, 3.5Hardness, 3.6 Porosity 3.7 Moisture content, 3.8 Permeability, 3.9 Swell index, Slake durability, 3.10 Thermal conductivity 3.11 Point load strength index, 3.12 Protodyakonov Strength Index(PSI) 3.13Impact strength index. 3.14 numerical 1	i. Q-Barton system and its application in designing support system in depillaring district of coal mine.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

iv. Physical, Chemical of OPC, PPC and PSC as per BIS
v. Advantages of use of PPC in construction.
vi. Properties and use of low heat cement in construction.

b. Mini Project:

Make a tale containing BIS code of various Cement produced in India and Broad Specification and its application.

MIN304/ MIN304-L.**4:** Familiarize with a concise overview of the cement manufacturing process.

Approximate Hours

Item	App. Hrs
Cl	11
LI	4
SW	2
SL	2
Total	19

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4.1 Comparing mechanical properties of Rock mass **SO4.2** Calculating modulus of different types of modulus from Poisson's ratio. **SO4.3** Calculating strain from stresses and Poisson's ratio **SO4.4** Calculate Poisson's ratio. **SO4.**5 Analyse plane slope failure	1. Determination of shear strength and tri-axial properties of rock 2. Measurement of core recovery and RQD from the various data collected	Unit -4.0 Mechanical Properties of Rocks 4.1 Compressive, tensile and shear strengths; 4.2 Modulus of elasticity; 4.3 Bulk modulus 4.4 Modulus of rigidity 4.5 Relation between E,K, G 4.6 Poisson's ratio and tri-axial strength 4.7 Field and laboratory determination of tri-axial strength. 4.8Determination of in- situ strength and in situ stresses 4.9 Methods and instrumentation. 4.10 Tutorial classes on modulus of elasticity, bulk modulus ,modulus of rigidity 4.11Tutorials on stress determination and Poissios ratio	i. Modulus of elasticity and its application. ii. Determination of strength of rock mass.

SW-4 **Suggested Sessional Work(SW):**

a. Assignments:

i. Write Thermo-Chemical Reaction occurred during clinker formation

ii. Describe briefly the dry process cement manufacture

c. Mini Project:

i. Visit to a cement a cement plant and writing a report.

MIN304/ MIN304-L.5: Comprehend the functions of different regulatory bodies in India that oversee the production and quality of cement.

Item	App Hrs
Cl	13
LI	6
SW	2
SL	1
Total	22

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO5.1 Apply theory of rock failure . **SO5.2 Apply knowledge to classify soils.** **SO5.3** Use elastic and time dependent properties of rock. **SO5.4 Design slope of waste dump.** **SO5.5** Monitoring of slope stability by instrumentation .	1. Determination of RMR of given field data 2. Determination of Protodyakonov index of given rocks 3. Determination of Schmidt hammer rebound number of various rocks	**Unit -5.0** Theories of rock failure 5.1 Elastic and time dependent properties of rocks 5.2 Dynamic properties , Post-failure phenomenon; 5.3 Soil Mechanics , Classification of soils; Strength 5.4 Consolidation and seepage of soils; 5.5 Stability of waste dumps 5.6 Factors affecting, monitoring and control measures. 5.7 Stress 5.8 Strain 5.9 Numerical 5.10 Problem 5.11 Case study 5.12 Numerical 2 5.13 Numerical 3 .	**1.** Case study of slope failure of Rajmahal OCP of ECL.

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. Explain different theories of rock failure.

ii. Explain factors affecting stability of waste dump

b. Mini Project:

Design of benches and learning use of FLAC

.

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)
MIN304/ MIN304-L.**1:** Role and status of rock mechanics in mining engineering.	11	4	2	1	18
MIN304/ MIN304-L.**2:** geological investigation of rock mass for geological description of rock mass	11	4	2	1	18
MIN304/ MIN304-L.**3:** classification of rock mass to find out RMR, RQD, RSR, Q-system.	14	4	2	1	21
MIN304/ MIN304-L.**4:** finding mechanical properties of Rocks	11	4	2	2	19
MIN304/ MIN304-L.**5:** Analyzing rock failure and designing slope and waste dump	13	6	2	1	22
Total Hours	60	22	10	6	98

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Understand the importance of rock mechanics in mining.	03	01	01	05
CO-2	Classify geological description of rock mass	02	06	02	10
CO-3	Apply RQD, RSR,RMR,Q-BARTON SYSTEM in support design .	03	07	05	15
CO-4	Utilise mechanical properties of rocks and in-situ strength in mining	-	10	05	15
CO-5	Use rock failure theories in understanding the stability features of waste dump and design.	03	02	-	05

Total	11	26	13	50

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

The end of semester assessment for Rock Mechanics and Strata Control 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. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
8. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Fundamentals and application of Rock Mechanics	Deb Debasis and Verma Abhiram Kumar	PHI Learning Pvt Ltd	2016
2	The Elements of Mechanics of Mining Ground	Verma B.S.	Tuhin &Co.	1981

Link

https://nptel.ac.in/

Cos, Pos and PSOs Mapping

Program Title: B. Tech. Mining Engineering

Course Code: MIN304/ MIN304-L

Course Title: Rock Mechanics & Strata Control

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/ development of solutions	Conduct investigations of complex problems	Modern Tool usage	The engineer and society	Environment and sustain ability:	Ethics	Individual and teamwork:	Communication:	Project management And finance:	Life-long learning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution mana	Development of the base for innovation & research in the field of mining engineering.
CO1 Understand the importance of rock mechanics in mining.	1	2	1	1	1	2	1	2	2	1	1	2	2	3	2	1
CO-2 CLASSIFY GEOLOGICAL DESCRIPTION OF ROCK MASS	1	1	2	2	1	2	3	2	1	1	2	2	2	1	2	1

CO3 Apply RQD, RSR,RMR,Q-BARTON SYSTEM in support design .	1	1	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO 4 Utilise mechanical properties of rocks and in-situ strength in mining .	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO 5 Use rock failure theories in understanding the stability features of waste dump and design.	1	2	1	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,67,8,9,10,11,12 PSO1,2,3,4	CO-1 Understand the importance of rock mechanics in mining.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1,1.2	Unit-1.0 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO- 2 CLASSIFY GEOLOGICAL DESCRIPTION OF ROCK MASS	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1,2.2	Unit-2 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9,2.10,2.11	SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-3 Apply RQD, RSR,RMR,Q-BARTON SYSTEM in support design .	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1,3.2	Unit-3 : 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11 3.12,3.13,3.14	SL3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-4. Utilise mechanical properties of rocks and in-situ strength in mining .	SO4.1 SO4.2 SO4.3 SO4.4, SO4.5	4.1,4.2	Unit-4: 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11	SL4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO -5 Use rock failure theories in understanding the stability features of waste dump and design.	SO5.1 SO5.2 SO5.3 SO5.4	5.1,5.2	Unit5: 5.1,5.2,5.3,5.4,5.5, 5.6,5.7,5.8,5.9,5.10, 5.11,5.12	SL5.1

Semester-V

Course Code: **PEC-MIN05/PEC-MIN05-L**

Course Title : **Mine Electrical Engineering**

Pre-requisite: Students should have basic knowledge of electrostatics & electromagnetic Physics, Mathematics, the fundamental acknowledgment of semiconductor devices, and protecting devices.

Rationale: A process of introducing formal knowledge of electrical machine principles, construction, and working of various transformers and D.C. machines, Induction Machines, and Synchronous machines with power semiconductor devices, distribution of power in mines, and protection systems. The various conservation acts will be discussed in this scheme with the safety measures.

Course Outcomes:

PEC-MIN05/PEC-MIN05-L.1: Understand the principle, working, and performance characteristics of DC generators and performance characteristics of DC motors with various speed control methods and Starters for DC machines.

PEC-MIN05/PEC-MIN05-L.2: Analyse the Construction and working of a three-phase Induction Motors, the basic concept of single-phase Induction Motors. The discussion about the construction and working of the Synchronous Machine will be done with their respective applications.

PEC-MIN05/PEC-MIN05-L.3: Understand the Electrical Drives and Power Semiconductor devices with the knowledge of the communication interference in mines.

PEC-MIN05/PEC-MIN05-L.4: Understand the protection schemes in mines and power distribution with power economics.

PEC-MIN05/PEC-MIN05-L: 5Acknowledge energy conservation in different scenarios and electrical safety.

Scheme of Studies:

Code	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)	PEC-MIN05/PEC-MIN05-L	Mine Electrical Engineering	4	2	1	1	8	5

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

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

SW: 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

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+AT)		
PCC	PEC-MIN05/PEC-MIN05-L	Mine Electrical Engineering	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

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

PEC-MIN05/PEC-MIN05-L.1: Understand the principle, working, and performance characteristics of DC generators and performance characteristics of DC motors with various speed control methods and Starters for DC machines.

Approximate Hours

Item	AppX Hrs
Cl	14
LI	10
SW	2
SL	1
Total	27

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 To attain the knowledge of the constructional details and working of DC Generator and motor with the basic information of principles of operation. **SO1.2**Derive the E.M.F. equation of the DC Machine. **SO1.3** Gaining knowledge about various DC Machines with performance criteria. **SO1.4**To Understand the starting methods of DC motor and performance attributes, with the knowledge of various speed control methods.	1. Study the constructional details of dc machine. 2. Study the starting techniques of DC machine. 3. Study the speed control methods of DC machine. 4. Obtain magnetizing and load characteristics of DC shunt machine. 5. Obtain load characteristics of DC Series motor.	**Unit-1:DC Machines** 1.1 Construction 1.2 Working (generator & motor) 1.3 EMF equation 1.4 Magnetizing Characteristics and Load Characteristics DC Generator 1.5 Starting of DC Motor 1.6 Speed/Current/Torque Characteristics of DC Series Motor 1.7 Speed Control Methods 1.8 Numerical 1.9 Problem 1.10 Problems 1 1.11 Problems 2 1.12 Problems 3 1.13 Problems 4 1.14 Problems 4	1. Understand the various concepts of DC Machines.

SW-1 Suggested Sessional Work(SW):

a. Assignments:

i. Solve numerical problems based on the DC machine's EMF equation, Performance characteristics, and speed control methods.

b. Mini Project:

i. Draw the basic diagrams of various machine circuits with theory.

PEC-MIN05/PEC-MIN05-L.2: Analyse the Construction and working of a three-phase Induction Motors, the basic concept of single-phase Induction Motors. The discussion about the construction and working of the Synchronous Machine will be done with their respective applications.

Approximate Hours

Item	AppX Hrs
Cl	15
LI	12
SW	2
SL	1
Total	30

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO2.1 To Understand the Construction and Working of Induction Machine. **SO2.2** Draw the equivalent diagrams of the Induction Machine. **SO2.3**To understand the speed, and torque-slip characteristics of Induction machines. **SO2.4** To understand the basic concept of single-phase Induction Machines. **SO2.5**To understand the construction and working of Alternators. **SO2.6** Derive the EMF Equation of Synchronous Machine. **SO2.7**To understand the voltage regulation and concept of synchronization. **SO2.8** To understand the working and applications of synchronous Motor.	1. Study the Constructional details of three-phase Induction machine. 2. Study the starting methods of three-phase Induction Machine. 3. Obtain no load, on load and full load characteristics of Induction motor. 4. Study the Constructional details of three-phase Synchronous machine. 5. Perform open circuit and short circuit test on Synchronous machine. 6. Determine the efficiency of three-phase Induction machine	**Unit-2Induction Machine, and Synchronous Machine** 2.1 Construction 2.2 Working 2.3 Equivalent Diagram 2.4 Concept of Slip and Torque- Slip Characteristics 2.5 Basic Concept of Single-Phase Induction Motor 2.6 Alternator: Construction, working 2.7 EMF Equation 2.8 Voltage Regulation 2.9 Concept of Synchronization 2.10 Synchronous Motor's Construction &Working 2.11 application as a condenser and as a reactor 2.12 Numerical 2.13 Problems 2 2.14 Case study 2.15 Solution	1. Learn and gain knowledge of Induction and Synchronous Machine.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Numerical Problems on EMF and Torque Equations.

ii. Numerical Problems of Performance Characteristics.

b. Mini Project:

a. Draft the Induction Machine Construction.

PEC-MIN05/PEC-MIN05-L.3: Electrical Drives and Power Semiconductor Controller, and signalling& communication.

Approximate Hours

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

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO3.1 To Understand the Power Semiconductor Devices. **SO3.2**To Understand the basicprinciples of operation of thyristor-controlled variable speed mine electrical drives. **SO3.3** To Understand the selection of the motors, and starters in mines for suitable operation and safety. **SO3.4**To Understand the Concept of Electrical Braking.	1. Study about the different types of semiconductor devices. 2. Study about the underground cables. 3. Study the concept of electrical braking.	**Unit-3:Electrical Drives and Power Semiconductor Controller, and signaling & communication.** 3.1 Introduction to power semiconductor devices 3.2 basic principles of operation of thyristor controlled variable speed mine electrical drives 3.3 Selection of motors and starters for mining applications 3.4 Electrical braking 3.5 Haulage and Coal face signaling systems for underground coal mines 3.6 Basic Concept of Underground Mine Communication 3.7 case study	1. To enhance the knowledge about power electronics, and communication engineering applications in mines.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Numerical Problems on semiconductor analogy.

b. Mini project:

Case study

PEC-MIN05/PEC-MIN05-L.4: Understand the protection schemes in mines and power distribution with power economics.

Approximate Hours

Item	AppX Hrs
Cl	13
LI	02
SW	2
SL	1
Total	18

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO4.1 To study the different types of Distribution Circuits. **SO4.2**To Understand the arrangement of Substation in various conditions. **SO4.3**To Study the distribution of power in mines **SO4.4**To understand the different types of electrical faults **SO4.5** To understand the working of circuit breakers. **SO4.6** To study the different types of Relays. **SO4.7** To analyze the power economics phenomenon.	1. Study different types of relays.	**Unit-4:Power Distribution in Mines, the Use of Switchgear and Protective Devices in Mines, and Power Economics** 4.1 Radial and Ring–main distribution systems 4.2 Substation arrangements for opencast and underground mines 4.3 Distribution of electrical power in mines 4.4 Mining type cable and its testing 4.5 Types of Electrical Faults 4.6 Types of circuit breakers 4.7 Gate end box 4.8 Drill panel 4.9 Thermal and induction disc type overload relays: mining type earth fault relay 4.10 Types of Industrial Tariffs 4.11 power factor improvement in mines. 4.12 Numerical 4.13 Problems	1. Make Well-Organized Notes on All Concepts of Power Semiconductor Devices including different protection schemes and power economics.

SW-4 Suggested Sessional Work (SW):

a. Assignments:

Draw the symbolic notation and circuit diagram of Power Semiconductor Devices and Protection Devices.

b. **Mini project:**

DC motor

PEC-MIN05/PEC-MIN05-L: 5 Acknowledge energy conservation in different scenarios and electrical safety.

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 Describe the efforts made in the field of energy conservation. **SO5.2**To Understand the Energy Conservation Acts. **SO5.3** Getting the information about the Bureau of Energy Efficiency of India. **SO5.4**To study the Energy Audit.		**Unit 5: Energy Conservation** 5.1 Energy Conservation Efforts 5.2 Energy Conservation Act 5.3 Bureau of Energy Efficiency in India. 5.4 Energy Audit. 5.5 DC Motor 5.6 AC motor 5.7 DC ciruiot 5.8 Induction Motor 5.9 Numerical 5.10 Numerical 1 5.11 Problems	1. To ensure Complete notes of the chapter.

SW-5 Suggested Sessional Work (SW):

a. Assignments:

Make the tabular list of Energy Conservation Acts.

b. Mini Project:

Define the Energy Audit under different Conditions.

Brief of Hours Suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Lab Lecture (Ll)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
PEC-MIN05/PEC-MIN05-L.1: Understand the principle, working, and performance characteristics of DC generators and performance characteristics of DC motors with various speed control methods and Starters for DC machines.	14	10	2	1	27
PEC-MIN05/PEC-MIN05-L.2: Analyse the Construction and working of a three-phase Induction Motors, the basic concept of single-phase Induction Motors. The discussion about the construction and working of the Synchronous Machine will be done with their respective applications.	15	12	2	1	30
PEC-MIN05/PEC-MIN05-L.3: Electrical Drives and Power Semiconductor Controller, and signalling& communication.	7	6	2	1	16
PEC-MIN05/PEC-MIN05-L.4: Understand the protection schemes in mines and power distribution with power economics.	13	2	2	1	18
PEC-MIN05/PEC-MIN05-L: 5 Acknowledge energy conservation in different scenarios and electrical safety.	11	0	2	1	14
Total Hours	60	30	10	5	105

Suggestion for End Semester Assessment

Suggested Specification Table(For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	DC Machine	02	05	05	12
CO-2	Induction Motor and Synchronous Machine	03	06	05	14
CO-3	Electrical Drives and Power Semiconductor Controllers, and Communication and signaling	02	03	05	10
CO-4	Power Distribution in Mines, Mining type switchgear and Protective Devices, Power Economics.	03	02	04	09
CO-5	Energy Conservation	01	02	02	05
	Total	11	18	21	50

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

The end-of-semester assessment for mine electrical engineering will be held with the written examination of 50 marks.

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

Course Curriculum Team:

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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 the electrical power plant
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter, WhatsApp,Mobile,Onlinesources)
9. Brainstorming

Suggested Learning Resources:

(a) **Books**:

S.No.	Title	Author	Publisher	Edition&Year
1	Electrical Machines	I.J. Nagrath & D.P.Kothari	Tata McGraw-Hill	Fourth-2018
2	Electrical Machines	Husain Ashfaq	Dhanpat Rai & Sons	Third-2016
3	Electrical Machinery	P.S.Bimbhra	Khanna Publisher	Seventh-2011
4	Electric Machinery	A.E. Fitzgerald, C.Kingsley Jr, and Umans	McGraw-Hill	Sixth-2002
5	Electric Machine and Transformers	Irving L., Kosow	Prentice Hall of India	Second-1991
6	The Performance and Design of AC machines	M.G. Say	Pitman& Sons	First-2005
7	Electrical Engineering in Mines	N.K. Dutta	New Central Book Agency Ltd.	First-2007
8	Electrical Drives	G.P. Dubey	Narosa	Second-2010
9	Electricity in Underground Mines	P.K. Chakravorti	CMPDIL Publications	

(b) Link https://nptel.ac.in/

Cos, POs and PSOs Mapping

Program Title: B. Tech. Mining Engineering
Course Code: PEC-MIN05/PEC-MIN05-L
Course Title: Mine Electrical Technology

Course Outcomes	Program Outcomes												Program Specific Outcome	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
	Engineering knowledge	Problem Solving	Design Skills	Laboratory Skills	Teamwork	Communication Skills	Ethical and Professional Behavior	Lifelong Learning	Global and Societal Impact	Project Management	Adaptability	Professional Development	Apply Electrical and interdisciplinary knowledge to analyze, design and manufacture products to address the needs of the society.	Apply state of the art tools and techniques to conceptualize, design and introduce new products, processes, systems and services.
CO1: Apply network theorems to solve electrical DC circuits.	2	2	3	2	2	1	1	1	2	1	1	2	2	2
CO2: Understand the concept of sinusoidal quantities and solve single phase AC circuits.	2	2	1	3	1	2	1	1	1	1	2	2	2	2
CO3:Analyze the three phase AC circuits and solve series and parallel magnetic circuits.	3	3	2	1	1	2	2	2	1	1	2	3	1	2
CO 4: Understand the basic operating principle, types, efficiency of Transformers.	2	3	3	2	3	2	1	3	2	1	2	2	3	3
CO 5: Understand the basic operating principle, types of machines.	2	3	3	1	2	3	2	3	1	2	2	2	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	CO-1: Apply network theorems to solve electrical DC circuits.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1, 2, 3, 4, 5	Unit-1: DC Network 1.1, 1.2, 1.3, 1.4, 1.5, 1.6,1.7,1.8,1.9,1.10,1.11,1.12,1.13,1.14	SL 1.1
PO:1,2,3,4,5,6,7,8,9,10,11,12 PSO 1, 2	CO-2: Understand the concept of sinusoidal quantities and solve single phase AC circuits.	SO2.1 SO2.2 SO2.3 SO2.4	1, 2, 3, 4, 5, 6	Unit-2: Single-Phase AC Circuit 2.1,2.2,2.3,2.4,2.5,2.6, 2.7, 2.8, 2.9,2.10,2.11,2.12,2.13,2.14,2.15	SL 2.1
PO:1,2,3,4,5,6,7,8,9,10,11,12 PSO 1, 2	CO-3: Analyze the three phase AC circuits and solve series and parallel magnetic circuits.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	1, 2, 3	Unit-3 :Three-Phase AC Circuit 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7	SL 3.1
PO:1,2,3,4,5,6,7,8,9,10,11,12 PSO 1, 2	CO-4: Understand the basic operating principle, types, efficiency of Transformers.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5 SO4.6	1	Unit-4:Single-Phase Transformer 4.1, 4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10, 4.11, 4.12, 4.13	SL 4.1
PO:1,2,3,4,5,6,7,8,9,10,11,12 PSO 1, 2	CO-5: Understand the basic operating principle, types of machines.	SO5.1 SO5.2 SO5.3 SO5.4	0	Unit 5: DC Machines 5.1,5.2,5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9,5.10,5.11	SL 5.1

Semester V

Course Code: PROJ-MIN01

Course Title: Semester Break Training Seminar

Pre-Requisite: The student should have basic knowledge about the surface mining and underground mining.

Rationale: The student studying mining engineering should develop fundamental understanding about the scope and application of theoretical machines operations, blasting operations, mine safety and productions systems.

Course Outcome:
The student
- PROJ-MIN01-L.1- will garner an insight into the theoretical aspects of surface mining operations.
- PROJ-MIN01-L.2- Understanding the principles of heavy earth moving machineries.
- PROJ-MIN01-L.3-Will develop complete knowledge and understanding of the explosive parameters.
- PROJ-MIN01-L.4 -Will comprehend the technical aspects the underground mine safety.
- PROJ-MIN01-L.5- Will garner an understanding about the need for adopting specific types of drilling operations.

Scheme of studies:

Code	Course code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total study Hours (CI+LI+SW+SL)	
SEM	PROJ-MIN01	Semester Break Training Seminar	0	2	1	1	4	1

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

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

Scheme of Assessment:
Practical

Code	Course Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA + ESA)
			Class Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+ SA+CAT +AT)		
SEM	PROJ-MIN01	Semester Break Training Seminar	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.

PROJ-MIN01-L.1- will garner an insight into the theoretical aspects of surface mining operations.

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	0
Laboratory Instructions (LI)	4
Sessional work (SW)	1
Self Learning	1
Total	6

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO 1.1- Define the drill machine with diagram. SO 1.2- Understand the principle of drill machine. SO 1.3- Understand the performance of different type of drill machine.	1.1 Describe the surface drill machine. 1.2 Describe the drill bit with diagram.		1.1 Explain the drill machine.

Suggested Sessional works:
a. Assignments:
Explain the drill bit.

PROJ-MIN01-L.2- Understanding the principles of heavy earth moving machineries.

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	0
Laboratory Instructions (LI)	4
Sessional work (SW)	1
Self Learning	1
Total	6

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO 2.1-Explain the HEMM. SO 2.2- Understand the type of HEMM. SO2.3- Understand the diagram of HEMM.	2.1 Define the HEMM and types. 2.2 Explain the HEMM with diagram.		1. Describe HEMM.

Suggested Sessional works: a. Assignments:
(i) Explain the HEMM in Surface mining.

PROJ-MIN01-L.3-Will develops complete knowledge and understanding of the explosive parameters.

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	0
Laboratory Instructions (LI)	4
Sessional work (SW)	1
Self Learning	1
Total	6

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO3.1- Define Explosive use in mining. SO3.2- Understand the categories of explosive. SO3.3- Understand the explosive properties.	3.1 Explosive use in mining. 3.2 Types of explosive use in mining.		a) Categories the explosive.

Suggested Sessional works: a. Assignments:

a) Write down the explosive use in mining.

PROJ-MIN01-L.4 -Will comprehend the technical aspects the underground mine safety.

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	0
Laboratory Instructions (LI)	4
Sessional work (SW)	1
Self Learning	1
Total	6

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO4.1- Understand the mine safety. SO4.2- Understand the types of safety apparatus. SO4.3- Describe the rescue apparatus.	4.1 safety apparatus. 4.2 Rescue apparatus.		1. Explain the mine safety.

Suggested Sessional works: a. Assignments:

1. Rescue apparatus use in underground mining.

PROJ-MIN01-L.5- Will garner an understanding about the need for adopting specific types of drilling operations.

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	0
Laboratory Instructions (LI)	4
Sessional work (SW)	1
Self Learning	1
Total	6

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO5.1-Understanding the term “drilling operations. SO5.2- SO5.3-	5.1 Describe the drilling operations use in mining. 5.2 Describe the drill performance use in mining.		1. Explain the drilling operations in mining.

Suggested Sessional works:

a. Assignments:

Review of drilling operations.

Brief of Hours suggested for the course outcome:

Course outcomes	Class Lectures (CL)	Laboratory Instructions (LI)	Sessional work (SW)	Self Learning (SL)	Total Hour (CL+LI+SW+SL)
PROJ-MIN01-L.1- will garner an insight into the theoretical aspects of surface mining operations.	0	4	1	1	6
PROJ-MIN01-L.2- Understanding the principles of heavy earth moving machineries.	0	4	1	1	6
PROJ-MIN01-L.3-Will develops complete knowledge and understanding of the explosive parameters.	0	4	1	1	6
PROJ-MIN01-L.4 -Will comprehend the technical aspects the underground mine safety.	0	4	1	1	6
PROJ-MIN01-L.5- Will garner an understanding about the need for adopting specific types of drilling operations.	0	4	1	1	6
Total Hours	0	20	5	5	30

Suggestions for End semester Assessment:

Suggested Specification Table

Cos	Unit Titles	Marks Distribution			Total; Marks
		R	U	A	
CO 1	will garner an insight into the theoretical aspects of surface mining operations.	3	3	1	7
CO 2	Understanding the principles of heavy earth moving machineries.	3	4	3	10
CO 3	Will develops complete knowledge and understanding of the explosive parameters.	3	5	5	13
CO 4	-Will comprehend the technical aspects the underground mine safety.	3	5	5	13
CO 5	Will garner an understanding about the need for adopting specific types of drilling operations.	2	3	2	7
	Total	14	20	16	50

Legend: R-Remember U-Understand A-Apply

The end of semester assessment for semester break training seminar will be held with written examination of 50 marks

Suggested Instructional/ Implementation Strategies:

1. **Improved lectures**
2. Tutorial
3. Case studies
4. Group discussion
5. Role play
6. Visit to mining industries
7. Demonstration
8. Digital media application in teaching learning process and mass media
9. Brainstorming

Suggested Learning Resources

Sl. No	Title	Author	Publisher	Edition & Year
1.	Mining and Environmental Sustainability	Prof. G. S. Roonwal	Daya publishing house	2014

(b) Link https://nptel.ac.in

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COs, POs & PSO Mapping

Program Title: B. Tech (Mining Engineering)
Course Code: PROJ-MIN01-L.
Course Title: Semester Break Training Seminar.

	Program Outcomes						Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
Course Outcome	Develop the skilled knowledge of communi-cation in verbal and written forms	Apply the complex systems as part of research projects	Create, select & apply appropriate techniques, resources & modern engineering & IT tools	Understand the impact of professional engineering solutions in societal & environmental practices	Apply ethical principles & commit to professional ethics & responsibilities and norms of the engineering practice	The ability to engage in self-directed, reflective & lifelong learning for the benefit of the society	Dev. Analy tical skill for complex mining problems	Specialized in depth knowledge in specific areas of mining	Capability to comprehend articulated needs for mining industry	Research orientation based on articulated needs
CO1- - will garner an insight into the theoretical aspects of surface mining operations.	2	2-	1	1	1	1	2	1	1	1
CO2- - Understanding the principles of heavy earth moving machineries.	1	-1	-2	-3	2	1	1	1	2	2
CO 3- Will develops complete knowledge and understanding of the explosive parameters.	2	3	1	1	3	2	2	1	3	1
CO 4- Will comprehend the technical aspects the underground mine safety.	2	3	2	3	1	2	2	1	3	1
CO 5- Will garner an understanding about the need for adopting specific types of drilling operations.	1	1	2	1	3	2	2	2	3	2

Legend: 1: Low 2: Medium 3: High

Course Curriculum Map

POs & PSOs Number	COs number & Title	SOs Number	Laboratory Instruction (LI)	Class Room Instructions (CI)	Self Learning (SL)
PO: 1,2,3,4,5,6 PSO: 1,2,3,4	CO1- - will garner an insight into the theoretical aspects of surface mining operations.	SO 1.1 SO 1.2 SO 1.3	1.1,1.2		SL 1.1
PO: 1,2,3,4,5,6 PSO: 1,2,3,4	CO2- - Understanding the principles of heavy earth moving machineries.	SO2.1 SO 2.2 SO 2.3	2.1,2.2		SL 2.1
PO: 1,2,3,4,5,6 PSO: 1,2,3,4	CO 3- Will develops complete knowledge and understanding of the explosive parameters.	SO 3.1` SO 3.2 SO 3.3	3.1,3.2		SL 3.1
PO: 1,2,3,4,5,6 PSO: 1,2,3,4	CO 4- Will comprehend the technical aspects the underground mine safety.	SO 4.1 SO 4.2 SO 4.3	4.1,4.2		SL 4.1
PO: 1,2,3,4,5,6 PSO: 1,2,3,4	CO 5- Will garner an understanding about the need for adopting specific types of drilling operations.	SO 5.1 SO 5.2 SO 5.3	5.1,5.2		SL 5.1

Semester V

Course Code: **OEC-MIN02**

Course Title: Eco-Friendly Mining

Pre-Requisite: The student should have adequate knowledge about the mining processes and the mining technologies so as to comprehend the general impacts of such mining processes and technologies on environment, society and economy.

Rationale: The student pursuing Master's degree(M.Tech) in Mining Engineering must develop adequate concept of different mining technologies and their impacts, both positive and adverse on economy and society along with environmental implications to comprehend in broader perspective its scopes & challenges and develop ability to formulate mitigation plans.

Course Outcome:

The student

OEC-MIN02.1- Garnering concept of Eco-friendly mining based on sustainable development principles. Formulation of SD framework for mining.

OEC-MIN02.2- Enactment of sustainability development principles in Acts, Laws & Regulations related to mining projects and activities

OEC-MIN02.3- Environmental impacts of mining and mitigation plans

OEC-MIN02.4-Energy security of India and need for sustainable coal mining. Short term and Long term perspective of energy mix in India and its impact on mining industry.

OEC-MIN02.5- Innovative mining technologies and their application for sustainable development.

Scheme of studies:

Code	Course code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total study Hours (CI+LI+SW+SL)	
(PEC)	**OEC-MIN02**	Eco-friendly 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.

Scheme of Assessment:
Theory

Code	Course Code	Course Title	**Scheme of Assessment(Marks)**							
			Progressive Assessment(PRA)						**End Semester Assessment (ESA)**	**Total Marks**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test2 (2 best out of3) 10 marks each(CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		(PRA+ESA)
PCC	OEC-MIN02	Eco-Friendly Mining	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.

OEC-MIN02.1:- Garnering concept of Eco-friendly mining based on sustainable development principles. Formulation of SD framework for mining

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	6
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	9

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO 1.1- Eco-friendly mining based on the concept of sustainable development SO 1.2- Chronology of events leading to SD concept SO 1.3- Unique features of mining Industry SO1.4-Understanding sustainable development framework for mining SO1.5-Comprehension of the implementation of SD principles in mining industry for eco-friendly mining		Unit1- Eco-friendly mining on the Concept of Sustainable Development 1.1- Domain of eco-friendly mining & its importance 1.2-Defining sustainable development and its concept 1.3-Chronology of the phases for development of the concept of Sustainable Development (SD) 1.4- Unique features of mining industry 1.5- Why it is challenging to apply SD principles in mining industry 1.6-Application of SD principles in Mining Industry- SD framework for mining	Study area: (i)Contribution of mining industry in national development and its impact on environment

Suggested Sessional works: a. Assignments:

(i) Importance of Mining Industry and need for eco-friendly mining based on principles of sustainable development

(ii) Unique features of Mining Industry- The challenges pertaining to the implementation of sustainability principles

b. Topic of Mini Project- I mpact of implementation of SD principles in mining on Technology improvement and innovative mining.

OEC-MIN02.2:- Enactment of sustainability development principles in Acts, Laws & Regulations related to mining projects and activities

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	10
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	13

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO 2.1-Dynamics in mining legislations for actualization of SD principles SO 2.2- Notification for EIA under Environmental Protection Act SO2.3- Formulation of Environmental Management Plan (EMP) SO 2.4- Mine Closure Plan (MCP) in phases & in final stage of a mine's life SO 2.5- Star Rating system in Indian mining leaseholds		Unit 2- Changes in mining laws for inclusion of SD principles 2.1-Legislative measures to implement SD principles in Indian mining industry 2.2 –EIA under Environmental Protection Act,1968 for all new & expansion projects 2.3-EIA procedures 2.4- Different methods of EIA study 2.5- Formulation of EMP 2.6- Mine Closure Plan and its implementation 2.7- Progressive and final mine closure plan 2.8- -Star Rating System-the method to implement SD principles in Indian mining industry 2.9-Star rating system implementation in Indian coal mining sector 2.10- Basic features of the template for evaluation of mine performances based on star rating system	(i)Changes in mining legislative framework in India in the context of SD

Suggested Sessional works: a. Assignments:

(i) An analysis into the changes in mining legislations in the context of sustainable development in mining industry

(ii) Effects of amendments in mining laws on techno-economic parameters of mining industry in India

b. Topic of Mini Project- An analysis into the feasibility of new and expansion mining projects in the context of eco-friendly mining

OEC-MIN02.3- Environmental impacts of mining and mitigation plans

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	11
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	14

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO3.1-Developing ability to assess the impact of mining activities on environment SO3.2-Comprehend the sources, dimension & mitigation plans to deal with water pollution due to mining activities SO3.3-Comprehend the impact of mining on air quality in mining complex and mitigation measures SO3.4- Impact of mining on Land environment and mitigation measures SO3.5-Understanding the need for preparing proper land use plan and its implementation.		Unit 3- Mining activities & environmental impacts 3.1-Macro & micro level impacts of mining on environment 3.2-Water pollution and water quality parameters 3.3-Physical water quality parameters 3.4-Chemical water quality parameters 3.5-Air pollution management due to mining activities 3.6-Air quality standards 3.7-Sources and prevention of air pollution in mines 3.8-Principles of operation for air pollution control equipment 3.9-Land environment and mining activities 3.10-Reclamation of mined out areas 3.11-Subsidence management	(i) Theoretical in depth studies of the impacts of different mining activities on environment and methods to deal with them

Suggested Sessional works: a. Assignments:

(i) Comparison between the impacts of opencast and underground mining on environment in mining complexes

(ii) Importance of land use plan for sustainability of mining industry in Indian context

b. Topic of Mini Project- Total impact of mining industry on national economy in consideration of sustainability principles and making mining industry socially and environmentally acceptable.

MIN 2.4:- Energy security of India and need for sustainable coal mining. Short term and Long term perspective of energy mix in India and its impact on mining industry.

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	8
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	11

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO4.1-Comprehending the criteria for energy security of any nation SO4.2-Acquiring knowledge about the present energy mix in India and its future perspective SO4.3-Analyzing the advantages and limitations of present day energy mix in India SO4.4-Garnaring knowledge and aspects of alternate sources of green energy to overcome the limitations of present energy mix SO4.5-Comprehension of the need for transformation in the energy mix in India to meet the challenges of sustainability in energy sector in India		Unit 4-Energy security with specific reference to sustainability in Indian context 4.1-Objective of energy security 4.2-Criteria for any resource as the mainstay of energy security for any nation 4.3-Present energy mix in Indian context 4.4-Short term and long term perspective of Indian energy mix 4.5-Sustainability of energy mix-the challenges 4.6-Sustainability concept and economic rules for non-renewable sources of energy 4.7-Alternative sources of renewable energy 4.8-Present status of renewable energy sources in India and their future perspective	Study area- (i)Impact of fossil fuel based energy and its impact on global warming and climate change (ii)In depth study of Clean coal technologies and different sources of alternative renewable sources of energy

Suggested Sessional works: a. Assignments:

(i) Role of fossil fuel based energy in Indian context and measures to overcome the limitations

(ii) Strategies in India to balance the energy security of nation and fulfilling the global commitment for reduction of carbon footprint

b. Topic of Mini Project- Can India outright change the form of national energy security from fossil fuel based energy dominance to non-fossil fuel based energy sources?

OEC-MIN02.5:- Innovative mining technologies and their application for sustainable development.

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	10
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	13

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO5.1-Understanding the term "Clean Coal Technology" and its implication in Indian context SO5.2-Aquiring knowledge about different forms of CCT in national as well as in global context SO5.3-Comprehension by analysis the role of CCT to balance the need for coal based power generation and reduction in carbon footprint. SO5.4- Importance of IGCC technology SO5.5- AI, Undersea mining & Space mining- the future prospects for mining industry.		Unit 5- Clean Coal Technologies (CCT) and Innovative Mining Technologies 5.1- Innovative mining technologies- need for Sustainable mining 5.2-Concept of clean coal technologies. Carbon neutral and carbon negative fuels 5.3-Coal gasification as a method of CCT 5.4-Mission Coal Gasification in India and its perspective 5.5-Coal Bed Methane (CBM) as an important source of CCT 5.6- Reservoir properties of CBM. Estimation of CBM resources in a coal seam 5.7-Technological procedure for CBM 5.8-Present status and perspective of CBM in Indian context 5.9-Compressed Natural Gas (CNG) as a cleaner fuel source 5.10-Liquefied Natural Gas (LNG) as a cleaner fuel source and with ability with overseas transport	Study area: (i) GoI initiatives for coal gasification and CBM projects as CCT

Suggested Sessional works: a. Assignments:

(i) Review of the coal gasification mission in India

(ii) A study of the behavior of a CBM well from the point of view of gas production and technological measures to improve upon it.

b. Topic of Mini Project- How far you foresee the potentiality of CCT as a greener energy source in India?

Brief of Hours suggested for the course outcome:

Course outcomes	Class Lectures (CL)	Laboratory Instructions (LI)	Sessional work (SW)	Self Learning (SL)	Total Hour (CL+LI+SW+SL)
MIN 2.1- Garnering concept of Eco-friendly mining based on sustainable development principles. Formulation of SD framework for mining	6	0	2	1	9
MIN 2.2- Enactment of sustainability development principles in Acts, Laws & Regulations related to mining projects and activities	10	0	2	1	13
MIN 2.3- Environmental impacts of mining and mitigation plans	11	0	2	1	14
MIN 2.4- Energy security of India and need for sustainable coal mining. Short term and Long term perspective of energy mix in India and its impact on mining industry	8	0	2	1	11
MIN 2.5- Innovative mining technologies and their application for sustainable development. Approximate hours:	10	0	2	1	13
Total Hours	45	0	10	5	60

Suggestions for End semester Assessment:

Suggested Specification Table

Cos	Unit Titles	Marks Distribution			Total; Marks
		R	U	A	
CO 1	- Garnering concept of Eco-friendly mining based on sustainable development principles. Formulation of SD framework for mining	3	3	1	7
CO 2	- Enactment of sustainability development principles in Acts, Laws & Regulations related to mining projects and activities	3	4	3	10
CO 3	Environmental impacts of mining and mitigation plans	3	5	5	13
CO 4	Energy security of India and need for sustainable coal mining. Short term and Long term perspective of energy mix in India and its impact on mining industry	3	5	5	13
CO 5	Innovative mining technologies and their application for sustainable development.	2	3	2	7
	Total	14	20	16	50

Legend: R-Remember U-Understand A-Apply

The end of semester assessment for Eco-Friendly Mining will be held with written examination of 50 marks

Suggested Instructional/ Implementation Strategies:

1. **Improved lectures**
2. Tutorial
3. Case studies
4. Group discussion
5. Role play
6. Visit to mining industries
7. Demonstration
8. Digital media application in teaching learning process and mass media
9. Brainstorming

Suggested Learning Resources

Sl.No	Title	Author	Publisher	Edition & Year
1.	Mining Environment Management Manual	NareshChandra Saxena	Scientific Publisher	2004
2.	Mining and Environmental Sustainability	Prof. G. S. Roonwal	Daya publishing house	2014

(b) Link https://nptel.ac.in

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COs, POs & PSO Mapping

Program Title: B. Tech (Mining Engineering)
Course Code: OEC-MIN02
Course Title: Eco-Friendly Mining

	Program Outcomes						Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
Course Outcome	Develop the skilled knowledge of communi-cation in verbal and written forms	Apply the complex systems as part of research projects	Create, select & apply appropriate techniques, resources & modern engineering & IT tools	Understand the impact of professional engineering solutions in societal & environmental practices	Apply ethical principles & commit to professional ethics & responsibilities and norms of the engineering practice	The ability to engage in self-directed, reflective & lifelong learning for the benefit of the society	Dev. Analy tical skill for complex mining problems	Specialized in depth knowledge in specific areas of mining	Capability to comprehend articulated needs for mining industry	Research orientation based on articulated needs
CO1- - Garnering concept of Eco-friendly mining based on sustainable development principles. Formulation of SD framework for mining	2	2-	1	1	-2	-1	2	1	1	1
CO2- - Enactment of sustainability development principles in Acts, Laws & Regulations related to mining projects and activities	1	-1	-2	-3	2	1	1	1	2	2
CO 3- Environmental impacts of mining and mitigation plans	2	3	1	1	3	2	2	1	3	1
CO 4- Energy security of India and need for sustainable coal mining. Short term and Long term perspective of energy mix in India and its impact on mining industry	2	3	2	3	1	2	2	1	3	1

CO 5- Innovative mining technologies and their application for sustainable development.	1	1	2	1	3	2	2	2	3	2

Course Curriculum Map

POs & PSOs Number	COs number & Title	SOs Number	Laboratory Instruction (LI)	Class Room Instructions (CI)	Self Learning (SL)
PO: 1,2,3,4,5,6 PSO: 1,2,3,4	CO 1- Garnering concept of Eco-friendly mining based on sustainable development principles. Formulation of SD framework for mining	SO 1.1 SO 1.2 SO 1.3 SO 1.4 SO 1.5		Unit 1- Eco-friendly mining on the concept of sustainable development 1.1, 1.2, 1.3, 1.4, 1.5, 1.6	SL 1.1
PO: 1,2,3,4,5,6 PSO: 1,2,3,4	CO 2- Enactment of sustainability development principles in Acts, Laws & Regulations related to mining projects and activities	SO2.1 SO 2.2 SO 2.3 SO 2.4 SO 2.5		Unit 2- Changes in mining laws for inclusion of SD principles 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10	SL 2.1
PO: 1,2,3,4,5,6 PSO: 1,2,3,4	CO 3- Environmental impacts of mining and mitigation plans	SO 3.1` SO 3.2 SO 3.3 SO 3.4 SO 3.5		Unit 3- Mining activities and environmental impacts 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10. 3.11	SL 3.1
PO: 1,2,3,4,5,6 PSO: 1,2,3,4	CO 4- Energy security of India and need for sustainable coal mining. Short term and Long term perspective of energy mix in India and its impact on mining industry	SO 4.1 SO 4.2 SO 4.3 SO 4.4 SO 4.5		Unit 4- Energy security with specific reference to sustainability in Indian context 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8	SL 4.1
PO: 1,2,3,4,5,6 PSO: 1,2,3,4	CO 5- Innovative mining technologies and their application for sustainable development.	SO 5.1 SO 5.2 SO 5.3 SO 5.4 SO 5.5		Unit 5- Clean coal technologies and innovative mining technologies 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10	SL 5.1

Semester VI

Course Code: PEC- MIN 03
Course Title: Innovative and Sustainable Mining

Pre-Requisite: The student should have basic knowledge about the mining technologies and their impact on environment, society and economy both at regional and national levels.
Rationale: The student studying mining engineering must develop adequate concept of different mining technologies and their impacts, both positive and adverse on economy and society along with environmental implications to comprehend in broader perspective its scopes & challenges and develop ability to formulate mitigation plans.

Course Outcome:
The student

PEC- MIN 03.1- Garnering concept of sustainability and the chronology of its development. Understanding the sustainability development framework in mining
PEC- MIN 03.2-. Environmental impacts of mining and mitigation plans
PEC- MIN 03.3-Energy security of India. Transformation in the energy mix in India to cope up with the global commitment of reducing carbon footprint
PEC- MIN 03.4 – Coal Bed Methane and other forms of clean coal technologies. Other non-conventional forms of energy
PEC- MIN 03.5- Innovative mining technologies and their application for sustainable development.

Scheme of studies:

Code	Course code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Totaql study Hours (CI+LI+SW+SL)	
Program Core (PCC)	PEC-MIN 03	Innovative & sustainable 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.

Scheme of Assessment:
Theory

Code	Course Code	Course Title	**Scheme of Assessment (Marks)**							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks (PRA+ ESA)**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+ CAT+AT)		
MIN	PEC-MIN 03	Advance rock mechanics and strata control	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.

PEC- MIN 03.1:- Garnering concept of sustainability and the chronology of its development

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	9
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	12

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO 1.1-Appraising the concept of sustainable development SO1.2-Understanding sustainable development framework for mining SO1.3-Comprehension of the implementation of SD principles in mining industry SO1.4-Dynamics in mining legislations for actualization of SD principles SO1.5-Acquiring knowledge about present status of application of SD principlesin Indian mining industry		Unit1- Concept of Sustainable Development & its importance 1.1-Defining sustainable development and its concept 1.2-Chronology of the phases for development of the concept of Sustainable Development (SD) 1.3- Unique features of mining industry 1.4-Application of SD principles in Mining Industry- SD framework for mining 1.5-Legislative measures to implement SD principles in Indian mining industry 1.6-EIA, EMP & MCP 1.7-Star Rating System-the method to implement SD principles in Indian mining industry, initially in non-coal mines 1.8-Star rating system implementation in Indian coal mining sector 1.9- Basic features of the template for evaluation of mine performances based on star rating system	Study area: (i)Changes in mining legislative framework in India in the context of SD

Suggested Sessional works: a. Assignments:

(i) Importance of application of SD principles in Indian mining scenario from techno-economic point of view

(ii) An analysis of the star rating template for identification of status of implementation of SD principles in Indian mines

b. Topic of Mini Project- Impact of implementation of SD principles in mining on Technology improvement and innovative mining.

PEC- MIN 03.2:- Environmental impacts of mining and mitigation plans

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	11
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	14

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO2.1-Developing ability to assess the impact of mining activities on environment SO2.2-Comprehend the sources, dimension & mitigation plans to deal with water pollution due to mining activities SO2.3-Comprehend the impact of mining on air quality in mining complex and mitigation measures SO2.4- Impact of mining on Land environment and mitigation measures SO2.5-Understanding the need for preparing proper land use plan and its implementation.		Unit 2- Mining activities & environmental impacts 2.1-Macro & micro level impacts of mining on environment 2.2-Water pollution and water quality parameters 2.3-Physical water quality parameters 2.4-Chemical water quality parameters 2.5-Air pollution management due to mining activities 2.6-Air quality standards 2.7-Sources and prevention of air pollution in mines 2.8-Principles of operation for air pollution control equipment 2.9-Land environment and mining activities 2.10-Reclamation of mined out areas 2.11-Subsidence management	(i) Theoretical in depth studies of the impacts of different mining activities on environment and methods to deal with them

Suggested Sessional works: a. Assignments:

(i) Comparison between the impacts of opencast and underground mining on environment in mining complexes

(ii) Importance of land use plan for sustainability of mining industry in Indian context

b. Topic of Mini Project- Total impact of mining industry on national economy in consideration of sustainability principles and making mining industry socially and environmentally acceptable.

PEC- MIN 03.3:- Energy security of India. Transformation in the energy mix in India to cope up with the global commitment of reducing carbon footprint

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	8
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	11

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO3.1-Comprehending the criteria for energy security of any nation SO3.2-Acquiring knowledge about the present energy mix in India and its future perspective SO3.3-Analyzing the advantages and limitations of present day energy mix in India SO3.4-Garnaring knowledge and aspects of alternate sources of green energy to overcome the limitations of present energy mix SO3.5-Comprehension of the need for transformation in the energy mix in India to meet the challenges of sustainability in energy sector in India		Unit 3-Energy security with specific reference to sustainability in Indian context 3.1-Objective of energy security 3.2-Criteria for any resource as the mainstay of energy security for any nation 3.3-Present energy mix in Indian context 3.4-Short term and long term perspective of Indian energy mix 3.5-Sustainability of energy mix- the challenges 3.6-Sustainability concept and economic rules for non-renewable sources of energy 3.7-Alternative sources of renewable energy 3.8-Present status of renewable energy sources in India and their future perspective	Study area- (i)Impact of fossil fuel based energy and its impact on global warming and climate change

Suggested Sessional works: a. Assignments:

(i) Role of fossil fuel based energy in Indian context and measures to overcome the limitations

(ii) Strategies in India to balance the energy security of nation and fulfilling the global commitment for reduction of carbon footprint

b. Topic of Mini Project- Can India outright change the form of national energy security from fossil fuel based energy dominance to non-fossil fuel based energy sources?

PEC- MIN 03.4:- Coal Bed Methane and other forms of clean coal technologies. Other non-conventional forms of energy

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	8
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	11

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO4.1-Understanding the term "Clean Coal Technology" and its implication in Indian context SO4.2-Aquiring knowledge about different forms of CCT in national as well as in global context SO4.3-Understanding Coal gasification method as a CCT SO4.4-Understanding CBM as a CCT SO4.5-Comprehension by analysis the role of CCT to balance the need for coal based power generation and reduction in carbon footprint.		Unit 4- Clean Coal Technologies (CCT) 4.1-Concept of clean coal technologies. Carbon neutral and carbon negative fuels 4.2-Coal gasification as a method of CCT 4.3-Process and the chemistry of coal gasification 4.4-Mission Coal Gasification in India and its perspective 4.5-Coal Bed Methane (CBM) as an important source of CCT 4.6- Reservoir properties of CBM. Estimation of CBM resources in a coal seam 4.7-Technological procedure for CBM 4.8-Present status and perspective of CBM in Indian context	Study area: (i)GoI initiatives for coal gasification and CBM projects as CCT

Suggested Sessional works: a. Assignments:

(i) Review of the coal gasification mission in India

(ii) A study of the behavior of a CBM well from the point of view of gas production and technological measures to improve upon it.

b. Topic of Mini Project- How far you foresee the potentiality of CCT as a greener energy source in India?

PEC- MIN 03.5:- Innovative mining technologies and their application for sustainable development.

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	9
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	12

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO5.1-Understanding the importance of Innovative Mining to steer the mining industry SO5.2-Acquiring the knowledge of generation and utilization of greener energy over larger area of operation SO5.3-Understanding the implication of more energy efficient systems SO5.4-Exploring the sea-bed for enhancing the mineral resource base of the nation and getting rare metals SO5.5-Exploration of space mining for mineral resources to cater the global need with sustainability		Unit 5-Innovative Mining Technologies for sustainable development 5.1-Importance of innovative mining technologies for sustainable growth of mining sector 5.2-Compressed Natural Gas (CNG) as a cleaner fuel source 5.3-Liquefied Natural Gas (LNG) as a cleaner fuel source and with ability with overseas transport 5.4-Integrated Gasification Combined Cycle (IGCC) Technology as a highly efficient energy source 5.5-Importance of Artificial Intelligence (AI) in mining sector at present and in future 5.6-Sea-bed mining 5.7-Asteroid mining 5.8 Case study 5.9 Case study 1	Study area: (i)Search for cleaner and more efficient mining technologies

Suggested Sessional works: a. Assignments:

(i) Rationale for selection of Innovative Mining Technologies

(ii) Scope and rationale behind sea bed and asteroid mining

b. Topic of Mini Project- Sustainability of Mining Industry depends on Innovative Mining Technologies and application f Artificial Intelligence.

Brief of Hours suggested for the course outcome:

Course outcomes	Class Lectures (CL)	Laboratory Instructions (LI)	Sessional work (SW)	Self Learning (SL)	Total Hour (CL+LI+SW+SL)
PEC- MIN 03.1- Garnering concept of sustainability and the chronology of its development. Understanding the sustainability development framework in mining	9	0	2	1	12
PEC- MIN 03- Environmental impacts of mining and mitigation plans	11	0	2	1	14
PEC- MIN 03.3- Energy security of India. Transformation in the energy mix in India to cope up with the global commitment of reducing carbon footprint	8	0	2	1	11
PEC- MIN 03.4- Coal Bed Methane and other forms of clean coal technologies. Other non-conventional forms of energy	8	0	2	1	11
PEC- MIN 03.5- Innovative mining technologies and their application for sustainable development.	9	0	2	1	12
Total Hours	45	0	10	5	60

Suggestions for End semester Assessment:

Suggested Specification Table

COs	Unit Titles	Marks Distribution			Total; Marks
		R	U	A	
CO 1	Garnering concept of sustainability and the chronology of its development. Understanding the sustainability development framework in mining	3	3	1	7
CO 2	Environmental impacts of mining and mitigation plans	3	4	3	10
CO 3	Energy security of India. Transformation in the energy mix in India to cope up with the global commitment of reducing carbon footprint	3	5	5	13
CO 4	Coal Bed Methane and other forms of clean coal technologies. Other non-conventional forms of energy Approximate hours:	3	5	5	13
CO 5	Innovative mining technologies and their application for sustainable development.	2	3	2	7
	Total	14	20	16	50

Legend: R-Remember U-Understand A-Apply

The end of semester assessment for Underground coal mining technologies will be held with written examination of 50 marks

Suggested Instructional/ Implementation Strategies:

1. **Improved lectures**
2. Tutorial
3. Case studies
4. Group discussion
5. Role play
6. Visit to mines and mineral processing industries
7. Demonstration
8. Digital media application in teaching learning process and mass media
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Surface Mining Technology	Das, S.K	Lovely Prakashan, Dhanbad	2, 1988
2	Introduction to Mining Technology, Vol. I & II	Pradhan, G.K	Mintech Publication, Bhubaneswar(An AKS University Initiative).	2020
3	Explosives & Blasting Techniques	Pradhan, G.K	Mintech Publication, Bhubaneswar(An AKS University Initiative).	2020

(a) Web link:

https://geology.com/
https://archive.nptel.ac.in/Harddisk/Direct_Download.html
https://epathshala.nic.in/
https://swayam.gov.in/

Curriculum Development Team

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Course Curriculum Map:

Program Title: B. Tech (Mining Engineering)
Course Code: PEC- MIN 03
Course Title: Innovative and Sustainable Mining

	Program Outcomes												Program Specific Outcomes			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
Course Outcome	Engg Know ledge	Prob Lem Ana- lysis	Des- ign/ Dev of Solu Tion	Inv- esti gat ion of complex problems	Mod ern tool usage	Eng Ineer & soc iety	Env Ironment & Sus tai nab ility	Work Eth ics	Ind Ivi Dual & te- am Wo- rk	Commu nica tion	Pro Ject Mgmt & Fin ance	Life lo ng Lea ning	Dev. Analy tical skill for identi-fying mine prob- lems for solutions	Garnering know Ledge about economic, env & soc ietal impacts of mining	Dev. Knowledg e for mine plan ing, operation & closure	Develop work ethics under mine statutes
CO1- Garnering concept of sustainability and the chronology of its development. Understanding the sustainability development framework in mining	2	1	1	1	1	1	2	1	1	1	1	2	1	1	1	1
CO 2 Environmental impacts of mining and mitigation plans	2	1	1	1	2	1	1	1	3	2	3	2	1	1	2	2
CO 3- Energy security of India. Transformation in the energy mix in India to cope up with the global commitment of reducing carbon	3	2	3	1	2	1	2	1	3	3	2	2	2	1	3	1
CO 4- Coal Bed Methane and other forms of clean coal technologies. Other non-conventional forms of energy Approximate hours:	3	2	3	1	2	1	2	1	3	3	2	2	2	1	3	1
CO 5- Innovative mining technologies and their application for sustainable development.	3	2	2	3	2	1	2	2	3	3	3	2	2	2	3	2

Legend: 1: Low 2: Medium 3: High

Course Curriculum Map:

POs & PSOs Number	COs number & Title	SOs Number	Laboratory Instruction (LI)	Class Room Instructions (CI)	Self Learning (SL)
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 1- Garnering concept of sustainability and the chronology of its development. Understanding the sustainability development framework in mining	SO 1.1 SO 1.2 SO 1.3 SO 1.4 SO 1.5		Unit 1- Concept of Sustainable Development & its importance 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9	SL 1.1
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 2- Environmental impacts of mining and mitigation plans	SO2.1 SO 2.2 SO 2.3 SO 2.4 SO 2.5		Unit 2- Mining activities and environmental impacts. 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11	SL 2.1
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 3- Energy security of India. Transformation in the energy mix in India to cope up with the global commitment of reducing carbon footprint	SO 3.1` SO 3.2 SO 3.3 SO 3.4 SO 3.5		Unit 3- Energy security with specific reference to sustainability in Indian context 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8	SL 3.1
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 4- Coal Bed Methane and other forms of clean coal technologies. Other non-conventional forms of energy	SO 4.1 SO 4.2 SO 4.3 SO 4.4 SO 4.5		Unit 4- Clean Coal Technology 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8	SL 4.1
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 5- Innovative mining technologies and their application for sustainable development.	SO 5.1 SO 5.2 SO 5.3 SO 5.4 SO 5.5		Unit 5- Innovative Mining Technologies 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7,1.8,1.9	SL 5.1

Semester VI

Course Code: **MIN305/MIN305-L**

Course Title: Mine Ventilation & Environment-II

Pre-requisite: Students should possess fundamental knowledge of key aspects of underground mining.

Rationale: The students studying Mining engineering should possess fundamental knowledge of key aspects of underground mining, the different gases present in the mine air, their pros and cons, dangers of mine fires and explosions and the mine environment affected by the mine gas, dust, temperature and their mitigation efforts necessary to comply with the statute.

Course Outcomes:

MIN305/MIN305-L.1: Identify different types of mine fires and their detection, monitoring and control measures.

MIN305/MIN305-L.2: Explain Spontaneous Heating

MIN305/MIN305-L.3: Summarize Mine Explosions

MIN305/MIN305-L.4: Illustrate about Mine Rescue and Recovery work

MIN305/MIN305-L.5: Assess mine inundation dangers.

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits(C)
			Cl	**LI**	**SW**	**SL**	**Total Study Hours(CI+LI+SW+SL)**	
PCC	MIN305/ MIN305-L	Mine Ventilation & Environment-II	4	2	1	1	8	5

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

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

SW: 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

Code	Course Code	Course Title	Scheme of Assessment(Marks)							
			Progressive Assessment(PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test2 (2 best out of 3) 10 mark each(CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks CA+CT+SA+CAT+AT)		
PCC	MIN305/ MIN305-L	Mine Ventilation & Environment-II	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

MIN305/MIN305-L.1: Mine Fires

Approximate Hours

Item	AppXHrs
Cl	12
LI	4
SW	1
SL	2
Total	19

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 Identify different types of mine fire. **SO1.2**Understand fire detection methods **SO1.3**Prescribe firefighting methods SO1**.4**Examine the monitoring data **SO1.**5 Evaluate the status of area behind sealed off areas .	1.1 Monitoring of sealed off areas and goaf fires. 1.2 Soda ash fire extinguishers and its application	**Unit-1.0 Mine Fire** 1.1 Classification of fires 1.2 Causes of fire 1.3 Detection of fire 1.4 Monitoring and control 1.5 Preventive measures 1.6 Fire fighting and inertization 1.7 Monitoring of atmosphere behind sealed off areas. 1.8 Reopening of sealed off areas 1.9 Case histories. 1.10 Numerical 1.11 Fire Types 1.12 Coward diagram	1. Recent incidences of mine fire. 2. Mine fires in metal mines.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Write up of recent mine fire incidence.

MIN305/MIN305-L.2: Explain spontaneous heating

Approximate Hours

Item	AppXHrs
Cl	12
LI	4
SW	2
SL	1
Total	19

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1 Understand spontaneous heating **SO2.2**Recognize spontaneous heating **SO2.3 Explain control measures** **SO2.4** Examine relationship between incubation period and spontaneous heating **SO2.5** Assess control measures for controlling fire in coal stock.	2.1 CO_2 fire extinguishers and its application . 2.2 Dry chemical fire extinguishers and its application.	Unit-2 **Spontaneous Heating-** 2.1 Mechanism, causes 2.2 Detection of spontaneous heating 2.3 Monitoring of spontaneous heating. 2.4 Control of spontaneous heating 2.5 Spontaneous heating in coal dumps on surface. 2.6 Incubation period 2.7 Preventing measures of spontaneous heating 2.8 Numericals 2.9 Problems 2.10 Numerical 1 2.11 Case study 2.12 Case study 1	i. Learning about recent spontaneous heating incidences in coal mines

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

a. Assignments:

i. Control measures for mitigation of spontaneous heating.

ii. Statutory provisions.

b. Mini Project:

Mine Study

MIN305/MIN305-L.3: Summarize Mine Explosions

Approximate Hours

Item	AppXHrs
Cl	12
LI	4
SW	2
SL	1
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1Recall types of mine explosions SO3.2 Determine mechanisms of explosion SO3.3Examine preventive measures SO3.4Determine reasons of explosion SO3.5 Assess case studies	3.1 Reasons of spontaneous heating, its preventive measures etc in underground and at surface. 3.2 Designing of stone dust barrier & water barrier in underground mines	**Unit-3:Mine Explosions** 3.1 Types, causes and mechanism of firedamp explosions. 3.2 Types, causes and mechanism of coal dust explosions. 3.3 Preventive measures 3.4 Stone dust barriers 3.5 Investigations after explosion 3.6 Case histories 3.7 Mine explosions 3.8 Mine explosions abroad. 3.9 Mine explosions abroad. 1 3.10 Mine explosions abroad. 2 3.11 Mine explosions abroad. 3 3.12 Mine explosions abroad. 4	i. Mine explosions in India.

SW-3 Suggested Sessional Work (SW):

a. **Assignments:**

i) Illustrate the various mine explosions

ii) Present one coal dust explosion case history.

b. **Mini Project:**

Case study

MIN305/MIN305-L.4: Illustrate about Mine Rescue and Recovery work

Approximate Hours

Item	AppXHrs
Cl	12
LI	4
SW	1
SL	2
Total	19

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4.1Explainmine rescue equipment SO4.2Discuss rescue equipment SO4.3 Describe Rescue stations SO4.4 Review of Training of personnel and organization of rescue station. SO4.5 Develop rescue and recovery work in connection with fire, explosion.	4.1 Study of flame safety lamp 4.2 Testing of methane with the flame safety lamp and estimation of the percentage.	**Unit-4:**Mine Rescue and Recovery work 4.1 Different types of rescue equipment 4.2 Test on rescue apparatus 4.3 Rescue stations; 4.4 Recovery and first-aid appliances 4.5 Training of personnel and organization of rescue station 4.6 Rescue and recovery work in connection with mine fire 4.7 Rescue and recovery work in connection with mine explosions and 4.8 other conditions 4.9 Safety chamber 4.10 case study 4.11 Numerical 4.12 Problems	i. Rescue stations in India ii. Rescue and recovery work of any accident.

SW-4Suggested Sessional Work (SW):

a. Assignments:

i. Discuss the necessity of Rescue Station

ii. Describe the facilities in a safety chamber

MIN305/MIN305-L.5: Assess dangers of mine inundation

Approximate Hours

Item	AppXHrs
Cl	12
LI	4
SW	1
SL	2
Total	19

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO5.1 Recall causes of mine inundation **SO5.2** Discuss preparatory measures. **SO5.3**Describe precautions necessary while approaching waterlogged areas **SO5.4**Determine the strength of water dams **SO5.**5Prepare plan for dewatering of old workiings	5.1 Exercise on Illumination survey. 5.2 Exercise on resuscitation.	**Unit5:Mine Inundation** 5.1 Causes of inundation. 5.2 Precautionary measures against inundation. 5.3 Precautions necessary while approaching old workings. 5.4 Pittop-Burnside boring apparatus. 5.5 Design and construction of water dams. 5.6 Recovery of flooded mines 5.7 Water blasts and its dangers. 5.8 Numericals 5.9 Coward diagram 5.10 Problems 5.11 Problems 1 5.12 Problems 2	1. Statutory requirements while approaching waterlogged workings. 2. Chasnala Mine Disaster

SW-5 Suggested Sessional Work (SW):

a. **Assignments:**

Precautionary measures required as per statute.
Inspection of water dams

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction	Sessional Work (SW)	Self Learning (Sl)	Total hour(Cl+SW+Sl)
MIN305/MIN305-L.1:Identify different types of mine fires and their detection, monitoring and	12	4	1	2	19
MIN305/MIN305-L.2:Explain Spontaneous Heating.	12	4	2	1	19
MIN305/MIN305-L.3:Summarize Mine Explosions.	12	4	2	1	19
MIN305/MIN305-L.4:Illustrate about Mine Rescue and Recovery work.	12	4	1	2	19
MIN305/MIN305-L.5:Assess mine inundation dangers.	12	4	1	2	19
Total Hours	60	20	7	8	95

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Identify different types of mine fires and their detection, monitoring and control.	03	01	01	05
CO-2	ExplainSpontaneous Heating.	02	06	02	10
CO-3	Summarize Mine Explosions.	03	07	05	15
CO-4	Illustrate about Mine Rescue and Recovery work	03	07	05	15
CO-5	Assess mine inundation dangers	03	02	-	05
Total		14	23	13	50

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

The end of semester assessment for Basic Mining Engineering will be held with written examination 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:

Improved Lecture
Tutorial
Case Method
Group Discussion
Role Play
Visit to mining industries
Demonstration
ICTBasedTeachingLearning (VideoDemonstration/TutorialsCBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Onlinesources)
Brainstorming

Suggested Learning Resources:

(a)Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Subsurface Ventilation Engineering	Malcolm J Mcpherson	Chapman and Hall	1993
2	Mine Disasters and Mine Rescue	M A Ramlu	The Orient Blackswan	2018
3	Mine Environment and ventilation	G B Misra	Oxford University Press	1998
4	Coal Mines Regulations 2017			

(b)Link

https://nptel.ac.in/

Curriculum Development Team

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Cos, POs and PSOs Mapping

Program Title: B. Tech. Mining Engineering

Course Code: MIN305/MIN305-L.

Course Title: Mine Ventilation & Environment-II

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2	PSO3	PSO4
	Engin eering knowl edge	Problema nalysis	Design/devel opmentof solutions	Conductinve stigations ofcomplex probl ems	Mod ern tool usag e	Theengi neerand society	Enviro nment and sustai n ability :	Ethics	Individual andteamw ork:	Commun ication:	Projectma nagement andfinanc e:	Life-longl earni ng	Develop analytic al skills in identifyi ng and accordi ngly take actions for solution of mining problem s.	Should develop sufficient knowledge about the economic, environmen tal and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation technique s, mine managem ent, conflict resolution managem ent and general	Develo pment of the base for innovat ion & researc h in the field of mining engine ering.
CO1:Identi fy different types of mine fires and their detection, monitoring and control.	1	2	1	1	1	2	1	2	2	1	1	2	2	3	2	1
CO 2 ExplainSpo ntaneous Heating.	1	1	2	2	1	2	3	2	1	1	2	2	2	1	2	1
CO3Summ arize Mine Explosions.	1	1	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO 4:Illustrate about Mine Rescue and Recovery work	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO5:Assess mine inundation dangers.	1	2	1	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map

POs &PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction(L I)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,67,8,9,10,11, 12 PSO1,2,3,4	CO1 : Identify different types of mine fires and their	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1,1.2	Unit-1.0Mine Fire 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11,1.12	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 2 ExplainSpontaneous Heating	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1,2.2	Unit-2Spontaneous heating 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9,2.10,2.11,2.12	SL2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO3 Summarize Mine Explosions.	SO3.1SO3.2 SO3.3, SO3.4 SO3.5	3.1,3.2	Unit-3 :Mine Explosions 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11,3.12	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO 4:**Illustrate about Mine Rescue and Recovery work	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1,4.2	Unit-4:Mine Rescue and Recovery Work 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.1 2	SL 4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 5: Assess mine inundation dangers**.**	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1,5.2	Unit5:Mine Inundation 5.1,5.2,5.3,5.4,5.5, 5.6, 5.7,5.8,5.9,5.10,5.11,5.12	SL 5.1

Semester VI

Course Code: **MIN306/MIN306-L**

Course Title : ADVANCE ROCK MECHANICS AND STRATA CONTROL

Pre-requisite: Student should have basic knowledge of stress and stress field, and properties of rock mass.

Rationale: The students studying advance rock mechanics will acquire stress and deformation related instrumentation like load cell, convergence recorder, bore hole extensometer. Students will acquire knowledge of measuring in situ and induced stresses. Students will acquire knowledge of Numerical modeling of rock masses and applications of numerical analysis.

Course Outcomes: The students will be able to

MIN306/MIN306-L.1: Interpret Stress State and design of Local and Mass Support System (Rock Enforcement).

MIN306/MIN306-L .2: Apply stress and deformation related instrumentation to measure rock movement and interpretation of data

MIN306/MIN306-L.3: Predict surface subsidence and assess rock bursts and bump. Apply measures to control subsidence and bursts.

MIN306/MIN306-L.4: Analyse mechanism of caving and slope failure. Apply FLAC 3D and FLAC 2D to assess slope failure.

MIN306/MIN306-L.5: Apply numerical analysis in geo mechanics by using different methods of numerical modeling of rock masses and computational methods too.

Scheme o Studies

Code			Scheme of studies(Hours/Week)					**Total Credits (C)**
	Course Code	**Course Title**	**Cl**	**LI**	**SW**	**SL**	**Total Study Hours(CI+SW+SL)**	
Program mining engineering	**MIN306/MIN306-L**	Advance rock mechanics and strata control	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.

Scheme of Assessment:

Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks** (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
MIN	MIN306 /MIN306-L	Advance rock mechanics and strata control	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.

MIN306/MIN306-L.1: Interpret Stress State and design of Local And Mass Support System (Rock Enforcement).

Approximate Hours

Item	AppXHrs
Cl	12
LI	4
SW	2
SL	1
Total	19

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 T o study about various types of stress fields **SO1.2** To find stresses around narrow and circular openings **SO1.3** Design of support system in bord and pillar **SO1.4** Evaluate various supports in longwall workings **So1.**5 Assess pressure on supports by instrumentation .	1.1Bore hole Extensometer and measurement of displacement with its help. 1.2 Measurement f strain by tape extensometer.	1.1 **Unit-1.0** Stress field and stress equation 1.2 In situ and induced stress 1.3 Stress distribution around narrow and circular openings. 1.4 Introduction to local and mass support system 1.5 Design of support system in shafts. 1.6 Support system in headings. 1.7 Supports system in junctions and depillaring areas. 1.8 Support system in gates 1.9longwall faces and stopes . 1.10 shot creting and guniting 1.11 filling and pillar as mass support system. 1.12 pressure on supports	1. Various methods of designing support system in underground

SW-1 Suggested Sessional Work (SW):

a. Assignments:

1. Design of support system in development district of bord and pillar from given data

b. Mini Project:

1. Strata monitoring devices and its applicability study

MIN306/MIN306-L.2: Apply stress and deformation related instrumentation to measure rock movement and interpretation of data

Approximate Hours

Item	AppXHrs
Cl	12
LI	4
SW	2
SL	1
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2. Read the rock movement and interpret it . **SO2.2** Identify location of installing instrument to measure convergence. **SO2.3**To understands the out-come reading of recorder and suggests measures for safety of persons. **SO2.4**To calculate in situ stresses from the data. **SO2.**5 To lean use of instruments of measuring induced stresses.	I1.Load cell and measurement of convergence I.2.Flat jack method and measurement of in situ stress .	**Unit -2.0** Apply stress and deformation related instrumentation to measure rock movement and interpretation of data. 2.1. Measurement of rock movements 2.2 interpretations of data. 2.3 Load cells1 2.4 Load cells-2 2.5 Convergence recorders. 2.6 Borehole extensometers-1 2.7 Borehole extensometers-2 2.8 Borehole cameras 2.6. Measurement of in-situ stresses. 2.10 Measurement of in-situ stresses 2.11Measurement of induced stresses. 2.12 Measurement of induced stresses	i. Different types of ISRM in situ stress measurements ex USBM, CSIRO.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Collect data and details of different types of load cells.
ii. Study different types of bore hole extensometers and compare their efficacy.

b.Mini Project:

Plan a plan for installation of strata monitoring instrument in depillaring district of bord and pillar working.

MIN306/MIN306-L.3: : Predict surface subsidence and assess rock bursts and bump. Apply measures to control subsidence and bursts.

Approximate Hours

Item	AppXHrs
Cl	12
LI	4
SW	2
SL	1
Total	19

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO3.1 Predict surface subsidence and bump. **SO3.2** Measurement of subsidence and showing in graph. **SO3.3** Preventive measures of subsidence at surface and taking safety measures. **SO3.4** Rock burst and bump prediction. **SO3.**5 Preventive measures of rock burst and bumps	1.Determination of ground vibrations with seismograph , and its effect on design of slopes 2.Factors influencing the stability of slope . Design for maintaining slope in adverse conditions	Unit -3.0 Predict surface subsidence and assess rock bursts and bump. Apply measures to control subsidence and bursts. finance 3.1 Factors controlling magnitude 3.2 extent of surface subsidence-prevention 3.3 Prevention and control of damage to surface. 3.4 Method of prediction of mining subsidence 3.5 control of subsidence. 3.6 Subsidence measurement technique 3.7 Rock burst and bump 3.8 Mechanism of occurrence of bump 3.9 prediction 3.10 control of rock burst. 3.11 Design of shaft pillar control. 3.12 Design of Tunnels and caverns .	1 study of subsidence and its types and monitoring of subsidence

SW-3 Suggested Sessional Work (SW):

a. Assignments:

1 Problem on subsidence
2 Rock bumps and bursts.

b. Mini Project:

Study of rock burst and bumps in chinakuri mine and KGF

MIN306/MIN306-L.4 Analyse mechanism of caving and slope failure. Apply FLAC 3D and FLAC 2D to assess slope failure.

Approximate Hours

Item	AppXHrs
Cl	4
LI	4
SW	2
SL	2
Total	12

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4.1 knowledge on mechanics of caving and caving cavability index **SO4.2** understanding the parameters of slope design **SO4.3** ; Analysis of slope failure **SO4.4** Study of drainage and reinforcement of slopes **SO4.**5 Using SSR for interpreting of slopes stability	LI1.Mechanism of rock bursting bumps and factors influencing it . LI2.Shorcreting method of support – principle , application etc..	4.1 Mechanics of caving 4.2 Cavability of rocks and caving height 4.3 Types of slope failure 4.4 Analysis of slope failure .	1. Different types of slope failure and their cause 2. Different Methods of analysis of slope failure

SW-4 Suggested Sessional Work (SW):

a. Assignments

1. Design of opencast slopes
2. Calculations of FOS of slopes of dumps

b. **Mini Project:**

1. Case study on slope failure of RAJ MAHAL Opencast

MIN306/MIN306-L.5: Apply numerical analysis in geo mechanics by using different methods of numerical modeling of rock masses and computational methods too.

Approximate Hrs

Item	AppXHrs
Cl	5
LI	4
SW	2
SL	1
Total	11

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO5.1 Knowledge on computational methods for numerical techniques **SO5.2** Various applications of numerical methods **SO5.3** Studying FEM and FDM methods of numerical modeling **SO5.4** Studying of DEM and MFM methods of numerical modeling **SO5.**Analysis of slope stability using FLAC 2D and FLAC 3D	LI 1 design of support system LI2.Application of numerical methods in geo –mechanics .	5.1 Introduction to numerical techniques 5.2 Computational methods 5.3 Numerical methods of modeling rock masses 5.4 Application of numerical analysis 5.5 Case study	**1.** Analysis of slope stability using flac 2d and flac 3d using acquired data

SW-5 Suggested Sessional Work (SW):

a. Assignments:

1. Principles of working of various NUMERICAL MODELLING methods

b. Mini Project:

1. Analysis of slope stability using FLAC 2D and FLAC 3D

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)
MIN306/MIN306-L.1: Interpret Stress State and design of Local and Mass Support System (Rock Enforcement).	12	4	1	2	19
MIN306/MIN306-L.2: Apply stress and deformation related instrumentation to measure rock movement and interpretation of data	12	4	2	1	19
MIN306/MIN306-L.3: Predict surface subsidence and assess rock bursts and bump. Apply measures to control subsidence and bursts.	12	4	2	1	19
MIN306/MIN306-L.4: Analyse mechanism of caving and slope failure. Apply FLAC 3D and FLAC 2D to assess slope failure.	4	4	2	2	12
MIN306/MIN306-L.5: Apply numerical analysis in geo mechanics by using different methods of numerical modeling of rock masses and computational methods too.	5	4	2	1	12
Total Hours	45	20	9	7	81

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Interpret Stress State and design of Local and Mass Support System (Rock Enforcement).	03	01	01	05
CO-2	Apply stress and deformation related instrumentation to measure rock movement and interpretation of data	02	06	02	10
CO-3	Predict surface subsidence and assess rock bursts and bump. Apply measures to control subsidence and bursts.	03	07	05	15
CO-4	Analyse mechanism of caving and slope failure. Apply FLAC 3D and FLAC 2D to assess slope failure.	-	10	05	15
CO-5	Apply numerical analysis in geo mechanics by using different methods of numerical modeling of rock	03	02	-	05

	masses and computational methods too.				
Total		11	26	13	50

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

The end of semester assessment for advance rock mechanics and strata control 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 mining plant
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook ,Twitter,Whatsapp,Mobile,Onlinesources)
9. Brainstorming

Suggested Learning Resources:

(a) **Books**:

S. No.	Title	Author	Publisher	Edition &Year
1	Fundamentals and applications of Rock Mechanics	Deb Debasis	PHI Learning Pvt. Ltd.	2016
2	Introduction to rock mechanics by IBM	IBM	IBM	

Link

https://nptel.ac.in/

Curriculum Development Team

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Cos, Pos and PSOs Mapping

Program Title: B. Tech. Mining Engineering

Course Code: MIN306/MIN306-L

Course Title: ADVANCE ROCK MECHANICS AND STRATA CONTROL

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conductinvestigations ofcomplex problems	Modern toolusage	Theengineersandsociety	Environment and sustainability:	Ethics	Individualandteam work:	Communication:	Projectmanagement andfinance:	Life-longlearning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of mining engineering
CO 1 Interpret Stress State and design of Local and Mass Support System	1	2	1	1	1	2	1	2	2	1	1	2	2	3	2	1
CO 2 Apply stress and deformation related instrumentation to measure rock movement and interpretation	1	1	2	2	1	2	3	2	1	1	2	2	2	1	2	1
CO 3 Predict surface subsidence and assess rock bursts and bump. Apply measures to control subsidence and bursts.	1	1	1	1	1	2	2	2	1	2	1	2	1	1	2	2

CO 4 Analyse mechanism of caving and slope failure. Apply FLAC 3D and FLAC 2D to assess slope failure.	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO 5 Apply numerical analysis in geo mechanics by using different methods of numerical modeling of rock masses and computational methods too.	1	2	1	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–Hig

Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,67,8,9,10,11,12 PSO1,2,3,4	CO-1 Understand the importance of rock mechanics in mining.	SO1.1 SO1.2 SO1.3 SO1.4, SO 1.5	1.1.1.2	Unit-1.0 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11,1.12	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO- 2 CLASSIFY GEOLOGICAL DESCRIPTION OF ROCK MASS	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1,2.2	Unit-2 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9,2.10,2.11,2.12	SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-3 Apply RQD, RSR,RMR,Q-BARTON SYSTEM in support design .	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1,3.2	Unit-3 : 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11,3.12	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-4. Utilise mechanical properties of rocks and in-situ strength in mining .	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1,4.2	Unit-4: 4.1,4.2,4.3,4.4,4	SL 4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO -5 Use rock failure theories in understanding the stability features of waste dump and design.	SO5.1 SO5.2 SO5.3 SO5.4	5.1,5.2	Unit5: 5.1,5.2,5.3,5.4,5.5	SL 5.1

Semester VI

Course Code: **MIN307/MIN307-L**

Course Title: **Mining Machinery-II**

Pre-Requisite: The student should have basic knowledge about the fundamentals of physics, mathematics and theoretical mechanics as well as adequate mining knowledge about field of application of different mining machines

Rationale: The student studying mining engineering with adequate concept of access and egress systems in the mines and advanced knowledge about operational details of underground mining activities should be able to correlate the deployment of types of mining machines encompassed in this course curriculum for application in field conditions.

Course Outcome:

The student

- **MIN307/MIN307-L**.1- will garner an insight into the theoretical aspects of physical and mechanical properties of metals and alloys and their application in construction of steel wire ropes as an important element in several mining activities
- **MIN307/MIN307-L**.2- Understanding the principles of operation of winding systems in vertical shafts along with acquiring the knowledge of the configuration of winding equipment, their safety features to meet the statutory requirement as per mines laws.
- **MIN307/MIN307-L**.3-Will develop complete knowledge and understanding of the design elements of different types of haulage systems for Underground mines and their proper selection criteria in terms of types and required motor power along with safety features as per statute.
- **MIN307/MIN307-L**.4 -Will comprehend the technical aspects associated with the use of different types of locomotives in underground mine conditions and different conveyor systems with analytical concept for their applicability in specific conditions
- **MIN307/MIN307-L**.5- Will garner an understanding about the need for adopting specific types of winning machines for their constructional and design details in underground coal mines, both for conventional and mechanized mines.

Scheme of studies:

Code	Course code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Totaql study Hours (CI+LI+SW+SL)	
Program Core (PCC)	MIN307/MIN307-L	Mine Machinery-II	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.

Scheme of Assessment:
Theory

<table>
<tr><th rowspan="3">Code</th><th rowspan="3">Course Code</th><th rowspan="3">Course Title</th><th colspan="8">Scheme of Assessment(Marks)</th></tr>
<tr><th colspan="6">Progressive Assessment(PRA)</th><th rowspan="2">End Semester Assessment
(ESA)</th><th rowspan="2">Total Marks
(PRA+ ESA)</th></tr>
<tr><th>Class/HomeAssignment5numr 3 marks each (CA)</th><th>Class Test2 (2bestout of3) 10 marks each(CT)</th><th>Seminar one
(SA)</th><th>Class Activity anyone
(CAT)</th><th>Class Attendance
(AT)</th><th>Total Marks
CA+CT+SA+CAT+AT)</th></tr>
<tr><td>PCC</td><td>MIN304/ MIN304-L</td><td>Underground Metaliferrous Mining</td><td>15</td><td>20</td><td>5</td><td>5</td><td>5</td><td>50</td><td>50</td><td>100</td></tr>
</table>

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.

MIN307/MIN307-L.1:- Physical & mechanical properties of metals and alloys- Construction of steel wire ropes

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	7
Laboratory Instructions (LI)	4
Sessional work (SW)	2
Self Learning	1
Total	14

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO1.1-Understanding certain basic physical properties of metal for rope manufacturing SO1.2-Comprehension of the constructional element and design of steel wire ropes SO1.3-Knowledge about applicability of wire ropes in mines for various purposes SO1.4-Analysis of constructional designs of ropes for determination of space factor and tensile strength	1- Socketing or capping of steel wire rope end 2- Interlocking wedge type cappel	Unit 1- Steel wire ropes and their use in mines 1.1-Physical and mechanical properties of engineering materials 1.2-Brief note on metals and alloys. Heat treatment of iron and steel 1.3-Steel wire ropes- Material composition and classification of ropes 1.4-Construction of stranded steel wire ropes 1.5-Lays of steel wire ropes. Flexibility criteria 1.6-Non-stranded steel wire ropes 1.7-Mass and strength of steel wire ropes	1. Basics of metallurgy and stress –strain behavior of metals

Suggested Sessional works: a. Assignments:

(i) Selection criteria for steel wire ropes based on their constructional details for variable purposes in the mines

(ii) Make a comparative statement between stranded and non-stranded ropes

b. Topic of Mini Project- Importance of heat treatment and other processes related to physic-mechanical properties of steel and other alloys in wire rope manufacturing industry.

MIN307/MIN307-L.2:- Winding systems in vertical shafts- their operation, safety and statutory requirement

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	16
Laboratory Instructions (LI)	8
Sessional work (SW)	2
Self Learning	1
Total	27

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO2.1-Aquiring knowledge about the winding systems in vertical shafts- its structures and equipment configuration SO2.2-Comprehension of the statutory provisions related to winding system in mines under mines regulation SO2.3-Garnering practical knowledge about functioning of important safety devices like automatic contrivance, speed control and braking systems of winders SO2.4-Conceptualization of the principles of operation of Koepe/ Friction winders and their implications SO2.5-Developing decision making capacity related to selection of types of winders, configuration of accessories in commensuration with hoisting capacity through the winding system.	1- Winding rope and cage attachment 2- Constructional details of detaching safety hooks 3- Calculation of Static Factor of Safety for winding ropes 4- Calculation of torque-time diagram and determination of winder motor power	Unit 2- Winders and winding system in vertical shafts 2.1-Purpose of winding system. Main structures of winding system 2.2-Main equipment and accessories for winding system 2.3-Main types of conveyance used in winder and comparison of their applicability 2.4- Important statutory provisions related to mine winding system 2.5-Detaching safety hooks, their types and function 2.6- Winding ropes and factor of safety 2.7-Recapping of winding ropes and its importance 2.8-Types of winders and their application 2.9-Basic features of Koepe winder and its principle of operation, 2.10-Winding cycle of a winder 2.11-Torque-time diagram for cylindrical drum winders 2.12- Torque time diagram for Koepe winder and winders with balance rope provision 2.13-Winding in deep mines and factor of safety for deep mine conditions 2.14- Automatic contrivance in winding system 2.14-Speed control for winding systems 2.15-Mechanical braking for winders 2.16-Electrical braking for winders	Study area: (i)Criteria for selection of winding systems in commensuration with multiple factors related to long term planning of the mine

Suggested Sessional works: a. Assignments:

(i) With graphical representation explain the torque time diagram for cylindrical drum winder without balance rope and compare the same with a cylindrical drum winder with balance rope

(ii) Calculate motor power for a winder based of torque-time variation during the winding cycle for a winder

b. Topic of Mini Project- Design the winding system for a deep mine with high level of production through vertical shaft hoisting assuming the conditions related to the mine.

MIN307/MIN307-L.3:- Design elements for different types of haulage systems- their operation and safety

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	8
Laboratory Instructions (LI)	4
Sessional work (SW)	2
Self Learning	1
Total	15

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO3.1-Acquiring knowledge of different types of haulage systems used in underground mines SO3.2-Aquintance with the main components of the different haulage systems SO3.3-Competency to select proper design of haulage systems in commensuration with ground conditions and level of duty parameters SO3.4- Enabling to calculate motor powers for different haulage systems SO3.5-Comprehension of the safety requirement for different haulage systems and ability to execute them.	1- Safety devices of haulage systems in underground mines 2- Layout for an Endless Haulage system in an underground mine	Unit 3- Underground transport system-Rope Haulages 3.1-Types and classification of haulage systems in underground mines 3.2-Direct rope haulage system. Its application and features 3.3-Main & Tail rope haulage system- its application and features 3.4-Endless rope haulage system and its layout 3.5-Gravity haulage system and calculation of minimum gradient for operation of gravity haulage 3.6-Calculation for direct haulage systems 3.7-Calculation for endless haulage system 3.8- Safety provisions in regulation related to haulage systems in underground mines.	Study area:- (i)Rationalization of underground haulage systems in mines

Suggested Sessional works: a. Assignments:

(i) Changing role of haulage systems in mines with advent of mechanization

(ii) Calculation of motor powers for a haulage for a given condition

b. Topic of Mini Project- Designing the composite haulage system in an extensive underground mine in consideration of the variation of working conditions & nature of duty for the haulages.

MIN307/MIN307-L.4:- Different types of locomotives, conveyors and UG mine transport system

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	8
Laboratory Instructions (LI)	6
Sessional work (SW)	2
Self Learning	1
Total	17

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO4.1-Acquiring knowledge about various systems of mine transport other than haulage system SO4.2-Comprehension of the types and features of locomotives in UG mines SO4.3-Construction and use of belt conveyors SO4.4-Construction and use of chain conveyors SO4.5-Comprehension of the selection of mine conveyance system depending on capacity and motor power	1- Layout of a belt conveyor detailing its design elements 2- Layout of Chain conveyors detailing its design elements 3- Calculation of haulage and locomotive power	Unit 4:- Underground transport system- Locomotives & Conveyors 4.1-Locomotives in under-ground mines- their purpose 4.2-Types of locomotives used in underground mines 4.3-Safety features for different types of locomotives 4.4-Types of conveyors and their application 4.5-Detailing of Belt conveyors and their constructional elements 4.6- Detailing of chain conveyors and their constructional elements 4.7-Shaker and other types of conveyors used in mines 4.8-Calculation of conveyor capacity	Study area: (i)Planning of mining method and creation of infrastructure for use of UG locomotives

Suggested Sessional works: a. Assignments:

(i) Mine conveyance systems for highly producing mines

(ii) Calculation of motor powers for Locomotives and conveyors

b. Topic of Mini Project- Designing the infrastructure in an underground mine for use of locomotive systems for mine conveyance.

MIN307/MIN307-L.5:- Design elements for wining machines in conventional and mechanized UG mines

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	6
Laboratory Instructions (LI)	2
Sessional work (SW)	2
Self Learning	1
Total	11

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO5.1-Comprehension of constructional and operational details of conventional mining machines SO5.2-Understanding of the specific features of mechanized development in Longwall mining SO5.3-Acquiring knowledge of constructional and operational features for mechanized very high capacity coal winning process SO5.4- Comprehension of the most critical strata control systems in PSLW system aimed at proper selection of supports	1- Load bearing elements of powered supports and strata control devices in powered supports	Unit 5:- Face machinery in underground mines 5.1-Constructional features of Side Discharge Loader (SDL) and Load Haul Dumper (LHD) 5.2-Development machine for Longwall development- Road Header 5.3-Winning machine for Longwall mining- Shearer 5.4-Constructional features of AFC and Beam stage loader at Longwall face 5.5-Types and basic design elements of Powered supports 5.6- Constructional, operational and safety features of powered supports	Study area: (i)Design elements of a PSLW system and their constructional features

Suggested Sessional works:

a. Assignments

(i) Rationale for selection of miming machines for winning process of minerals/coal

(ii) Calculation of rated support capacities for Powered supports in a given condition

b. **Topic of Mini Project-**

Planning for equipment selection at a Longwall mine right from development phase to operational phase.

Brief of Hours suggested for the course outcome:

Course outcomes	Class Lectures (CL)	Laboratory Instructions (LI)	Sessional work (SW)	Self Learning (SL)	Total Hour (CL+LI+SW+SL)
MIN307/MIN307-L.1- Physical & mechanical properties of metals and alloys- Construction of steel wire ropes	7	4	2	1	14
MIN307/MIN307-L.2- Winding systems in vertical shafts- their operation, safety and statutory requirement	16	8	2	1	27
MIN307/MIN307-L.3- Design elements for different types of haulage systems- their operation and safety	8	4	2	1	15
MIN307/MIN307-L.4- Different types of locomotives, conveyors and UG mine transport system	8	6	2	1	17
MIN307/MIN307-L.5- Design elements for wining machines in conventional and mechanized UG mines	6	2	2	1	11
Total Hours	45	24	10	5	84

Suggestions for End semester Assessment:

Suggested Specification Table

COs	Unit Titles	Marks Distribution			Total; Marks
		R	U	A	
CO 1	Physical & mechanical properties of metals and alloys- Construction of steel wire ropes	3	3	1	7
CO 2	Winding systems in vertical shafts- their operation, safety and statutory requirement	3	4	3	10
CO 3	Design elements for different types of haulage systems- their operation and safety	3	5	5	13
CO 4	Different types of locomotives, conveyors and UG mine transport system	3	5	5	13
CO 5	Design elements for wining machines in conventional and mechanized UG mines	2	3	2	7
	Total	14	20	16	50

Legend: R-Remember U-Understand A-Apply

The end of semester assessment for Underground coal mining technologies will be held with written examination of 50 marks

Suggested Instructional/ Implementation Strategies:

1. **Improved lectures**
2. Tutorial
3. Case studies
4. Group discussion
5. Role play
6. Visit to mines and mineral processing industries
7. Demonstration
8. Digital media application in teaching learning process and mass media
9. Brainstorming

Suggested Learning Resources

Sl.No	Title	Author	Publisher	Edition & Year
1.	Elements of Mining Technology	D J Deshmukh	A K Mishra Publication	

Link

https://nptel.ac.in/

Curriculum Development Team

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COs, POs & PSO Mapping

Program Title: B.Tech (Mining Engineering)
Course Code: MIN307/MIN307-L
Course Title: Mining Machinery-II

	Program Outcomes												Program Specific Outcomes			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
Course Outcome	Engg Know ledge	Prob Lem Ana-lysis	Des-ign/ Dev of Solu tion	Inv-esti gat ion of complex problems	Mod ern tool usage	Eng Ineer & soc iety	Env Ironment & Sus tai nab ility	Work Eth ics	Ind Ivi Dual & te-am Wo-rk	Commu nica tion	Pro Ject Mgmt & Fin ance	Life lo ng Lea ning	Dev. Analy tical skill for identi-fying mine prob-lems for solutions	Garnering know Ledge about economic, env & soc ietal impacts of mining	Dev. Knowledge for mine plan ing, operation & closure	Develop work ethics under mine statutes
CO1- Physical & mechanical properties of metals and alloys- Construction of steel wire ropes	2	1	1	1	1	1	2	1	1	1	1	2	1	1	1	1
CO2- Winding systems in vertical shafts- their operation, safety and statutory requirement	2	1	1	1	2	1	1	1	3	2	3	2	1	1	2	2
CO 3- Design elements for different types of haulage systems- their operation and	3	2	3	1	2	1	2	1	3	3	2	2	2	1	3	1

safety																
CO 4- Different types of locomotives, conveyors and UG mine transport system	3	2	3	1	2	1	2	1	3	3	2	2	2	1	3	1
CO 5- Design elements for wining machines in conventional and mechanized UG mines	3	2	2	3	2	1	2	2	3	3	3	2	2	2	3	2

Course Curriculum Map:

POs & PSOs Number	COs number & Title	SOs Number	Laboratory Instruction (LI)	Class Room Instructions (CI)	Self Learning (SL)
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 1- Physical & mechanical properties of metals and alloys- Construction of steel wire ropes	SO 1.1 SO 1.2 SO 1.3 SO 1.4	1.1 1.2	Unit 1- Steel wire ropes and their use in mines 1.1 to 1.7 (7 Lectures)	SL 1.1
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 2- Winding systems in vertical shafts- their operation, safety and statutory requirement	SO2.1 SO 2.2 SO 2.3 SO 2.4 SO 2.5	2.1 2.2 2.3 2.4	Unit 2- Winders and winding systems in vertical shafts 2.1 to 2.16 (16 lectures)	SL 2.1
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 3- Design elements for different types of haulage systems- their operation and safety	SO 3.1` SO 3.2 SO 3.3 SO 3.4 SO 3.5	3.1 3.2	Unit 3- Underground transport system- Rope haulages 3.1 to 3.8 (8 bLectures)	SL3.1
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 4- Different types of locomotives, conveyors and UG mine transport system	SO 4.1 SO 4.2 SO 4.3 SO 4.4 SO 4.5	4.1 4.2 4.3	Unit 4- UG transport system-Locomotives and conveyors 4.1 to 4.8 (8 Lectures)	SL 4.1
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 5- Design elements for wining machines in conventional and mechanized UG mines	SO 5.1 SO 5.2 SO 5.3 SO 5.4	5.1	Unit 5- Face machinery in UG mines 5.1 to 5.6 (6 Lectires)	SL 5.1

Semester-VI

Course Code: **MIN304/MIN304-L**

Course Title: Underground Metaliferrous Mining

Pre-requisite: Student should have basic knowledge of underground mining, minerals, rocks and their properties.

Rationale: Students pursuing Mining Engineering need a solid grasp of extracting rocks from beneath the earth's surface. This involves a foundational understanding of underground mining and access methods.

Course Outcomes:

MIN304/MIN304-L.1: Plan the manner of access to the belowground deposits.

MIN304/MIN304-L.2: Apply their knowledge in selecting the most suitable stopping method

MIN304/MIN304-L.3: Evaluate the different development methods and their advantages and drawbacks.

MIN304/MIN304-L.4: Conduct comparative study of different stopping methods to decide the inventory requirements.

MIN304/MIN304-L.5: Develop team skills in planning a stope the equipment selection

Scheme of Studies:

Code	**Course Code**	**Course Title**			**Scheme of studies (Hours/Week)**			**Total Credits(C)**
			Cl	**LI**	**SW**	**SL**	**Total Study Hours(CI+LI+SW+SL)**	
(PCC)	**MIN304/MIN304-L**	Underground Metaliferrous Mining	3	2	1	1	5	4

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

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

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

SL: Self Learning,

C: Credits.

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

Scheme of Assessment:
Theory

Code	Course Code	Course Title	Scheme of Assessment(Marks)							
			Progressive Assessment(PRA)						**End Semester Assessment (ESA)**	**Total Marks (PRA+ ESA)**
			Class/HomeAssignment5numr 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)		
PCC	**MIN304/ MIN304-L**	Underground Metaliferrous Mining	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.

MIN304/MIN304-L.1: Mine Access and Development

Approximate Hours

Item	ApproxHrs
Cl	9
LI	4
SW	2
SL	2
Total	17

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 Define basic terminology of underground Metaliferrous mining **SO1.2**Understand different access methods **SO1.3**Select different Development methods **SO1.4**Use of development methods **SO1.**5 Manner of development .	1.1 Metal Mining Terminology 1.2 Manual Raising.	**Unit-1.0 Metal Mine Development** 1.1 Metal mining terms 1.2 Metal mining terms (contd) 1.3 Mine Access methods 1.4 Drivage techniques 1.5 Development in horizontal direction 1.6 Development in upwards direction 1.7 Manual raising 1.8 Multi-compartmental raising 1.9 Numerical	1. Types of development 2. Importance of mine development.

SW-1Suggested Sessional Work(SW):

a. Assignments:

i. Raising methods.

b. Mini Project:

i. Men and machinery deployment in a development face.

MIN304/MIN304-L.2: Overview of stopping methods

Approximate Hours

Item	ApproxHrs
Cl	9
LI	4
SW	1
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1 Knowledge of classification of stoping methods **SO2.2**Understand stoping methods **SO2.3**Implementation of stoping methods. **SO2.4**Understand the requirement of stoping **SO2.**5 Assessment of stoping types	2.1 Various stopping methods 2.2 Stope layouts.	Unit-2 **Mining administration** 2.1 Overview of various stoping Methods. 2.2Factors influencing selection of stoping methods. 2.3 Classification of different stoping methods. 2.4 Stope layouts- initial development work 2.5 stope preparation work for access 2.6 Stope layout- final development work 2.7stope preparation work for - open stoping 2.8stope preparation work for - supported toping 2.9stope preparation work for – stoping with caving	i. Early stoping methods

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Classification of stoping methods

ii. factors collectively responsible for determining the most appropriate stoping method.

MIN304/MIN304-L.3: Open stoping methods

Approximate Hours

Item	ApproxHrs
Cl	9
LI	4
SW	1
SL	1
Total	11

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO3.1 Defineopen stopng **SO3.2Apply selection method of open stoping** **SO3.3**Explain open stoping methods in detail **SO3.4**Assess the different open stoping methods **SO3.**5 Analyze the different open stoping methods	3.1 Room and Pillar layout 3.2 Square set stopping layout.	**Unit-3:Open stoping** 3.1 Breast stoping 3.2 Stull Stoping 3.3 Room and Pillar 3.4 Stope and Pillar 3.5 Shrinkage stoping 3.6 Square set stoping 3.7 Sublevel stoping 3.8 Long hole stoping 3.9 VCR stoping	**i.** Open stoping in Indian mines

SW-3Suggested Sessional Work (SW):

a. **Assignments:**

i) **Illustration of open stoping methods**

ii) **Planning for open stoping methods.**

MIN304/MIN304-L.4: Supported stoping methods

Approximate Hours

Item	ApproxHrs
Cl	9
LI	4
SW	1
SL	2
Total	16

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4.1 Understand Supported stoping method SO4.2Analyse the requirement of supported stoping SO4.3 Explain supported stoping methods SO4.4 Describe reasons for supported stoping methods SO4.5Apply supported stoping method	.4.1 Shrinkage layout 4.2 Post and pillar layout	**Unit-4:Supported stoping method** **4.1** Supported stoping method **4.2** Cut and Fill stoping method. **4.3** Variations of Cut and Fill method 4.4 Post and Pillar Method 4.5 Post and Pillar Method with variations 4.6 Supported Sub level stoping method 4.7 Supported Shrinkage stoping 4.8 Supported Square set stoping 4.9 Supported stope and pillar stoping method.	i. Importance of supported stoping. ii. Environmental effects of supported stoping.

SW-4Suggested Sessional Work (SW):

(a) Assignments:
(i) Applicability of supported stoping based on statutory requirements.
(ii) Describe environmental impact of supported stoping.

MIN304/MIN304-L.5: Stoping with caving and special mining methods

Approximate **Hours**

Item	ApproxHrs.
Cl	9
LI	4
SW	2
SL	2
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO5.1 Understand caving. **SO5.2**Explain the necessity of caving **SO5.3**Explain the different stoping method with caving. **SO5.4**Analyze different stoping methods with caving. **SO5.**5Apply suitable stoping method with caving.	5.1 Block caving layout 5.2 Top slicing layout	**Unit5:Stoping with caving** 5.1Top Slicing 5.2 Block Caving 5.3 Various stoping methods with caving 5.4 Stoping of superimposed veins and parallel lodes. 5.5 Combined methods 5.6Deep mining with difficult conditions. 5.7 Numerical 5.8 Problems 5.9 Case study	1. Indian metal mines with great depth. 2. Mines at great depth in South Africa.

SW-5 Suggested Sessional Work (SW):

a. **Assignments:**
Evaluation of safety factors of workings at depth.

b. Mini Project:
Effects on miners while working at great depths.

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)
MIN304/MIN304-L.1: Mine Access and development	**9**	**4**	2	2	**17**
MIN304/MIN304-L.2:Overview of stoping methods	9	4	1	1	15
MIN304/MIN304-L.3:Open stoping methods	9	**4**	1	1	15
MIN304/MIN304-L.4:Supported stoping methods	9	4	1	2	16
MIN304/MIN304-L.5:Stoping with caving and special mining methods.	6	**4**	2	2	17
Total Hours	45	**20**	7	8	80

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Mine Access and Development	03	01	01	05
CO-2	Overview of stoping methods	02	06	02	10
CO-3	Open stoping methods	03	07	05	15
CO-4	Supported stoping methods	03	07	05	15

CO-5	Stoping with caving and special mining methods	03	02	-	05
Total		14	23	13	50

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

The end of semester assessment for Basic Mining Engineering 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 mining industries
7. Demonstration
8. ICTBasedTeachingLearning (VideoDemonstration/TutorialsCBT, Blog, Facebook, Twitter, Whatsapp, Mobile,Onlinesources)
9. Brainstorming

Suggested Learning Resources:

(a)Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Elements Of Mining Technology Vol II	D.J. Deshmukh	Denett& Co. Nagpur, New Delhi, Chennai Pune	2016
2	Introductory Mining Engineering	Howard L Hartman	Wiley India (P) Ltd.	2007
3	SME Mining Engineering Handbook	Society of Mining, Metallurgy and Exploration	Society of Mining, Metallurgy and Exploration Inc.	2011
4.	Surface and Underground Excavations	Ratan Raj Tatiya	A ABalkema Publishers	2005

(b) **https://nptel.ac.in/courses/105107122**

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Cos, Pos and PSOs Mapping

Program Title: B. Tech. Mining Engineering

Course Code: MIN304/MIN304-L

Course Title: Underground Metalliferous Mining

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conducting investigations ofcomplex problems	Modern toolusage	The engineer and society	Environment and sustain ability:	Ethics	Individual andteamwork:	Communication:	Project management andfinance:	Life-longlearning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of mining engineering.
CO1:Mine Access and Development	1	2	1	1	1	2	1	2	2	1	1	2	2	3	2	1
CO2:Overview of stoping methods	1	1	2	2	1	2	3	2	1	1	2	2	2	1	2	1
CO3: Open stoping methods	1	1	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO4:Supported stoping methods	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO5:Stoping with caving and special mining methods.	1	2	1	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

POs & PSOs No.	Cos No .& Titles	SOs No.	Laboratory Instruction (L I)	Classroom Instructions (CI)	Self Learning(SL)
PO1,2,3,4,5,67,8,9,10,11,12 PSO1,2,3,4	CO1 :Mine Access and Development	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1,1.2	Unit-1.0 Mine development 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,	1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO2 :Overview of stoping methods	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1,2.2	Unit-2Stoping method 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9	2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO3: Open stoping methods	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1,3.2	Unit-3 :Open stoping method 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8, 3.9	3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO4:Supported stoping methods	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1,4.2	Unit-4:Supported stoping methods4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO5:Stoping with caving and special mining methods.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1,5.2	Unit5:Stoping with caving and special methods 5.1,5.2,5.3,5.4,5.5, 5.6,5.7,5.8,5.9	5.1

Semester-VI

Course Code: **MIN308/MIN308-L**

Course Title: Coal and Non-Coal Mineral Processing

Pre-requisite: Student should have basic knowledge of scope and purpose of mining and its methods.

Rationale: The students studying any Engineering should possess fundamental understanding about mining methods in India. They should have some idea about principle and techniques related to Mining methods.

Course Outcomes:

MIN308/MIN308-L.1: Explain the various aspects of beneficiation of ores and industrial minerals for value addition.
MIN308/MIN308-L.2: Describe the Scope, objectives, and limitations of mineral processing (communition & liberation).
MIN308/MIN308-L.3: Explain the Industrial screens, mechanical classifiers, hydro cyclones, gravity separation.
MIN308/MIN308-L 4: Explain coal processing, grade improvement, Indian scenario.
MIN308/MIN308-L.5: Evaluate beneficiation of coal and simple ores of gold, iron, manganese.

Scheme of Studies:

Code	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)	**MIN308/MIN308-L**	Coal and Non-Coal Mineral Processing	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.

Scheme of Assessment:

Theory

<table>
<tr><th rowspan="3">Code</th><th rowspan="3">Course Code</th><th rowspan="3">Course Title</th><th colspan="8">Scheme of Assessment (Marks)</th></tr>
<tr><th colspan="6">Progressive Assessment (PRA)</th><th rowspan="2">End Semester Assessment
(ESA)</th><th rowspan="2">Total Marks
(PRA+ ESA)</th></tr>
<tr><th>Class/Home Assignment 5 number 3 marks each (CA)</th><th>Class Test 2 (2 best out of 3) 10 marks each (CT)</th><th>Seminar one (SA)</th><th>Class Activity any one (CAT)</th><th>Class Attendance (AT)</th><th>Total Marks (CA+CT+SA+CAT+AT)</th></tr>
<tr><td>PCC</td><td>MIN308/ MIN308-L</td><td>Coal and Non-Coal Mineral Processing</td><td>15</td><td>20</td><td>5</td><td>5</td><td>5</td><td>50</td><td>50</td><td>100</td></tr>
</table>

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.

MIN308/MIN308-L.1: Explain the terminologies, classification and opening of Coal and Non-Coal Mineral Processing.

Approximate Hours

Item	Approx. Hrs
Cl	9
LI	2
SW	2
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1. Describe Scope, objectives. **SO1.2** Demonstrate limitations of Mineral Dressing **SO1.3** Interpret Role of microscopic study. **SO1.4** Explain Sampling. **SO1.5** Describe Importance and methods used in ore-dressing.	1.1 . Cut-off grade; Stripping ratio Opening of Benches	**Unit-1: Introduction** 1.1 Scope 1.2 Objectives 1.3 Limitations of Mineral Dressing 1.4 Role of microscopic study. 1.5 Sampling 1.6 Methods of sampling 1.7 Importance of ore-dressing. 1.8 Methods used in ore-dressing. 1.9 Case study	1. Surface Mine Design Basic Parameters. .

SW-1 Suggested Sessional Work (SW):

a. **Assignments:**

Explain Factors influencing in location of mine openings..

b. **Mini Project:** Methods of sampling

MIN308/MIN308-L.2: Describe the Scope, objectives, and limitations of mineral processing (communition & liberation).

Approximate Hours

Item	Approx. Hrs
Cl	9
LI	2
SW	2
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1 Describe Theory and practice of crushing & grinding. **SO2.2** Explain Conventional units used-their fields of application and limitation. **SO2.3** Discuss Sizing and Classification. **SO2.4** Explain Laws of setting of solids in fluid. **SO2.5** Explain Laboratory methods of sizing and interpretation of sizing data.	2.1 Bucket wheel excavators.	**Unit-2: Communities and Liberation** 2.1 Theory and practice of crushing 2.2 Theory and practice of grinding 2.3 Conventional units used-their fields of application and limitation. 2.4 Sizing and Classification. 2.5 Laws of setting of solids in fluid. 2.6 Laboratory methods of sizing 2.7 Interpretation of sizing data. 2.8 Industrial sizing by screens; Types of classifiers 2.9 Classification as means of sizing by screens.	1. Mine scheduling.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Discuss Laws of setting of solids in fluid.

b. **Mini Project:** Sizing and Classification

MIN308/MIN308-L.3: Explain the Industrial screens, mechanical classifiers, hydro cyclones, gravity separation.

Approximate Hours

Item	Approx. Hrs
Cl	9
LI	2
SW	2
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 Explain Flowing film concentration like spirals and shaking table. **SO3.2** Describe Heavy Media separation; Theory, applications. **SO3.3** Discuss Froth Flotation, physicochemical. **SO3.4** Analyse principles underlying flotation-reagents, flotation machines. **SO3.5** Assess Flotation of sulphides, oxides and non-metals.	3.1 Froth Flotation,.	**Unit-3 :Concentration Methods** 3.1 Jigging 3.2 Flowing film concentration like spirals and shaking table 3.3 Heavy Media separation 3.4 Theory, applications and limitations of each method 3.5 Introductory Froth Flotation 3.6 Physicochemical. 3.7 Principles underlying flotation-reagents 3.8 Flotation machines. 3.9 Flotation of sulphides, oxides and non-metals.	i. Study of Heavy Media separation.

SW-3 Suggested Sessional Work (SW):

a. **Assignments:**

i. Discuss Froth Flotation,.

b. **Mini Project:** Flotation machines

MIN308/MIN308-L.4: Explain coal processing, grade improvement, Indian scenario.

Approximate Hours

Item	Approx. Hrs
Cl	9
LI	2
SW	2
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4.1 Discuss about Electrostatic and magnetic methods. **SO4.2** Explain Fields of application and limitations. **SO SO4.3** Evaluate Dewatering and drying: Thickening, filtration and drying. **SO4.4** Demonstrate Coal Processing. **SO4.5** Discuss Coal wash ability, crushing.	4.1 Coal washing for coking and non-coking coal.	**Unit-4: Electrical Methods of Concentration** 4.1 Electrostatic and magnetic methods 4.2 Their principles of operation. 4.3 Fields of application and limitations. 4.4 Dewatering and drying 4.5 Thickening, filtration and drying. 4.6 Coal Processing: Dry and wet processing of coal. 4.7 Coal washing for coking and non-coking coal. 4.8 Coal wash ability, crushing 4.9 Sizing and cleaning of coal.	i.Dewatering and drying

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Discuss Coal wash ability, crushing.

b. Mini Project:

Surface mine layout

MIN308/MIN308-L.5: Evaluate beneficiation of coal and simple ores of gold, iron, manganese.

Approximate Hours

Item	Approx. Hrs
Cl	9
LI	2
SW	2
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO5.1 Describe Simplified Flow Sheets. **SO5.2** Explain Beneficiation of coal. **SO5.3** Describe Beneficiation of simple ores of gold, iron. **SO5.4** Discuss Beneficiation of simple ores of manganese, bauxite. **SO5.5** Explain Beneficiation of simple ores of lead-zinc with reference to Indian deposits.	5.1 In-pit crushing and conveying.	**Unit 5: Flow Sheets** 5.1 Simplified Flow Sheets. 5.2 Beneficiation of coal. 5.3 Beneficiation of simple ores of gold 5.4 Beneficiation of simple ores of iron. 5.5 Beneficiation of simple ores of copper 5.6 Beneficiation of simple ores of manganese 5.7 Beneficiation of simple ores of bauxite. 5.8 Beneficiation of simple ores of calcium 5.9 Beneficiation of simple ores of lead-zinc with reference to Indian deposits.	1 dredging, leaching.

SW-5 Suggested Sessional Work (SW):

a. Assignments:

Discuss Beneficiation of simple ores of manganese, bauxite.

b.Mini Project: Case study

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)
MIN308/MIN308-L..1: Explain the various aspects of beneficiation of ores and industrial minerals for value addition.	9	2	2	1	14
MIN308/MIN308-L..2: Describe the Scope, objectives, and limitations of mineral processing (communition & liberation).	9	2	2	1	14
MIN308/MIN308-L..3: Explain the Industrial screens, mechanical classifiers, hydro cyclones, gravity separation.	9	2	2	1	14
MIN308/MIN308-L..4: Explain coal processing, grade improvement, Indian scenario.	9	2	2	1	14
MIN308/MIN308-L..5: Evaluate beneficiation of coal and simple ores of gold, iron, manganese.	9	2	2	1	14
Total Hours	45	10	10	5	70

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Introduction	03	01	01	05
CO-2	Communition and Liberation	02	06	02	10
CO-3	Concentration Methods	03	07	05	15
CO-4	Electrical Methods of Concentration	-	10	05	15
CO-5	Flow Sheets	03	02	-	05
	Total	11	26	13	50

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

The end of semester assessment for Mining Geology-II will be held with written examination of 50 marks

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

Suggested Instructional/Implementation Strategies:

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

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Mineral Processing	Jain, S.K	CBS Publishers & Distributors, Delhi,	2018
2	Operational Handbook of Mineral Processing	Murty, V.V.R	Dennet & Co., Nagpur	2020
3	Textbook of Mineral Processing	Rao, DVS	Scientific Publishers (India),	2017

(a) Web link:

https://geology.com/

https://archive.nptel.ac.in/Harddisk/Direct_Download.html

https://epathshala.nic.in/

https://swayam.gov.in/

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Cos, Pos and PSOs Mapping

Program Title: B. Tech. Mining Engineering
Course Code: MIN308/MIN308-L
Course Title: Coal and Non-Coal Mineral Processing

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1 2	PSO1	PSO2	PSO3	PSO4
	Engi neeri ng Kno wled ge	Probl em analy sis	Design/ develop ment of solutio ns	Conduct investigatio ns of complex problems	Modern Tool usage	The engineer and society	Enviro nment and sustain ability:	Ethics	Individ ual and teamwo rk:	Communi cation:	Project managem ent And finance:	Life-long learning	Develop analytical skills in identifyin g and accordin gly take actions for solution of mining problems .	Should develop sufficient knowledg e about the economic, environme ntal and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques , mine managem ent, conflict resolution managem ent and general managem ent and safety in mines.	Devel opme nt of the base for innov ation & resear ch in the field of minin g engine ering.
CO-1 Explain the terminologies, classification and opening of Coal and Non-Coal Mineral Processing.	1	2	1	1	1	2	1	2	2	1	1	2	2	3	2	1
CO-2 Explain the Planning of surface mines, excavation sequence. India.	1	1	2	2	1	2	3	2	1	1	2	2	2	1	2	1
CO-3 Describe Drilling mechanism, selection of drills for coal and other formations.	1	1	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO-4 Explain Methods of excavation & transportation.	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO-5 Evaluate application and selection of Special methods of mining.	1	2	1	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map

Pos & PSOs No.	Cos No. & Titles	SOs No.	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,67,8,9,10,11,12 PSO1,2,3,4	CO-1 Explain the terminologies, classification and opening of Coal and Non-Coal Mineral Processing.	SO1.1 SO1.2 SO1.3 SO1.4, SO1.5	Unit-1.0 Application 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-2 Explain the Planning of surface mines, excavation sequence.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	Unit-2 Surface Mine Planning 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9	SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-3 Describe Drilling mechanism, selection of drills for coal and other formations.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	Unit-3 : Drilling/Blast hole drilling 3.1,3.2,3.3,3.4,3.5,,3.6,3.7,3.8,3.9	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-4 Explain Methods of excavation & transportation.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	Unit-4: Methods of excavation and transportation 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	SL 4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO -5 Evaluate application and selection of Special methods of mining.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	Unit5: Application and selection of Special methods of mining 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9	SL 5.1

Semester VI

Course Code: PROJ-MIN02

Course Title: Mini Project Work on Innovative and Sustainable mining

Pre-Requisite: The student should have basic knowledge about the surface mining and underground mining.

Rationale: The student studying mining engineering should develop fundamental understanding about the scope and application of theoretical machines operations, blasting operations, mine safety and productions systems.

Course Outcome:
The student

PROJ-MIN02-L.1- will garner an insight into the theoretical aspects of artificial intelligence.
PROJ-MIN02-L.2- Understanding the CBM.
PROJ-MIN02-L.3-Will develops complete knowledge and understanding of the explosive parameters.
PROJ-MIN02-L.4 -Will comprehend the technical aspects of new innovative mining ideas.
PROJ-MIN02-L.5- Will garner an understanding about the need for adopting the long wall mining.

Scheme of studies:

Code	Course code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total study Hours (CI+LI+SW+SL)	
PROJ	PROJ-MIN02	Mini Project Work on Innovative and Sustainable mining	0	2	1	1	4	1

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

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

Scheme of Assessment:
Practical

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks (PRA + ESA)**
			Class Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+ SA+CAT +AT)		
PROJ	PROJ-MIN02	Mini Project Work on Innovative and Sustainable mining	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.

PROJ-MIN02-L.1- will garner an insight into the theoretical aspects of artificial intelligence.

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	0
Laboratory Instructions (LI)	4
Sessional work (SW)	1
Self Learning	1
Total	6

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO 1.1- Define the artificial intelligence. SO 1.2- Understand the importance of artificial intelligence.. SO 1.3- Understand the artificial intelligence use in mining industry.	1.1 Describe the artificial intelligence. 1.2 Describe the importance of artificial intelligence use in mining.		1.1 Explain the artificial intelligence.

Suggested Sessional works:

a. Assignments:

Explain the artificial intelligence in mining industry.

PROJ-MIN02-L.2- Understanding the CBM.

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	0
Laboratory Instructions (LI)	4
Sessional work (SW)	1
Self Learning	1
Total	6

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO 2.1-Explain the CBM SO 2.2- Understand the importance of CBM. SO2.3- Understand the diagram of CBM	2.1 Explain the CBM. 2.2 Explain the importance and extraction of CBM.		1. Describe CBM

Suggested Sessional works: a. Assignments:

(i) Explain the CBM use in mining.

PROJ-MIN01-L.3-Will develops complete knowledge and understanding of the explosive parameters.

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	0
Laboratory Instructions (LI)	4
Sessional work (SW)	1
Self Learning	1
Total	6

Session Outcomes (SOs)	**Laboratory Instructions (LI)**	**Class Room Instructions (CI)**	**Self Learning (SL)**
SO3.1- Define Explosive use in mining. SO3.2- Understand the categories of explosive. SO3.3- Understand the explosive properties.	3.1 Explosive use in mining. 3.2 Types of explosive use in mining.		a) Categories the explosive.

Suggested Sessional works: a. Assignments:

a) Write down the explosive use in mining.

PROJ-MIN02-L.4 -Will comprehend the technical aspects of new innovative mining ideas.

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	0
Laboratory Instructions (LI)	4
Sessional work (SW)	1
Self Learning	1
Total	6

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO4.1- Understand the mine design. SO4.2- Understand the mine design software. SO4.3- Describe the blast free mining.	4.1 Mine design as per software. 4.2 Blast fee mining as per requirement.		1. Explain the mine design as per software.

Suggested Sessional works: a. Assignments:

1. Explain the blast free mining.

PROJ-MIN02-L.5- Will garner an understanding about the need for adopting the long wall mining.

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	0
Laboratory Instructions (LI)	4
Sessional work (SW)	1
Self Learning	1
Total	6

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO5.1-Understanding the term "longwall mining. SO5.2- Explain the importance of longwall mining. SO5.3- Explain the method extraction of longwall mining.	5.1 Describe the longwall mining methods. 5.2 Describe the support of longwall mining		1. Explain the longwall mining

Suggested Sessional works:

a. Assignments:

Review of longwall mining.

Brief of Hours suggested for the course outcome:

Course outcomes	Class Lectures (CL)	Laboratory Instructions (LI)	Sessional work (SW)	Self Learning (SL)	Total Hour (CL+LI+SW+SL)
PROJ-MIN02-L.1- will garner an insight into the theoretical aspects of artificial intelligence.	0	4	1	1	6
PROJ-MIN02-L.2- Understanding the CBM.	0	4	1	1	6
PROJ-MIN01-L.3-Will develops complete knowledge and understanding of the explosive parameters.	0	4	1	1	6
PROJ-MIN02-L.4 -Will comprehend the technical aspects of new innovative mining ideas.	0	4	1	1	6
PROJ-MIN02-L.5- Will garner an understanding about the need for adopting the long wall mining.	0	4	1	1	6
Total Hours	0	20	5	5	30

Suggestions for End semester Assessment:

Suggested Specification Table

Cos	Unit Titles	Marks Distribution			Total; Marks
		R	U	A	
CO 1	will garner an insight into the theoretical aspects of artificial intelligence.	3	3	1	7
CO 2	Understanding the CBM.	3	4	3	10
CO 3	Will develops complete knowledge and understanding of the explosive parameters.	3	5	5	13
CO 4	- Will comprehend the technical aspects of new innovative mining ideas.	3	5	5	13
CO 5	Will garner an understanding about the need for adopting the long wall mining.	2	3	2	7
	Total	14	20	16	50

Legend: R-Remember U-Understand A-Apply

The end of semester assessment for Mini project work on innovative and sustainable mining will be held with written examination of 50 marks

Suggested Instructional/ Implementation Strategies:

1. **Improved lectures**
2. Tutorial
3. Case studies
4. Group discussion
5. Role play
6. Visit to mining industries
7. Demonstration
8. Digital media application in teaching learning process and mass media
9. Brainstorming

Suggested Learning Resources

Sl. No	Title	Author	Publisher	Edition & Year
1.	Mining and Environmental Sustainability	Prof. G. S. Roonwal	Daya publishing house	2014

(b) Link https://nptel.ac.in

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COs, POs & PSO Mapping

Program Title: B. Tech (Mining Engineering)
Course Code: PROJ-MIN02
Course Title: Mini Project Work on Innovative and Sustainable mining

	Program Outcomes						Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
Course Outcome	Develop the skilled knowledge of communi-cation in verbal and written forms	Apply the complex systems as part of research projects	Create, select & apply appropriate techniques, resources & modern engineering & IT tools	Understand the impact of professional engineering solutions in societal & environmental practices	Apply ethical principles & commit to professional ethics & responsibilities and norms of the engineering practice	The ability to engage in self-directed, reflective & lifelong learning for the benefit of the society	Dev. Analy tical skill for complex mining problems	Specialized in depth knowledge in specific areas of mining	Capability to comprehend articulated needs for mining industry	Research orientation based on articulated needs
CO1- will garner an insight into the theoretical aspects of artificial intelligence.	2	2-	1	1	1	1	2	1	1	1
CO2- - Understanding the CBM.	1	-1	-2	-3	2	1	1	1	2	2
CO 3- Will develops complete knowledge and understanding of the explosive parameters.	2	3	1	1	3	2	2	1	3	1
CO 4- Will comprehend the technical aspects of new innovative mining ideas.	2	3	2	3	1	2	2	1	3	1
CO 5- Will garner an understanding about the need for adopting the long wall mining.	1	1	2	1	3	2	2	2	3	2

Legend: 1: Low 2: Medium 3: High

Course Curriculum Map

POs & PSOs Number	COs number & Title	SOs Number	Laboratory Instruction (LI)	Class Room Instructions (CI)	Self Learning (SL)
PO: 1,2,3,4,5,6 PSO: 1,2,3,4	CO1- - will garner an insight into the theoretical aspects of artificial intelligence.	SO 1.1 SO 1.2 SO 1.3	1.1,1.2		SL 1.1
PO: 1,2,3,4,5,6 PSO: 1,2,3,4	CO2- - Understanding the CBM.	SO2.1 SO 2.2 SO 2.3	2.1,2.2		SL 2.1
PO: 1,2,3,4,5,6 PSO: 1,2,3,4	CO 3- Will develops complete knowledge and understanding of the explosive parameters.	SO 3.1` SO 3.2 SO 3.3	3.1,3.2		SL 3.1
PO: 1,2,3,4,5,6 PSO: 1,2,3,4	CO 4- Will comprehend the technical aspects of new innovative mining ideas.	SO 4.1 SO 4.2 SO 4.3	4.1,4.2		SL 4.1
PO: 1,2,3,4,5,6 PSO: 1,2,3,4	CO 5- Will garner an understanding about the need for adopting the long wall mining.	SO 5.1 SO 5.2 SO 5.3	5.1,5.2		SL 5.1

Semester VII

Course Code: **MIN401/MIN401-L**

Course Title: Mine Planning and Design & Mineral Economics

Pre-requisite: The students studying Mining engineering should possess fundamental knowledge of key aspects of underground mining,

Rationale: ThestudentsstudyingMiningengineeringshouldpossessfoundationalunderstandingand advanced knowledge of mining methods. Additionally, student sought to acquire fundamental insights into various general regulations, acts and administration as per requirement of mining industries.

Course Outcomes:

MIN401/MIN401-L.1: Identify the Fundamentals of mine planning:

MIN401/MIN401-L.2: Explain Techno economics of Production planning

MIN401/MIN401-L.3: Summarize mine infrastructure planning.

MIN401/MIN401-L.4: Illustrate Planning for mine sub systems:

MIN401/MIN401-L.5: Assess Project Planning & Environmental Management

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits(C)
			Cl	LI	SW	SL	Total Study Hours(CI+LI+SW+SL)	
PCC	**MIN401/ MIN401-L**	Mine Planning and Design & Mineral Economics	3	2	1	1	6	4

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

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

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

SL: Self Learning,

C: Credits.

Note:

SW&SLhastobeplannedandperformedunderthecontinuousguidanceandfeedbackofteacherto ensure outcome of Learning.

Scheme of Assessment:
Theory

Code	Course Code	Course Title	**Scheme of Assessment(Marks)**							
			Progressive Assessment(PRA)						**End Semester Assessment**	**Total Marks**
			Class/Ho meAssign ment5num ber 3 marks each (CA)	Class Test2 (2bestout of3) 10 marks each(CT)	Semin ar one (SA)	Class Activi ty anyon e (CAT)	Class Attendance (AT)	Total Marks CA+CT+SA+CAT+AT)	**(ESA)**	(PRA +ESA)
PEC	**MIN401/MIN 401-L**	Mine Planning and Design & Mineral Economics	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.

MIN401/MIN401-L.1: Fundamentals of mine planning

Approximate Hours

Item	AppXHrs
Cl	08
LI	4
SW	1
SL	2
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 Understandmine planning and its importance **SO1.2**Understand mining revenues and costs **SO1.3**Recall depreciation by different methods SO1**.4**Examine planning steps and inputs **SO1.**5 Evaluate mineral inventory estimates .	1. PV FW Calculation 2. Cash Flow	**Unit-1.0 Fundamentals of mine planning** 1.1 Mine planning and its importance 1.2 Calculation of PV, FW, NPV, IRR etc. 1.3 Depreciation calculation by different methods. 1.4 Cash flow 1.5 Mine planning components 1.6 Factors affecting mine planning 1.7 Mineral Inventory estimates. 1.8 Preparing plan reports.	1. Determining cash flows. 2. Demonstrate mine planning components

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Write up of cash flow planning

b. Mini Project:

c. Other Activities(Specify):

MIN401/MIN401-L.2: Techno economics and Production planning

Approximate Hours

Item	AppXHrs
Cl	8
LI	4
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1 Discuss Systems requirements in mine planning; **SO2.2**Recall techno economic decisions of mine planning. **SO2.3Determine optimum mine life.** **SO2.4**Relate economic decision making for mine accesses(shaft or incline); **SO2.**5 Calculate cash flows, mine and mill plant size.	1. Mine life calculation 2. Cash Flow calculation	Unit-2 **Techno economics and Production planning** 2.1 Systems requirements in mine planning 2.2 concepts and techniques of mine optimization; 2.3 economic decision making for mine accesses(shaft or incline 2.4 determination of optimum mine size and Taylor's mine life rule. 2.5 Sequencing by nested pits 2.6 Cash flow calculations 2.7 Mine and mill plant sizing 2.8 Lanes algorithm for estimation of optimum mill cut-off grade.	**i.**Evaluating mine access decisions

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

a. **Assignments:**
   i. Mine optimization factors
   ii. Mine and mill size determination
b. **Mini Project:**
   Determining the life of a mine based on Taylor's formula.

MIN401/MIN401-L.3: Summarize mine infrastructure planning

Approximate Hours

Item	AppXHrs
Cl	09
LI	4
SW	2
SL	1
Total	16

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO3.1 Recall mine facility locations and their optimization methods **SO3.2** Determineplanning and design of surface layout **SO3.**3 Examine Mine access design of shaft systems; **SO3.4** Determine planning and design of filling and stowing plants **SO3.**5 Assess design of drainage system in surface mine	1. Shaft systems 2. Power requirement.	**Unit-3:Mine Infrastructure Planning** 3.1 planning and design of surface layout 3.2 classification of surface layout 3.3 Mine access design of shaft systems; 3.4 planning for power requirement 3.5 planning of mineral handling plants; 3.6 planning and design of filling and stowing plants; 3.7 future mine planning – issues and challenges 3.8 design of drainage system in surface mines 3.9 Selection of mining system vis-à-vis equipment system.	i. Evaluating the plan of a stowing plant.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i) Drawing a stowing plant
Planning a stowing plant pipe layout.

b. Mini Project:

Designing a surface drainage system.

MIN401/MIN401-L 4: Planning for mine sub systems:

Approximate Hours

Item	AppXHrs
Cl	9
LI	4
SW	1
SL	2
Total	16

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4.1 Concept of taxation; principles of mine taxation **SO4.2** mineral sector taxation methods and tax incentives **SO4.3** ; mineral taxation in India **SO4.4** Market structure; market analysis **SO4.**5 International mineral study groups, associations and cartels; pricing of minerals, factors affecting minerals price. .	1. Mining industry importance 2. Land of sea	Unit -4.0 Mineral taxation, markets and trade 4.1 Concept of taxation; principles of mine taxation 4.2 mining taxation structure; mineral sector taxation methods and tax incentives 4.3 mineral taxation in India 4.4 role of taxes; taxes affecting mineral sector; 4.5 Market structure; market analysis; export of minerals 4.6 ; International mineral study groups, associations and cartels 4.7 pricing of minerals, factors affecting minerals price 4.8 Case study 4.9 case study .	1. Mineral taxation in India 2. Market structure and pricing of minerals

SW-4Suggested Sessional Work (SW):

a. Assignments:

i. Describe stripping ratios of coal mines.

MIN401/MIN401-L.5: Assess dangers of mine inundation

Approximate Hours

Item	AppXHrs
Cl	11
LI	4
SW	2
SL	1
Total	18

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO5.1 Concept of small mines; socio economic significance of small mines **SO5.2** elements of NMP of a nation **SO5.3** salient features of NMP 2019 **SO5.4** effective implementation of NMP **SO5.5** EXIM policy of India	1. Mine valuation 2. DCF calculation.	**Unit -5.0** Small Mines and NMP 5.1 Concept of small mines; socio economic significance of small mines 5.2 problems of small mines; concept of small deposit 5.3 infrastructures in mining areas; 5.4 co products and byproducts in mining 5.5 objectives and elements of NMP of a nation 5.6 salient features of NMP 2019. 5.7 effective implementation of NMP 5.8 EXIM policy of India 5.9 environmental hazards and their protection measures 5.10 Calculation 5.11 Numericals	1. Evolution of NMP and changes in it .

SW-5 Suggested Sessional Work (SW):

a. Assignments:

Mine Closure Plan
Environmental effect of mining

b. Mini Project:

Discuss the closure plan of the mine visited.

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)
MIN401/MIN401-L.1: Identify the Fundamentals of mine planning:	8	4	1	2	**15**
MIN401/MIN401-L.2: Explain Techno economics of Production planning.	8	4	1	2	15
MIN401/MIN401-L.3:Summarize mine infrastructure planning.	9	4	1	2	16
MIN401/MIN401-L.4:Illustrate Planning for mine sub systems	9	4	1	2	16
MIN401/MIN401-L.5:Assess Project Planning & Environmental Management	11	4	2	1	18
Total Hours	45	20	5	10	80

Suggestion for End Semester Assessment

Suggested Specification Table(For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Identify the Fundamentals of mine planning:	03	01	01	05
CO-2	Explain Techno economics of Production planning.	02	06	02	10
CO-3	Summarize mine infrastructure planning.	03	07	05	15
CO-4	Illustrate Planning for mine sub systems	03	07	05	15
CO-5	Assess Project Planning & Environmental Management	03	02	-	05
Total		14	23	13	50

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

The end of semester assessment for Basic Mining Engineering willbeheldwithwrittenexaminationof50 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 mining industries
7. Demonstration
8. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blo
9. Facebook,Twitter,Whatsapp,Mobile,Onlinesources)

Suggested Learning Resources:

(a)Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Principles of Mine Planning	Bhattacharya, J	Allied Publishers Pvt. Ltd,	2003
2	Mine Economics	Deshmukh, R.T	Myra publication	1986
3	Coal Mines Regulations 2017			

Link

https://nptel.ac.in/courses/105105170

Curriculum Development Team

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Cos, POs and PSOs Mapping

Program Title: B. Tech. Mining Engineering

Course `Code: MIN401/MIN401-L

Course Title: Mine Planning and Design & Mineral Economics

Course Outcomes	Program Outcomes												Program Specific Outcome			
	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 investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustain ability:	Ethics	Individual and team work:	Communication:	Project management and finance:	Life-long learning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of mining engineering.
CO1:Identify the Fundamentals of mine planning:	1	2	1	1	1	2	1	2	2	1	1	2	2	3	2	1
CO 2 Explain Techno economics of Production planning**.**	1	1	2	2	1	2	3	2	1	1	2	2	2	1	2	1
CO3 Summarize mine infrastructure planning.	1	1	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO 4: Illustrate Planning for mine sub systems	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO5:Assess Project Planning & Environmental Management	1	2	1	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

POs &PSOs No.	Cos No``.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,67, 8,9,10,11,12 PSO1,2,3,4	CO1 :**I**dentify the Fundamentals of mine planning:	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1,1.2	Unit-1.0Fundamentals of mine planning 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8	SL1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO2: Explain Techno economics of Production planning.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1,2.2	Unit-2Techno economics of Production planning. 2.1,2.2,2.3,2.4,2.5,2.6,2.7, 2.8	SL2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO3:Summarize mine infrastructure planning.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1,3.2	Unit-3 :mine infrastructure planning 3.1,3.2,3.3,3.4,3.5,3.6, 3.7, 3.8,3.9	SL3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	**CO 4:**Illustrate Planning for mine sub systems	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1,4.2	Unit-4:Planning for other sub system 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	SL4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 5: AssessProject Planning & Environmental Management.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1,5.2	Unit5:Assess Project Planning & Environmental Management 5.1,5.2,5.3,5.4,5.5, 5.6, 5.7,5.8,5.9,5.10,5.11	SL5.1

Semester-VII

Course Code: **BSC401**

Course Title: Quantitative Decision Making

Pre-requisite: Student should have the knowledge of computer application, numerical solving and apply in mining industries to solve the problems.

Rationale: The students studying the knowledge of computer application, numerical solving and apply in mining industries to solve the problems. Also students study the various mining solutions which are beneficial for mining industries as per requirement.

Course Outcomes:

BSC401 .1: Describe about the basic concept of operation research.

BSC401 .2: Explain about the importance of linear programming like simplex methods.

BSC401 .3: Discuss about the importance of network analysis like CPM and PERT which is benefitted for mining solutions.

BSC401 .4: Illustrate the study about queue theory and problems solving.

BSC401 .5: Understand the non-linear programming problems.

Scheme of Studies:

Code	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)	**BSC401**	Quantitative Decision Making	4	0	1	1	5	4

Legend: **CI:** Class room Instruction (Includes different instructional strategiesi.e. Lecture(L) and T utorial (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 plannedandperformedunderthecontinuousguidanceandfeedbackofteacherto ensure outcome of Learning.

Scheme of Assessment:

Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment5 number 3 marks each (CA)	Class Test2 (2bestout of3) 10 marksea ch(CT)	Seminar one (SA)	Class Activityanyone (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
PCC	**BSC401**	Quantitative Decision Making	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 irmastery of Session Outcomes (SOs),culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

BSC401 .1: Describe about the basic concept of operation research.

Approximate Hours

Item	Appx. Hrs
Cl	12
LI	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 Importance of operation research. SO1.2 Discuss about the Scope of Operation Research SO1.3Learn about the Advantages of OR SO1.4 Discuss about the Characteristics of Operation Research SO1.5 Describe about the Limitation of Operation Research .	.	**Unit-1.0 Introduction to Operation Research** 1.1Definition of OR. 1.2Various authors suggested by definitions of OR 1.3 Various authors suggested by definitions of OR 1.4History of OR Part 1 1.5History of OR Part 2 1.6Characteristics of OR 1.7Advantages of OR 1.8Scope of OR 1.9Advantages of OR 1.10Limitation of OR 1.11 Various authors OR 1.12 Problems	1. Operation Research 2. Importance of Operation Research

SW-1 Suggested Sessional Work (SW):

a. Assignments:

ii. Importance of OR

BSC401 .2: Explain about the importance of linear programming like simplex methods.

Approximate Hours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 Knowledge a brief on linear programming SO2.2 Understand the simplex methods SO2.3 Understand the problems of dual theory SO2.4Toknow the dynamic programming SO2.5 Learn about the problems	.	**Unit-2 Linear Programming and Dynamic Programming** 2.1 Linear Programming 2.2. Simplex methods 2.3 Steps of simplex methods 2.4 Problems of Simplex methods 2.5 Dual Problems analysis 2.6 Dynamic problems 2.7 post optimality analysis 2.8 recursive equation approach, 2.9 computational procedure, forward and backward computations and problems of dimensionality. 2.10 Graphical methods 2.11 Problem 2.12 Numerical	ii. Learning about the linear programming iii. Dynamic programming

SW-2 Suggested Sessional Work (SW):

Assignments:

i. Dynamic programming

BSC401 .3: Discuss about the importance of network analysis like CPM and PERT which is benefitted for mining solutions.

Approximate Hours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO3.1 Describe network analysis SO3.2Able to select numerical SO3.3 Explain the inventory models SO3.4Explain the project evaluation SO3.5 Analyze the problems	.	**Unit-3: Network Analysis** 3.1 Introduction of Network analysis critical path calculations, 3.2 variance and standard deviation 3.3 probability and cost considerations in project 3.4 scheduling, 3.5 construction of time chart and resource leveling. 3.6 nventory Models: 3.7 deterministic and probabilistic models. 3.8 Numerical 3.9 Numerical 3.10 Problem 3.11 Numerical 3.12 umerical	1 CPM 2 PERT

SW-3Suggested Sessional Work (SW):

Assignments:

1. `Importance of CPM and PERT

BSC401 .4: Illustrate the study about queue theory and problems solving.

Approximate Hours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4.1Explain Queuing Theory SO4.2 Application of Queuing Theory SO4.3 Benefits in Mining Industry SO4.4 Analyze Numerical SO4.5 Explain queuing theory Problems	.	**Unit-4: Queuing Theory:** 4.1 Basic concepts, 4.2 axiomatic derivation of the arrivals and departures, 4.3 distribution for Poisson queues, 4.4Poisson queuing models, 4.5 non-Poisson queuing models 4.6 queuing models with priorities for service. 4.7 Problems 4.8 Numerical 4.9 Numerical 4.10 Problems 4.11 Problems 4.12 Problems `	i. Importance of Queuing Theory ii. Numerical

SW-4 Suggested Sessional Work (SW):

a.Assignments:

1. Discuss about queuing theory

BSC401 .5: Understand the non-linear programming problems.

Approximate Hours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
SO5.1Explain the non-linear programming SO5.2Preparation of Numerical SO5.3Impotance of non-linear programming SO5.4Describe the programming – separable, quadratic, stochastic SO5.5Discuss problems		**Unit5: Non-linear Programming:** 5.1 Basic concept 5.2 Problems 5.3 Unconstrained external problems, 5.4constrained external problems, 5.5 programming – separable, 5.6 quadratic, stochastic and 5.7 geometric. 5.8 Problem 5.9 Numerical 5.10 Numerical 5.11 Problems 5.12 Numericals	1. Non-linear problem 2. Numerical

SW-5Suggested Sessional Work (SW):

a.Assignments:

1. Importance of non-linear programming

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour(Cl+SW+Sl)
BSC401 .1: Describe about the basic concept of operation research.	12	1	2	**15**
BSC401 .2: Explain about the importance of linear programming like simplex methods.	12	1	2	**15**
BSC401 .3: Discuss about the importance of network analysis like CPM and PERT which is benefitted for mining solutions.	12	1	2	**15**
BSC401 .4: Illustrate the study about queue theory and problems solving.	12	1	2	**15**
BSC401 .5: Understand the non-linear programming problems.	12	1	2	**15**
Total Hours	60	5	10	75

Course Curriculum Team

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Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Describe about the basic concept of operation research.	03	02	-	05
CO-2	Explain about the importance of linear programming like simplex methods.	02	06	02	10
CO-3	Discuss about the importance of network analysis like CPM and PERT which is benefitted for mining solutions.	03	07	05	15
CO-4	Illustrate the study about queue theory and problems solving.	03	07	05	15
CO-5	Understand the non-linear programming problems.	02	02	01	05
Total		14	23	13	50

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

The end of semester assessment for Basic Mining Engineering will be held with writtenexaminationof50 marks.

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

Suggested Learning Resources:

(a)Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Operation Research	H. A Eiselt & Carl – Louis Sandblom	Springer	3rd and 2010
2	Operation Research – Theory and Application	J. K. Sharma	Trinity Press	6th and 2006

Link

https://www.stonybrook.edu/commcms/ams/graduate/or/

https://www.bbau.ac.in/dept/UIET/EME-601%20Operation%20Research.pdf

Cos, Pos and PSOs Mapping

Program Title: B. Tech. Mining Engineering

Course Code: BSC401

Course Title: Quantitative Decision Making

Course Outcomes	Program Outcomes												Program Specific Outcome			
	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 investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability:	Ethics	Individual and team work:	Communication:	Project management and finance:	Life-long learning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of mining engineering.
CO1: Describe about the basic concept of operation research.	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**2**	**2**	**1**	**1**	**2**	**2**	**3**	**2**	**1**
CO 2: Explain about the importance of linear programming like simplex methods.	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**
CO3: Discuss about the importance of network analysis like CPM and PERT which is benefitted for mining solutions.	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO 4: Illustrate the study about queue theory and problems solving.	**2**	**2**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO5: Understand the non-linear programming problems.	**1**	**2**	**1**	**1**	**1**	**3**	**3**	**3**	**-**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

POs & PSOs No.	CO s No. & Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,67,8,9,1 0,11,12 PSO1,2,3,4	CO1: Describe about the basic concept of operation research.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 Introduction to Operation Research 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11,1.12	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 2 Explain about the importance of linear programming like simplex methods.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2 Linear programming and dynamic programming 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9,2.10,2.11,2.12	SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO3 Discuss about the importance of network analysis like CPM and PERT which is benefitted for mining solutions.	SO3.1S O3.2 SO3.3 SO3.4 SO3.5		Unit-3: Network Analysis 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8, 3.9,3.10,3.11,3.12	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 4: Illustrate the study about queue theory and problems solving.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4:Queuing Theory 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12	SL 4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 5: Understand the non-linear programming problems.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit5:Non-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	SL 5.1`

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Semester-VII

Course Code: **MIN 402/MIN402-L**

Course Title: Mining Machinery III

Pre-requisite: Student should have basic knowledge of Mine Machineries used in mines andEquipments used for their excavation.

Rationale: The students studying Mining Engineering should possess foundational understanding about Mining, They must know about machineries and most important how to excavate mineral economically and safely. They must have knowledge about different types of pumps, their installation care and maintenance.

Course Outcomes:

MIN 402/MIN402-L:1.1 Understand about the pumps used in mines their construction, operation and characteristics
MIN 402/MIN402-L: 1.2 Mineral handling and screening equipment
MIN 402/MIN402-L: 1.3 Preventative, Predictive maintenance and Condition monitoring
MIN 402/MIN402-L: 1.4 Advances in Mining Machineries
MIN 402/MIN402-L: 1.5 Methods of assessing efficiency of HEMM and other machineries

Scheme of Studies:

Code	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)	MIN 402/MIN402-L	Mining Machinery III	3	2	1	1	7	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L), 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 feed back of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

<table>
<tr><th rowspan="3">Code</th><th rowspan="3">Course Code</th><th rowspan="3">Course Title</th><th colspan="8">Scheme of Assessment (Marks)</th></tr>
<tr><th colspan="6">Progressive Assessment (PRA)</th><th rowspan="2">End Semester Assessment

(ESA)</th><th rowspan="2">Total Marks

(PRA+ ESA)</th></tr>
<tr><th>Class/Home Assignment 5 number 3 marks each (CA)</th><th>Class Test 2 (2 best out of 3) 10 marks each (CT)</th><th>Seminar one

(SA)</th><th>Class Activity any one `

(CAT)</th><th>Class Attendance

(AT)</th><th>Total Marks

(CA+CT+SA+CAT +AT)</th></tr>
<tr><td>PCC</td><td>MIN 402/MIN402-L</td><td>Mining Machinery III</td><td>15</td><td>20</td><td>5</td><td>5</td><td>5</td><td>50</td><td>50</td><td>100</td></tr>
</table>

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.

MIN 402/MIN402-L1: To understand about the pumps used in mines their construction, operation and characteristics

Approximate Hours

Item	Approx. Hrs
Cl	9
LI	4
SW	2
SL	2
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO1.1 Principal types, construction, operation and characteristics **SO1.2** Calculation of size and efficiency of the pumps **SO1.3** Installation, operation care and maintenance; Frictional resistance; **SO1.4** Damage due to corrosion and abrasion, and precaution **SO1.5** Cleaning and replacement of pipes; location and design of mine sumps.	1.1 Design of mine pump with its installation, care and maintenance. 1.1 Turbine pump with constructional details and characteristic curves.	**Unit1:** Pumps and Pumping 1.1 Principal of pumps and operation 1.2 Construction and Size 1.3 Efficiency of the Pumps 1.4 Installation, Operation and Maintenance 1.5 Installation of pumps in shafts and Roadways 1.6 Damage due to corrosion 1.7 Damage due to abrasion 1.8 Cleaning of Pipes 1.9 Location of the Sump	1. Working of Turbine Pump 2. Location of middle sump and Main Sump

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Installation of Pumps

b. Mini Project:

i. Draw Efficiency graph of the pumps

MIN 402/MIN402-L2: Mineral handling and screening equipment

Approximate Hours

Item	Approx. Hrs
Cl	9
LI	4
SW	2
SL	2
Total	17

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1 Layouts of pit-top and pit-bottom **SO2.2** Mineral handling and screening equipment e.g. Creepers; Tipplers; **SO2.3** Layouts of railway siding of mines. **SO2.4** Storage bunker and Pit bottom **SO2.5** Installations and circuit with cage and skip systems.	2.1 Types of signaling systems used in mines for modern system of hoisting. 2.2 Pit-top layout with shaft for handling 2000 tonnes production per day.	**Unit-2:** Handling of Minerals 2.1 Layouts of pit-top and pit-bottom 2.2 Details of banking 2.3 Mineral handling and screening equipment 2.4 Layout of Creepers 2.5 Installation of Tipplers 2.6 Layouts of railway siding of mines 2.7 Construction of Storage bunker 2.8 Pit bottom installations 2.9 Circuit with cage and skip systems.	i Layout of Pit Bottom and pi top and proper circuit ii Layout of Railway Siding

SW-2 Suggested Sessional Work (SW):

a. Assignments:

ii. How to transport the mineral from face to the surface

iii. Write notes Creeper

b. Mini Project:

Lay out of storage bunker at Railway Siding

MIN 402/MIN402-L3: Preventative, Predictive maintenance and Condition monitoring

Approximate Hours

Item	Approx. Hrs
Cl	9
LI	4
SW	3
SL	2
Total	18

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO3.1 Preventative and predictive maintenance of Equipments **SO3.2** Condition monitoring and Workshops **SO3.3** Automation and remote control of mining equipment **SO3. 4** Safety regulations and different signaling systems in mines. **SO3.5** Low profile dumpers and high wall machinery	3.1 Pit-top layout with direct rope haulage. 3.2 Designing of various pit-bottom layouts. .	**Unit-3 :** Preventative and predictive maintenance of Mine equipment 3.1 Preventative maintenance 3.2 Predictive maintenance 3.3 Condition monitoring and Workshops 3.4 Automation and remote control of mining equipment 3.5 Safety regulations and different signaling systems 3.6 Jumbo drill machine, 3.7 Simbha Drill Machine 3.8 Low profile Dump Truck 3.9 High Wall Machinery	i. Study of Condition Monitoring ii. High Wall Machinery

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Safety standards and different signaling systems in underground mine
ii. Automation and remote control of mining equipment in the world today

b. **Mini Project:**

Prepare a note on working of Low Profile Dump Truck

c. Other Activities (Specify):

Collect data of Predictive and Preventive Maintenance

MIN 402/MIN402-L4: Advances in Mining Machineries in India

Approximate Hours

Item	Approx. Hrs
Cl	9
LI	4
SW	2
SL	2
Total	17

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4.1 Robotics in Movable Machines **SO4.2** Energy Conservation efforts in Mining Machinery **SO4.3** Energy Conservation efforts in Air Compressors, Pumps, Conveyors **SO4.4** Energy Conservation efforts in Belt and other Conveyors **SO4.5** Underground and surface mine applications.	4.1 Application of creeper and tippler in mineral handling 4.2 Design of mine sumps and their selection of site in mines.	**Unit-4:** Advances in Mining Machineries 4.1 Robotics In Machineries 4.2 Energy Conservation efforts in Mining Machinery 4.3 Air Compressors 4.4 Pumps 4.5 Conveyors, 4.6 High HP engines 4.7 underground applications. 4.8 surface mine applications. 4.9 Other Equipments	i Use of Remote control and Robot in Machineries ii Energy Conservation in Main Ventilator

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Discuss about Robotic of Mining Underground Equipments

ii. Evaluate Energy Consumption in Underground Equipments

b. **Mini Project:**

i. Visit a Mine for effect of Energy Conservation

MIN 402/MIN402-L5: Methods of assessing efficiency of HEMM and other machineries

Approximate Hours

Item	Approx. Hrs
Cl	9
LI	4
SW	2
SL	2
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO5.1 Methods of assessing efficiency of HEMM **SO5.2** Methods of assessing efficiency of other machineries **SO5.3** Standards laid by CMPDI for Efficiency Measurement **SO5.4** Availability of Equipments **SO5.5** Utilization of Equipments	5.1 Planning and scheduling of maintenance of machinery used in mines. 5.2 Layout of muck movement through ore passes bunkers, u/g crusher and shaft.	**Unit 5:** Calculating Efficiency of Machineries 5.1 Methods of assessing efficiency of Dumpers 5.2 Methods of assessing efficiency of Shovels 5.3 Methods of assessing efficiency of Dragline 5.4 Methods of assessing efficiency of other HEMM 5.5 Standards laid by CMPDI 5.6 standards laid by other organizations 5.7 Calculating the availability of Equipments 5.8 Calculating the utilization of Equipments 5.9 Calculating the availability of Equipments in underground	i. Utilization of Equipments ii. Availability of the Equipments

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. Methods of assessing efficiency of HEMM

b. **Mini Project:**

Prepare power point presentation for utilization hours of HEMM

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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+LI+SW+Sl)
MIN402.1: Understand about pumps construction, operation characteristics	9	4	2	2	17
MIN 402/MIN402-L2: Mineral handling and screening equipment	9	4	2	2	17
MIN 402/MIN402-L3: Preventative, Predictive maintenance and Condition monitoring	9	4	3	2	18
MIN 402/MIN402-L4: Advances in Mining Machineries and Robotics	9	4	2	2	17
MIN 402/MIN402-L5: Methods of assessing efficiency of HEMM and other machineries	9	4	2	2	17
Total Hours	45	20	11	10	86

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Pumps and Pumping	03	01	01	05
CO-2	Mineral Handling	02	06	02	10
CO-3	Preventive Maintenance	03	07	05	15
CO-4	Robotic in Mines	-	10	05	15
CO-5	Calculation of Efficiency	03	02	-	05
Total		11	26	13	50

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

The end of semester assessment for Mining Machinery III 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 mining industries
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration / Tutorials CBT, Blog, Face book, Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) **Books**:

S. No.	Title	Author	Publisher	Edition & Year
1	Maintenance Engineering and Management	Mishra R.C. & Pathak, K.	PHI Learning Private Ltd, New Delhi,	2012
2	Water problem in mines	Rakesh & Lele	Dhanbad Publisher	2013
3	Mine Hoisting	Ramlu, M.A.,	Oxford & IBH Publishing	2015

(b) **Web link**:

nptel.ac.in/noc.
https://www.mining equipmentltd.com
https://www.minetech .com
https://swayam.gov.in/

Course Curriculum Team

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Cos. Pos and PSOs Mapping

Program Title: B. Tech. Mining Engineering

Course Code: MIN402/MIN402-L

Course Title: Mining Machinery - III

Course Outcomes	Program Outcomes												Program Specific Outcome			
	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 investigation of complex problems	Modern Tool usage	The engineer and society	Environment and sustain ability:	Ethics	Individual and team work:	Communication:	Project management And finance:	Life-long learning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of mining engineering.
CO-1 Understand pumps construction, operation and characteristics	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**2**	**2**	**1**	**1**	**2**	**2**	**3**	**2**	**1**
CO-2Mineral handling and screening equipment	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**-**	**2**	**1**
CO-3 Preventative, Predictive maintenance and Condition monitoring	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
CO-4 Advances in Mining Machineries and Robotics.	**2**	**2**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO-5 Methods of assessing efficiency of HEMM and other	**1**	**2**	**1**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	CO-1. To understand about the pumps used in mines their construction, operation and characteristics	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1 1.2	Unit-1.0 Pumps and Pumping 1.1,1.2,1.3,1.4,1.5,1.6, 1.7, 1.8, 1.9	SL1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO- 2 Mineral handling and screening equipment	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1 2.2	Unit-2 Mineral Handling 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9	SL2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-3 Preventative, Predictive maintenance and Condition monitoring	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1 3.2	Unit-3 : Preventive Maintenance 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9	SL3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-4. Advances in Mining Machineries and role of robotics	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1 4.2	Unit-4: Advance and Robotics in Mining 4.1, 4.2, 4.3, 4.4 ,4.5, 4.6, 4.7, 4.8, 4.9	SL4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO -5. Methods of assessing efficiency of HEMM and other machineries	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1 5.2	Unit5: Efficiency of HEMM 5.1, 5.2, 5.3, 5.4, 5.5,5.6, 5.7, 5.8, 5.9	SL5.1

Semester-VII

Course Code: **OEC-MIN03**

Course Title: EIA & EMP of Mining Industry

Pre-requisite: Student should have the knowledge of control setup for environmental management of mining operations in India.

Rationale: The students studying the knowledge of the command and control setup for environmental management of mining operations in India. Also, students studying carry our preliminary design and implementation scheme for environmental management of simple projects.

Course Outcomes:

OEC-MIN02.1: Describe about the knowledge of EIA.

OEC-MIN02.2: Explain about the knowledge of EMP.

OEC-MIN02.3: Discuss about the negative impact of mining on environment.

OEC-MIN02.4: Illustrate the study of quality management system.

OEC-MIN02.5: Discuss about the various mining laws, policy and regulation.

Scheme of Studies:

Code	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)	**OEC-MIN03**	EIA & EMP of Mining Industry	3	0	1	1	5	3

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

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

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

SL: Self Learning,

C: Credits.

Note: SW & SL has to be plannedandperformedunderthecontinuousguidanceandfeedbackofteacherto ensure outcome of Learning.

Scheme of Assessment:

Theory

Code	Course 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	**OEC-MIN03**	EIA & EMP of Mining Industry	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.

OEC-MIN03.1: Describe about the knowledge of EIA.

Approximate Hours

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

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 Understand the EIA SO1.2 Issues in the preparation of EIA SO1.3 Explain the Regulatory Provision of EIA in India; SO1.4 Describe EIA process, screening, scoping and baseline studies SO1.5 Understand the Documentation of EIA .	.	**Unit-1.0 Concept of EIA** 1.1 General concept of EIA, 1.2 Objective of EIA 1.3 Issues in preparation of EIA, 1.4 `Regulatory Provision of EIA in India; 1.5 EIA ``Process, screening, scoping and baseline studies of EIA, 1.6 Impact prediction and analysis, mitigation planning, monitoring and surveillance; 1.7 Steps of EIA 1.8 Documentation of EIA 1.9Final report of EIA	1. Concept of EIA 2. Regulatory Provision of EIA in India;

SW-1Suggested Sessional Work(SW):

`a. Assignments:

1. Concept of EIA

OEC-MIN03.2: Explain about the knowledge of EMP.

Approximate Hours

`

Item	AppXHrs
Cl	9
LI	0
SW	1
SL	2
Total	12

``Session Outcomes (SOs)	Laboratory` Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 Explain the EMP **SO2.2Understand the** issue in preparation of EMP **SO2.3**Understand the EMP process, screening, scoping and baseline studies **SO2.4** To know the Regulatory provision of EMP in India **SO2.**5 Learn about documentation of EMP	.	**Unit-2 Concept of EMP** 2.1 General concept of EMP, 2.2 Issues in preparation of EMP, 2.3 Regulatory Provision of EMP in India; 2.4 EMP Process, screening, scoping and baseline studies of EIA, 2.5 Impact prediction and analysis, mitigation planning, monitoring and surveillance; 2.6 Documentation of EMP 2.7 Objective of EMP 2.8 Measures for fugitive emissions 2.9 Report of EMP	1. Importance of EMP in mining Industry 2. `Regulation of EMP

SW-2 Suggested Sessional Work (SW):

a. Assignments:

1. Explain the EMP

OEC-MIN03.3: Discuss about the negative impact of mining on environment.

Approximate Hours

Item	AppXHrs
Cl	09
LI	0
SW	1
SL	2
Total	12

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO3.1Able to know air quality. **SO3.2** Explain the standard and measure of air quality. **SO3.3 Able to know water quality.** **SO3.4 Importance of water quality** **SO3.**5 Explain the standard and measure of noise quality.	.	**Unit-3: Problems during extraction of Mineral** 3.1 Air Quality: Definition, 3.2 Parameters affecting air quality, 3.3 Standard and measure of air quality, 3.4 Noise Quality: Problems, 3.5 Parameters affecting Noise quality, 3.6 Standard and Measurement of noise 3.7 Water Quality: Problems, 3.8 Parameters affecting water quality, 3.9 Standard and measurement of water quality	**1.** Explain air quality. **2.** Explain the noise quality.

SW-3Suggested Sessional Work (SW):

a. Assignments:

1. Explain the air quality.

OEC-MIN03.4: Illustrate the study of quality management system.

Approximate Hours

Item	AppXHrs
Cl	9
LI	0
SW	1
SL	2
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO4.1Explain the quality assurance. SO4.2 Study about the total quality management SO4.3 Understand about the ISO SO4.4 Study about the design and implementation of ISO SO4.5 Explain the Measurement Systems in Environmental Management	.	**Unit-4: Concept of Quality** 4.1 Concepts of 'quality assurance' 4.2 Total quality management'; 4.3 Objective of total quality management 4.4 General approach, - requirements of ISO14001, 4.5 Other ISO14000 standards, 4.6 Engineering aspects of ISO14001 requirements; 4.7 Design of ISO14001; 4.8 Implementation of ISO14001; 4.9 Measurement Systems in Environmental Management,	1. Explain the quality management system. 2. Concept of ISO

SW-4 Suggested Sessional Work (SW):

a. Assignments:

ii. Discuss about quality management system.

OEC-MIN03.5: Discuss about the various mining laws, policy and regulation.

Approximate Hours

Item	AppXHrs
Cl	09
LI	0
SW	1
SL	2
Total	12

Session Outcomes (SOs)	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
SO5.1 Study about the environment concerns in India. **SO5.2** Study about environmental laws and regulations **SO5.3** Explain the legislation relating to environment protection **SO5.4** Discuss the environmental economics and auditing **SO5.**5Discuss the Reliability and Risk Assessment for Environmental		**Unit 5: Environmental Legislation** 5.1 Environmental concerns in India 5.2 Environmental Laws 5.3 Environmental Regulations; 5.4 Environmental Clearance procedure in India, 5.5 Legislation relating to environment protection, 5.6 Alternative land uses, 5.7 Environmental economics and auditing, 5.8 Reliability and Risk Assessment for Environmental Protection 5.9 Project work	1. Discuss about the environmental laws, 2. Regulation and legislation

SW-5 Suggested Sessional Work (SW):

a.Assignments:

1. Environmental laws, regulation and legislation

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour(Cl+SW +Sl)
OEC-MIN03.1: Describe about the knowledge of EIA.	9	1	2	**12**
OEC-MIN03.2: Explain about the knowledge of EMP.	9	1	2	**12**
OEC-MIN03.3: Discuss about the negative impact of mining on environment.	9	1	2	**12**
OEC-MIN03.4: Illustrate the study of quality management system.	9	1	2	**12**
OEC-MIN03.5: Discuss about the various mining laws, policy and regulation.	9	1	2	**12**
Total Hours	45	5	10	60

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Describe about the knowledge of EIA	01	01	03	05
CO-2	Explain about the knowledge of EMP.	02	04	04	10
CO-3	Discuss about the negative impact of mining on environment.	03	05	07	15
CO-4	Illustrate the study of quality management system.	03	04	08	15
CO-5	Discuss about the various mining laws, policy and regulation.	01	01	03	05
Total		14	23	13	50

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

The end of semester assessment for Basic Mining Engineering willbeheldwithwrittenexaminationof50 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 Learning Resources:

(a)Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Environmental Impact Assessment	Canter L. W.	McGraw Hill Inc.	2nd & 1996
2	Mining Competition Handbook (For GATE, Overman, Mining Sirdar and others competitive exams)	Dr. Sandeep Prasad	Orange Books Publication	1st and 2023
3.	Introduction to Environmental Impact Assessment	Glasson J., Therivel R. and Chadwick A.		2013
4.	Morris P. and Therivel R. 2009. Methods of Environmental Impact Assessment. Routledge.			
5.	Mercus J. J. 1997. Mining Environmental Handbook: Effects of Mining on the Environment and American Environmental Controls on Mining. Imperial College Press, London.			

Link

- https://moef.gov.in/moef/division/environment-divisions/environmental-impact-assessment-eia/introduction/index.html
- https://environmentclearance.nic.in/DownloadPfdFile.aspx?FileName=h8WMCLOVLe/fwRTM2TqOTWc9dNKs0BzrHbKUDUi7PzEYIoGFnhEOJVbm+9xobQ/g&FilePath=93ZZBm8LWEXfg+HAlQix2fE2t8z/pgnoBhDlYdZCxzXTbTpOQqzWjBW0IF63rxBVcDlG0LKdfbGNs0Ou/TEvAA==
- https://www.sgu.se/en/itp308/knowledge-platform/3-mining-environment/
- https://earth.org/environmental-problems-caused-by-mining/

`Cos, Pos and PSOs Mapping

Program Title: B. Tech. Mining Engineering

Course Code: OEC-MIN03

Course Title: EIA & EMP of Mining Industry

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conducting vestigations ofcomplex problems	Modern toolusage	The engineer and society	Environment and sustain ability:	Ethics	Individual andteamwork:	Communication:	Project management andfinance:	Life-longlearning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of mining engineering.
CO1: Describe about the knowledge of EIA	1	2	1	1	1	2	1	2	2	1	1	2	2	3	2	1
CO 2 Explain about the knowledge of EMP.	1	1	2	2	1	2	3	2	1	1	2	2	2	1	2	1
CO3 Discuss about the negative impact of mining on environment.	1	1	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO 4: Illustrate the study of quality management system.	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO5: Discuss about the various mining laws, policy and regulation.	1	2	1	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

POs & PSOs No.	Cos No.& Titles	SOs No.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,67,8 ,9,10,11,12 PSO1,2,3,4	CO1 : Describe about the knowledge of EIA.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 Concept of EIA 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	SL 1.1`
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 2 Explain about the knowledge of EMP.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2 General Concept 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9	SL2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO3 Discuss about the negative impact of mining on environment.	SO3.1S O3.2 SO3.3 SO3.4 SO3.5		Unit-3 : Problems during extraction of Mineral 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8, 3.9	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 4: Illustrate the study of quality management system.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4: Concept of Quality 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	SL 4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 5: Discuss about the various mining laws, policy and regulation.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit5: Environmental Legislation 5.1,5.2,5.3,5.4,5.5, 5.6, 5.7, 5.8, 5.9	SL 5.1

Semester-VII

Course Code: OEC-MIN04

Course Title: Disaster Management

Pre-Requisite: The student should have basic understanding of the term "Disaster" and its different forms
Rationale: Developing a general awareness about causes, circumstances, effects and general management approaches towards handling an emergency situation arising out of a disaster or a natural calamity.

Course Outcome (CO)
The student

OEC-MIN04.1- To provide basic conceptual understanding of disasters
OEC-MIN04.2- To understand approach of disaster management
OEC-MIN04.3- Mitigation and management techniques in case of disasters
OEC-MIN04.4- To build skills to respond to disasters
OEC-MIN04.5- Assessment of social, environmental and economic impact of disasters

Scheme of studies:

Code	Course code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total study Hours (CI+LI+SW+SL)	
Program Elective(PE)	OEC-MIN04	Disaster Management	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.

Scheme for assessment:

Code	Course code	Course Title	Scheme Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester assessment	Total Marks
			Class/ home assignment 5nos 3 marks each (CA)	Class tests 3 nos (2 best out of 3) 10 marks each (CT)	Seminar 1 no. (SA)	Class activity (any one) (CAT)	Class Attendance (AT)	Total Marks (CA+ CT+ SA+ CAT+ AT)		
PE	OEC-MIN04	Disaster Management	15	20	5	5	5	50	50	100

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

OEC-MIN04.1:- To provide basic conceptual understanding of disasters

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	10
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	13

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO1.1- Developing concept of disasters SO1.2- Identification of hazards that may lead to disasters SO1.3- Risk assessment for disasters and assessment of their vulnerability SO1.4- Comprehension of types of disasters- natural and man-made SO1.5- Classification of disasters		Unit 1- Definitions and types of disasters 1.1- Hazards and disasters 1.2- Risk and vulnerability of disasters 1.3- Natural and man-made disaster classification 1.4- Types of natural disasters- Earthquakes, flood, draught 1.5- Land slides and land subsidence 1.6- Cyclones and avalanches 1.7- Volcanoes and Tsunami 1.8- Man-made disasters- Terrorism, gas and radiation 1.9- Toxic waste disposal, oil spills 1.10- Forest fires	Study Area: (i)Hazard identification that may lead to disasters

Suggested Sessional works: a. Assignments

(i) Analysis of the reasons for disasters and their classification

(ii) Need for development of disaster management plan and their implementation

b. Mini Project: - Strategies to identify the hazards and formulation of disaster management plan

OEC-MIN04.2:- To understand approach of disaster management

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	6
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	9

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self study
SO2.1- Understanding potentiality of earthquakes SO2.2- Comprehension of Indian geological faults to assess disaster potential SO2.3- Importance of management in flood affected areas and prepare mitigation plan SO2.4- Land affecting disasters to be identified SO2.5- Fire hazards and causes of disasters due to various types of fire to be identified. .		Unit 2- Study of important disasters 2.1- Earthquakes and its types. Seismic zones of India 2.2-Major fault systems of Indian plate 2.3- Types of flood and their management 2.4- Draught types and its management 2.5- Land slides and subsidence – their management 2.6-Major fires and their management	Study area: (i)Study on hazard identification methods

Suggested Sessional Works:

a. Assignments

(i) In-depth analysis of Indian geology to understand and predict potentiality of natural disasters

(ii) Analysis of man-made disasters and formulation of plans to avoid the same

b.Mini Project:-

Need for broad based planning to combat effects of natural and man-made disasters in Indian context

OEC-MIN04.3:- Mitigation and management techniques in case of disasters

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	8
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	11

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO3.1- Understanding the principles of disaster management SO3.2- Comprehension of disaster management policy SO3.3- Authorities in case of disaster management and their organizational structure at different levels SO3.4- Warning systems to minimize effects of disaster as part of combat plan SO3.5- Features of construction in highly seismic zones		Unit 3- Mitigation and management techniques of disaster 3.1- Basic principles of disaster management 3.2- Disaster management cycle 3.3- Disaster management policy 3.4- National and state bodies for disaster management 3.5- Organizational structure of state level disaster management bodies and their functions 3.6- Organizational structure of national level disaster management bodies and their functions 3.7- Early warning systems 3.8-Building designs and constructions in highly seismic zones, retrofitting of buildings	Study area: (i)National policy on disaster management

Suggested Sessional works:

a. Assignments

(i) Present status of disaster management and scope for improvement

(ii) Recent technological developments for disaster management

b. **Topic for Mini Project-**

Early warning system development- Key to successful Disaster Management.

OEC-MIN04.4:- To build skills to respond to Disasters

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	11
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	14

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO4.1- Identification of training needs and modalities on disaster management. SO4.2- Awareness generation- an integral part of disaster management activity SO4.3- Assessment of risks associated with disasters and their quantification SO4.4- An analytical approach towards disaster management SO4.5- Formulation of disaster management plan		Unit 4- Training, awareness program & project on Disaster Management 4.1- Trainiand skill for disaster preparedness 4.2- Awareness generation program 4.3- Usage of GIS and remote sensing technology in disaster management 4.4- Risk assessment in disasters 4.5- Quantification of risks 4.6- Case studies on disasters 4.7- Analysis of disasters 4.8- Preparation of comprehensive disaster 4.9 management plan 4.10 Case Study 4.11 Mining study	Study area:- (i)Case studies of disasters in India and abroad

Suggested Sessional works:

a. Assignments:

(i) Risk assessment of impending disaster and quantification of its impacts on surroundings from economic, social and environmental point of view

(ii) Development of skills for usage of modern technologies in disaster management

b. **Topic for Mini Project-**

Anticipation and mitigation of challenges associated with management of any disaster and the role of awareness build up in this respect.

OEC-MIN04.5- Assessment of social, environmental and economic impact of disasters

Approximate hours:

Item	Approximate Hours
Class room Instructions (CI)	10
Laboratory Instructions (LI)	0
Sessional work (SW)	2
Self Learning	1
Total	13

Session Outcomes (SOs)	Laboratory Instructions (LI)	Class Room Instructions (CI)	Self Learning (SL)
SO5.1- Impact of disaster on bottom line parameters SO5.2- Assessment of environmental impacts of disaster SO5.3- Direct and indirect effects of disaster SO5.4- Analysis of disaster management system based on site realities SO5.5- Management of resources during disaster management		Unit 5- Social, Environmental and Economic impacts of disasters 5.1- Assessment of social 5.2 impacts of disasters 5.3- Environmental impacts of natural disasters 5.4- Environmental impacts of man-made disasters 5.5- Analysis into the economic 5.6 impacts of any disaster 5.7- Analysis and evaluation of direct 5.8 indirect impacts of a disaster 5.9- Resource mobilization 5.10 utilization in dealing with a post disaster situation	Study area: (i)Holistic effect of a disaster on society, economy and environment

Suggested Sessional works:

a. **Assignments:**

(i) Direct and indirect effects of a disaster

(ii) Holistic approach of disaster management

b. **Topic for Mini Project-**

Case studies to analyze the reasons of a disaster and to formulate strategies to minimize its effects, if not eliminate.

Brief of Hours suggested for the course outcome:

Course outcomes	Class Lectures (CL)	Laboratory Instructions (LI)	Sessional work (SW)	Self Learning (SL)	Total Hour (CL+LI+SW+SL)
OEC-MIN04.1-To provide basic conceptual understanding of disasters	10	0	2	1	13
OEC-MIN04.2-To understand approach of disaster management	6	0	2	1	9
OEC-MIN04.3-Mitigation & management techniques in case of disasters	8	0	2	1	11
OEC-MIN04.4- To build skills to respond to disasters	`11	0	2	1	14
OEC-MIN04.5-Assessment of social, environmental & economic impact of disasters	10	0	2	1	3
Total Hours	45	0	10	5	60

Suggestions for End semester Assessment:

Suggested Specification Table

COs	Unit Titles	Marks Distribution			Total; Marks
		R	U	A	
CO 1	Definitions and types of disasters	3	3	1	7
CO 2	Study of important disasters	3	4	3	10
CO 3	Mitigation & management techniques of disasters	3	5	5	13
CO 4	Training, awareness program and project on disaster management	3	5	5	13
CO 5	Social, environmental and economic impacts of disasters	2	3	2	7
	Total	14	20	16	50

Legend: R-Remember U-Understand A-Apply

The end of semester assessment for Underground coal mining technologies will be held with written examination of 50 marks

Suggested Instructional/ Implementation Strategies:

1. **Improved lectures**
2. Tutorial
3. Case studies
4. Group discussion
5. Role play
6. Visit to mines and mineral processing industries
7. Demonstration
8. Digital media application in teaching learning process and mass media
9. Brainstorming

Suggested Learning Resources

Sl.No	Title	Author	Publisher	Edition & Year
1.	Disaster Management Guidelines	GoI-UND Directorate Risk Program	NA	2009-2012
2.	Introduction to International Disaster Management	Damon P Copola	Butterworth Heinman	2006
3.	Disaster Management & Risk Reduction-Role of env. knowledge	Gupta AK, Nair SS, Chatterjee s	Narosa Publishing House, Delhi	2013
4.	Disaster Management	Murthy DBN	Deep & Deep Publication Pvt Ltd, New Delhi	2012
5.	Managing Natural Disasters	Modh S	Mac Millan Publishers India ltd.	2012

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COs, POs & PSO Mapping:

Program Title: B. Tech (Mining Engineering)
Course Code: OEC-MIN04
Course Title: Disaster Management

	Program Outcomes												Program Specific Outcomes			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
Course Outcome	Engg Know ledge	Prob Lem Ana-lysis	Des-ign/ Dev of Solu tion	Inv-esti gat ion of complex problems	Mod ern tool usage	Eng Ineer & soc iety	Env Ironment & Sus tai nab ility	Work Eth ics	Ind Ivi Dual & te-am Wo-rk	Commu nica tion	Pro Ject Mgmt & Fin ance	Life lo ng Lea ning	Dev. Analy tical skill for identi-fying mine prob-lems for solutions	Garnering know Ledge about economic, env & soc ietal impacts of mining	Dev. Knowledge for mine plan ing, operation & closure	Develop work ethics under mine statutes
CO1-To provide basic conceptual understanding of disasters	2	1	1	1	1	1	2	1	1	1	1	2	1	1	1	1
CO 2-To understand approach of disaster management	2	1	1	1	2	1	1	1	3	2	3	2	1	1	2	2
CO 3- Mitigation & management techniques in case of disasters	3	2	3	1	2	1	2	1	3	3	2	2	2	1	3	1
CO 4- To build skills to respond to disasters	3	2	3	1	2	1	2	1	3	3	2	2	2	1	3	1
CO 5- Assessment of social, environmental and economic impact of disasters	3	2	2	3	2	1	2	2	3	3	3	2	2	2	3	2

Legend: 1 : Low 2: Medium 3: High

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Course Curriculum Map:

POs & PSOs Number	CO numbers and title	SOs Number	Laboratory Instruction (LI)	Class Room Instructions (CI)	Self Learning (SL)
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO1-To provide basic conceptual understanding of disasters	SO 1.1 SO 1.2 SO 1.3 SO 1.4 SO 1.5		Unit 1Definitions and types of disasters 1.1,1.2,1.3,1.4,1.5,1.6, 1.7, 1.8, 1.9, 1.10	SL 1.1
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 2-To understand approach of disaster management	SO2.1 SO 2.2 SO 2.3 SO 2.4 SO 2.5		Unit 2- Study of important disasters2.1,2.2,2.3,2.4,2.5,2.6.	SL 2.1`
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 3- Mitigation & management techniques in case of disasters	SO 3.1` SO 3.2 SO 3.3 SO 3.4 SO 3.5		Unit 3- Mitigation and management techniques of disasters 3.1,3.2,3.3,3.4,3.5,3.6, 3.7,3.8.	SL 3.1
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 4- To build skills to respond to disasters	SO 4.1 SO 4.2 SO 4.3 SO 4.4 SO 4.5		Unit 4-Training, awareness program and project on disaster management 4.1,4.2.4.3,4.4,4.5,4.6, 4.7,4.8,4.9,4.10,4.11	SL 4.1
PO: 1,2,3,4,5,6,7,8,9,10,11,12 PSO: 1,2,3,4	CO 5- Assessment of social, environmental and economic impact of disasters	SO 5.1 SO 5.2 SO 5.3 SO 5.4 SO 5.5	```	Unit 5- Social, environmental and economic impacts of disasters 5.1,5.2,5.3,5.4,5.5,5.6.5.7,5.8,5.9,5.10``	SL 5.1

Semester-VII

Course Code: **OEC-MIN05**

Course Title: Mineral Resources of India

Pre-requisite: Student should have basic knowledge of scope and purpose of geology, Rocks, Minerals, various methods of age determination of rock and minerals.

Rationale: The students studying any Engineering should possess fundamental understanding about minerals mines in India. They should have some idea about PSU companies related to Mining industries.

Course Outcomes:

OEC-MIN04.1: Describe the properties of metallic and non-metallic minerals.
OEC-MIN04.2: Explain the regulatory frame of mineral authority in India.
OEC-MIN04.3: Describe the PSU and its role in mining
OEC-MIN04.4: Explain the distribution of non-metallic mineral resources in India
OEC-MIN04.5: Evaluate the distribution of non-metallic mineral resources in India

Scheme of Studies:

Code	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)	**OEC-MIN05**	Mineral Resources of India	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.

Scheme of Assessment:

Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment (ESA)**	**Total Marks (PRA + ESA)**
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
PCC	OEC-MIN05	Mineral Resources of India	15	20	5	5	5	50	50	100

`Course-Curriculum Detailing:

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

OEC-MIN05.1: Describe the properties of metallic and non-metallic minerals.

Approximate Hours

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

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO1. Describe the Minerals. **SO1.2** Demonstrate Physical properties of minerals. **SO1.3** Interpret Metallic and Non-metallic minerals. **SO1.4** Explain Distribution of metallic minerals. **SO1.5** Describe Distribution of non-metallic minerals.		**Unit-1: Introduction** 1.1 Minerals 1.2 Physical properties of minerals 1.3 Chemical properties of minerals 1.4 Metallic and Non-metallic minerals 1.5 Study of limestone mica, gypsum coal etc 1.6 Study of iron, gold, copper etc 1.7 Distribution of metallic minerals. 1.8 Distribution of non-metallic minerals. 1.9 Case studies	1. Distribution of metallic minerals..

SW-1 Suggested Sessional Work (SW):

a. Assignments:

1. Explain Physical properties of minerals.

OEC-MIN05.2: Explain the regulatory frame of mineral authority in India.

Approximate Hours

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

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1 Describe Ministry of Mines. **SO2.2**Explain Organizational structure. **SO2.3**Cabinet minister – Minister of state. **SO2.4** Geological Survey of India. **SO2.5** Indian Bureau of Mines.		**Unit-2: Governing Body Of Minerals In India** 2.1 Ministry of Mines 2.2 Organizational structure. 2.3 Cabinet minister – Minister of state. 2.4 Geological Survey of India 2.5 Indian Bureau of Mines. 2.6 DGMS 2.7 Ministry of coal 2.8 Mining and mineral statistics 2.9 SAIL	i.Ministry of Mines.

SW-2 Suggested Sessional Work (SW):

a.Assignments:

1. Discuss the Organizational structure of IBM.

OEC-MIN05.3: Describe the PSU and its role in mining

Approximate Hours

Item	Approx. 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 Explain National Aluminium Company Limited (NALCO), Bhubaneswar. **SO3.2** Describe Hindustan Copper Limited (HCL), Kolkata. **SO3.3** Discuss Mineral Exploration Corporation Limited (MECL), Nagpur. **SO3.4** Analyse National Institute of Rock Mechanics (NIRM), Kolar Gold Fields, Karnataka. **SO3.5** Assess National Institute of Miners' Health (NIMH), Nagpur.		**Unit-3 : Public Sector Companies & Institutions** 3.1 National Aluminium Company Limited (NALCO), Bhubaneswar 3.2 Hindustan Copper Limited (HCL), Kolkata 3.3 Mineral Exploration Corporation Limited (MECL), Nagpur 3.4 National Institute of Rock Mechanics (NIRM), Kolar Gold Fields, Karnataka 3.5 National Institute of Miners' Health (NIMH), Nagpur. 3.6 National mineral development and corporation(NMDC) 3.7 Hindalco 3.8 Gujarat mineral development corporation Ltd 3.9 Coal India Ltd	1. Study of iron, manganese, radioactive minerals, asbestos, mica.

SW-3 Suggested Sessional Work (SW):

a.Assignments:

i. Discuss about iron Mineral Exploration Corporation Limited (MECL), Nagpur

OEC-MIN054: Explain the distribution of non-metallic mineral resources in India.

Approximate Hours

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

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO4.1 Discuss about Occurrence Mineral fuels. **SO4.2** Coal & lignite – Petroleum. **SO4.3** Evaluate Metallic Minerals Bauxite Chromites - Iron ore - Manganese ore. **SO4.4** Demonstrate Industrial Minerals – Barytes - Kyanite, andalusite & sillimanite. **SO4.5** Evaluate Talc/steatite/ pyrophyllite – Mica.		**Unit-4:Mineral Resources** 4.1 Occurrence Mineral fuels. 4.2 Coal & lignite 4.3 Petroleum 4.4 Metallic Minerals Bauxite, Chromites 4.5 Metallic Minerals Iron ore - Manganese ore. 4.6 Industrial Minerals – Barytes, Kyanite, 4.7 Industrial Minerals – andalusite & sillimanite 4.8 Magnetite - Apatite & rock phosphate 4.9 Talc/steatite/ pyrophyllite – Mica.	1. Occurrence of coal and its types

SW-4 Suggested Sessional Work (SW):

a.Assignments:

i. Discuss about Occurrence Mineral fuels.

OEC-MIN05.5: Evaluate the distribution of non-metallic mineral resources in India.

Approximate Hours

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

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO5.1 Describe Occurrence of metals. **SO5.2** Explain Aluminium. **SO5.3** Describe Copper. **SO5.4** Discuss Steel **SO5.5** Explain Lead – Zinc – Gold.		**Unit 5: Metal Mineral Resources** 5.1 Occurrence of metals. 5.2 Aluminium. 5.3 Copper. 5.4 Steel 5.5 Lead 5.6 Zinc 5.7 Gold 5.8 Silver 5.9 Lead	1. Application of remote sensing in geological mapping.

SW-5 Suggested Sessional Work (SW):

a.`Assignments:

i. Describe Occurrence of metals.

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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)
OEC-MIN05.1: Describe the properties of metallic and non-metallic minerals.	9	1	1	11
OEC-MIN05.2: Explain the regulatory frame of mineral authority in India.	9	1	1	11
OEC-MIN05.3: Describe the PSU and its role in mining.	9	1	1	11
OEC-MIN05``.4: Explain the distribution of non-metallic mineral resources in India.	9	1	1	11
OEC-MIN05.5: Evaluate the distribution of non-metallic mineral resources in India.	9	1	1	11
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	
CO-1	Introduction	03	01	01	05
CO-2	Governing Body Of Minerals In India	02	06	02	10
CO-3	Public Sector Companies & Institutions	03	07	05	15
CO-4	Mineral Resources	-	10	05	15
CO-5	Metal Mineral Resources	03	02	-	05
Total		11	26	13	50

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

The end of semester assessment for Mining Geology-II will be held with written examination of 50 marks

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

Suggested Instructional/Implementation Strategies:

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

Suggested Learning Resources:

(c) **Books**:

S. No.	Title	Author	Publisher	Edition & Year
1	Indian mineral resources	S.Krishnaswamy	Oxford & IBH	2, 1979
2	A Text Book of Geology	P.K. Mukherjee	World press	2013
3	Engineering and general geology	Parbin Singh	Katson Educational Series	2013

(a) **Web link**:

https://archive.nptel.ac.in/Harddisk/Direct_Download.html

https://epathshala.nic.in/

https://swayam.gov.in/

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<u>Cos. Pos and PSOs Mapping</u>

Program Title: B. Tech. Mining Engineering
Course Code: OEC-MIN05
Course Title: Mineral Resources of India

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering Knowledge	Problem analysis	Design/ development of solutions	Conduct investigations of complex problems	Modern Tool usage	The engineer and society	Environment and sustainability:	Ethics	Individual and team work:	Communication:	Project management And finance:	Life-long learning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of mining
CO-1 Describe the properties of metallic and non-metallic minerals.	1	2	1	1	1	2	1	2	2	1	1	2	2	3	1	1
CO-2 Explain the regulatory frame of mineral authority in India.	1	1	2	2	1	2	3	2	1	1	2	2	2	1	2	1
CO-3 Describe the PSU and its role in mining.	1	1	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO-4 Describe the PSU and its role in mining.	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO-5 Evaluate the distribution of non-metallic mineral resources in India.	1	2	1	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,67,8,9,10,11,12 PSO1,2,3,4	CO-1 Describe the properties of metallic and non-metallic minerals.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	Unit-1.0 Introduction 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-2 Explain the regulatory frame of mineral authority in India.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	Unit-2 Governing Body Of Minerals In India 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9	SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-3 Describe the PSU and its role in mining.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	Unit-3 : Public Sector Companies & Institutions 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-4 Describe the PSU and its role in mining.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	Unit-4: Mineral Resources 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	SL 4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO -5 Evaluate the distribution of non-metallic mineral resources in India.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	Unit5: Metal Mineral Resources 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9	SL 5.1

Semester-VII

Course Code: **OEC-MIN06**

Course Title: Remote Sensing & Geospatial Technology

Pre-requisite: Student should have basic knowledge of scope and purpose of geology, Rocks, Minerals, various methods of age determination of rock and minerals.

Rationale: The students studying any Engineering should possess fundamental understanding about minerals mines in India. They should have some idea about PSU companies related to Mining industries.

Course Outcomes:

OEC-MIN06.1: Describe the various features of Photogrammetry.
OEC-MIN06.2: Explain the Remote sensing process and data collection.
OEC-MIN06.3: Describe the GIS system and their attributes.
OEC-MIN06.4: Analyse the spatial data and geography distributions.
OEC-MIN06.5: Analyse and measure the spatial pattern of featurevalues.

Scheme of Studies:

Code	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)	OEC-MIN06	Remote Sensing & Geospatial Technology	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.

Scheme of Assessment:

Theory

<table>
<tr><th rowspan="3">Code</th><th rowspan="3">Course Code</th><th rowspan="3">Course Title</th><th colspan="8">Scheme of Assessment (Marks)</th></tr>
<tr><th colspan="6">Progressive Assessment (PRA)</th><th rowspan="2">End Semester Assessment
(ESA)</th><th rowspan="2">Total Marks
(PRA+ ESA)</th></tr>
<tr><th>Class/Home Assignment 5 number 3 marks each (CA)</th><th>Class Test 2 (2 best out of 3) 10 marks each (CT)</th><th>Seminar one
(SA)</th><th>Class Activity any one
(CAT)</th><th>Class Attendance
(AT)</th><th>Total Marks (CA+CT+SA+ CAT+AT)</th></tr>
<tr><td>PCC</td><td>OEC-MIN06</td><td>Remote Sensing & Geospatial Technology</td><td>15</td><td>20</td><td>5</td><td>5</td><td>5</td><td>50</td><td>50</td><td>100</td></tr>
</table>

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.

OEC-MIN06.1: Describe the various features of Photogrammetry.

Approximate Hours

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

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO1. Describe the Principles & types of aerial photograph. **SO1.2** Demonstrate Geometry of Vertical aerial photograph. **SO1.3** Interpret Scale & Height measurement on single vertical aerial photograph. **SO1.4** Explain Fundamentals of stereoscopy **SO1.5** Describe fiducial points, parallax measurement using fiducial line.		**Unit-1: Introduction to Photogrammetry** 1.1 Principles of aerial photograph. 1.2 Types of aerial photograph. 1.3 Geometry of Vertical aerial photograph. 1.4 Scale measurement on single vertical aerial photograph 1.5 Height measurement on single vertical aerial photograph 1.6 Fundamentals of stereoscopy 1.7 Fiducial points 1.8 Parallax measurement using fiducial line. 1.9 Stereoscopy in GIS	1. Geometry of Vertical aerial photograph.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

Explain Fundamentals of stereoscopy.

OEC-MIN06.2: Explain the Remote sensing process and data collection.

Approximate Hours

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

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1 Describe Basic concept of remote sensing, Data and Information. **SO2.2**Explain Remote sensing data Collection, Remote sensing advantages & Limitations. **SO2.3**Evaluate Remote Sensing process. **SO2.4** Analyse Electro-magnetic Spectrum, Energy interactions with atmosphere. **SO2.5** Evaluate Indian Satellites and Sensors characteristics, Resolution, Map and Image and False color composite.		**Unit-2:** Remote Sensing 2.1 Basic concept of remote sensing, 2.2 Data and Information 2.3 Remote sensing data Collection 2.4 Remote sensing advantages & Limitations. 2.5 Remote Sensing process. 2.6 Electro-magnetic Spectrum 2.7 Energy interactions with atmosphere and with earth surface features (soil, water, vegetation). 2.8 Indian Satellites and Sensors characteristics, Resolu 2.9 Map and Image and False color composite.	i. Remote Sensing process.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

Describe Basic concept of remote sensing, Data and Information.

OEC-MIN06.3: Describe the PSU and its role in mining

Approximate Hours

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

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 Explain Map Projections: Types of Map Projections-Map projection parameters Commonly used Map Projections **SO3.2** Map Projections: Types of Map Projections-Map projection parameters Commonly used Map Projections. **SO3.3** Discuss GIS Operations: Spatial Data Input- Attribute data Management –Data display- Data Exploration- Data Analysis. **SO3.4** Analyse Coordinate Systems: Geographic Coordinate System. **SO3.5** Assess Map Projections: Types of Map Projections-Map projection parameters.		**Unit-3 :** Geographic Information Systems 3.1 Introduction to GIS; 3.2 Components of a GIS. 3.3 Map Projections: Types of Map Projections 3.4 Map projection parameters Commonlyused Map Projections 3.5 GIS Operations: Spatial Data Input 3.6 Attribute data Management –Data display- Data Exploration- Data Analysis. 3.7 Coordinate Systems: Geographic Coordinate System 3.8 Map Projections: Types of Map Projections 3.9 Map projection parameters Commonlyused Map Projections.	1. Map Projections: Types of Map Projections.

SW-3 Suggested Sessional Work (SW):

a. **Assignments:**

i Discuss GIS Operations: Spatial Data Input- Attribute data Management Mini Project:

OEC-MIN06.4: Analyse the spatial data and geography distributions.

Approximate Hours

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

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4.1 Discuss about spatial measurements and statistics. **SO4.2** Analyse Geographic analysis with statistics Understanding spatial data distributions **SO4.3** Evaluate geographic distributions - Finding the center - Measuring the compactness of the distribution. **SO4.4** Demonstrate orientationand direction - Testing statistical significance. **SO4.5** Evaluate Case Studies.		**Unit-4:** Analysis Of Spatial Distributions 4.1Introduction spatial measurements and statistics. 4.2 Geographic analysis with statistics 4.3 Understanding spatial data distributions. 4.4 Measuring geographic distributions 4.5 Finding the center 4.6 Measuring the compactness of the distribution. 4.7 Measuring orientationand direction 4.8 Testing statistical significance 4.9 Case Studies.	i. Geographic analysis with statistics Understandi ng spatial

SW-4Suggested Sessional Work (SW):

a. **Assignments:**

1.Discuss about spatial measurements and statistics.

OEC-MIN06.5: Analyse and measure the spatial pattern of featurevalues.

Approximate Hours

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

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO5.1 Describe Statistical parameters to characterize patterns. **SO5.2** Explain the pattern of feature locations - Measuring the spatial pattern of feature values. **SO5.3** Describe spatial neighborhoods and weights. **SO5.4** Discuss Parameters for identification of clusters. **SO5.5** Analyse of features clusters.		**Unit 5:** Analysis Of Spatial Patterns 5.1 Identifying spatial patterns. 5.2 Statistical parameters to characterize patterns 5.3 Measuring the pattern of feature locations 5.4 Measuring the spatial pattern of featurevalues 5.5 Defining spatial neighborhoods and weights. 5.6 Identifying clusters 5.7Parameters for identification of clusters. 5.8Analysis of features clusters 5.9 clusters of similar values.	1. Application of remote sensing in geological mapping.

SW-5 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Describe spatial neighborhoods and weights.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
OEC-MIN06.1: Describe the various features of Photogrammetry.	9	1	1	11
OEC-MIN06.2: Explain the Remote sensing process and data collection.	9	1	1	11
OEC-MIN06.3: Describe the GIS system and their attributes.	9	1	1	11
OEC-MIN06.4: Analyse the spatial data and geography distributions.	9	1	1	11
OEC-MIN06.5: Analyse and measure the spatial pattern of featurevalues.	9	1	1	11
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	
CO-1	Introduction to Photogrammetry	03	01	01	05
CO-2	Remote Sensing	02	06	02	10
CO-3	Geographic Information Systems	03	07	05	15
CO-4	Analysis Of Spatial Distributions	-	10	05	15
CO-5	Analysis Of Spatial Patterns	03	02	-	05
Total		11	26	13	50

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

The end of semester assessment for Mining Geology-II will be held with written examination of 50 marks

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

Suggested Instructional/Implementation Strategies:

i. Improved Lecture
ii. Tutorial
iii. Case Method
iv. Group Discussion
v. Role Play
vi. Visit to mining industry
vii. Demonstration
viii. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
ix. Brainstorming

Suggested Learning Resources:

(d) **Books**:

S. No.	Title	Author	Publisher	Edition & Year
1	Remote Sensing and GIS	Lilles and Kiefer	John Willey	2008
2	Introduction to Geographic Information System	Kang-Tsung Chang	McGraw-Hill	2015
3	Concepts & Techniques of GIS	C. P. Lo Albert, K.W. Yonng	Prentice Hall(India) Publications	2013

(a) **Web link**:

https://archive.nptel.ac.in/Harddisk/Direct_Download.html

https://epathshala.nic.in/

https://swayam.gov.in/

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<u>**Cos. Pos and PSOs Mapping**</u>

Program Title: B. Tech. Mining Engineering
Course Code: OEC-MIN06
Course Title: Remote Sensing & Geospatial Technology

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2	PSO3	PSO4
	Engineering Knowledge	Problem analysis	Design/ development of solutions	Conduct investigations of complex problems	Modern Tool usage	The engineer and society	Environment and sustainability:	Ethics	Individual and teamwork:	Communication:	Project management And finance:	Life-long learning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of mining engineering
CO-1 Describe the various features of Photogrammetry. minerals.	1	2	1	1	1-	2	1	2	2	1	1	2	2	3	2	1
CO-2 Explain the Remote sensing process and data collection. India.	1	1	2	2	1	2	3	2	1	1	2	2	2	1	2	1
CO- Describe the GIS system and their attributes.	1	1	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO-4 Analyse the spatial data and geography distributions.	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO-5 Analyse and measure the spatial pattern of featurevalues.in India.	1	2	1	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,67,8,9,10,11,12 PSO1,2,3,4	CO-1 Describe the various features of Photogrammetric.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	Unit-1.0 Introduction to Photogrammetric 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-2 Explain the Remote sensing process and data collection.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	Unit-2 Remote Sensing 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9	SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-3 Describe the GIS system and their attributes.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	Unit-3 : Geographic Information Systems 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-4 Analyse the spatial data and geography distributions.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	Unit-4: Analysis Of Spatial Distributions 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	SL 4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO -5 Analyse and measure the spatial pattern of featurevalues.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	Unit5: Analysis Of Spatial Patterns 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9	SL 5.1

Semester-VIII

Course Code: **MIN403**

Course Title: Mine Management General Safety & Mine Legislation

Pre-requisite: Student should have basic knowledge of scope and purpose of geology, Rocks, Minerals, various methods of age determination of rock and minerals.

Rationale: The students studying Mining field should possess foundational understanding about historical binding of rock and minerals. Helps us identify and mitigate natural hazards such as earthquakes, coastal erosion, flooding, and landslides.

Course Outcomes:

MIN403.1: Explain the various aspects various management principles and branches of management

MIN403.2: Describe the Acts and Rules for Health and Safety

MIN403.3: Describe the Acts and Rules for Health and Safety

MIN403.4: Describe the Acts and Rules for Mineral Conservation and Environmental protection

MIN403.5: Comprehend the MMDR Act 1957 and Rules.

Scheme of Studies:

Code	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)	**MIN403**	Mine Management General Safety & Mine Legislation	4		1	1	6	4

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

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

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

SL: Self Learning,

C: Credits.

Note:

SW&SLhastobeplannedandperformedunderthecontinuousguidanceandfeedbackofteac herto ensure outcome of Learning.

Scheme of Assessment:

Theory

<table>
<tr><td rowspan="3">Code</td><td rowspan="3">Course Code</td><td rowspan="3">Course Title</td><td colspan="8">Scheme of Assessment(Marks)</td></tr>
<tr><td colspan="6">Progressive Assessment(PRA)</td><td rowspan="2">End Semester Assessment (ESA)</td><td rowspan="2">Total Marks
(PRA+ESA)</td></tr>
<tr><td>Class/HomeAssignment5number 3 marks each (CA)</td><td>Class Test2 (2bestoutof3) 10 marks each(CT)</td><td>Seminar one (SA)</td><td>Class Activity anyone (CAT)</td><td>Class Attendance (AT)</td><td>Total Marks (CA+CT+SA+CAT+AT)</td></tr>
<tr><td>PCC</td><td>MIN403</td><td>Mine Management General Safety & Mine Legislation</td><td>15</td><td>20</td><td>5</td><td>5</td><td>5</td><td>50</td><td>50</td><td>100</td></tr>
</table>

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.

MIN403.1: Explain the various aspects various management principles and branches of management.

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 Describe Principles of Scientific Management. **SO1.2**Explain the Organization. **SO1.3**Determination of Planning and control. **SO1.4** Explain Forms of Business Organization **SO1.5** Analyze Private and public enterprises with special reference to mining of minerals.		**Unit-1.0Management** 1.1 Principles of Scientific Management 1.2 Management 1.3 Organization 1.4 Structure 1.3 Planning and control 1.4 Forms of Busines 1.5 Organization 1.6 Private enterprises with special reference to mining of minerals. 1.7 Public enterprises with special reference to mining of minerals. 1.8 Control 1.9 Numerical 1.10 Problems 1.11 Tutorials 1 1.12 Tutorials 2	1. Planning and control. 2. Organization.

SW-1Suggested SessionalWork (SW):

a. **Assignments:**

i. Explain Forms of Business Organization

MIN403.2: Describe the Acts and Rules for Health and Safety.

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO2.1 Describe the Dispute resolving . **SO2.2** Evaluate the Behavioral Sciences for Management. **SO2.3** Analyze the Systems of inventory control. **SO2.4** Comprehend the Management Information Systems (MIS) **SO2.**5 Describe Socio-Economic Impact of Mining.		**Unit-2 Basic Principles** 2.1 Dispute resolving. 2.2 Behavioral Sciences for Management 2.3 Conflict management 2.4 Inventory: Systems of inventory control 2.5 Purchase procedures. 2.6 Monitoring techniques. 2.7 Management Information Systems (MIS) 2.8 Socio-Economic Impact of Mining 2.9 Economics of mining 2.10 Case studies on Project Monitoring 2.11 Effect on community 2.12 Before, during and after mining.	i. Systems of inventory control.

SW-2 Suggested Sessional Work (SW):

a.Assignments:

Comprehend the Management Information Systems (MIS).

b.Mini Project:

Marking of major active volcano zones in world map

MIN403.3: Describe the technical circulars and gazette notifications related to Mines Safety**.**

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO3.1 Infer Mine Legislation. **SO3.2** Explain Health and Safety Laws. **SO3.3** Explain The Mines Act, 1952; Mines Rules, 1955. **SO3.4** Interpret CMR 2017, Metalliferous Mine Regulation, 1961. **SO3.5** Relate the Mines Rescue Rules, 1985.		**Unit-3 : Overview of Mines Safety in India** 3.1 Overview 3.2 Mine Legislation 3.3 Health and Safety Laws 3.4 The Mines Act, 1952 3.5 Mines Rules, 1955. 3.6 CMR 2017 3.7 Metalliferous Mine Regulation, 1961. 3.8 Mines Rescue Rules, 1985 3.9 Provisions of Indian Electricity Rules, 1956 applicable to mines. 3.10 Mine Vocational Training Rules, 1966 3.11 Other rules and legislation applicable to metalliferous mines 3.12 General Safety in Mines	i. The Mines Act, 1952; Mines Rules, 1955.

SW-3 Suggested Sessional Work (SW):

a.Assignments:

i. Explain Health and Safety Laws.

b.Mini Project: Case study

MIN403.4: Describe the Acts and Rules for Mineral Conservation and Environmental protection.

Approximate Hours

Item	Approx. Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4.1 Distinguish various Accident statistics; frequency rate and severity. **SO4.2** Evaluate Basic causes of accident occurrence. **SO4.3**Demonstrate Investigations into accidents. **SO4.4** Classify Contribution of human elements in mine safety**.** **SO4.5** Describe Risk Management: Theory and application.		**Unit-4:Accidents and their classification** 4.1 Accident statistics 4.2 frequency rate and severity rates. 4.3 Basic causes of accident occurrence 4.4 Investigations into accidents 4.5 Accident reports 4.6 In-depth study into various causes of accidents 4.7 Measures for improving safety in mines 4.8 TRAP (take responsibility in accident prevention) 4.9 Contribution of human elements in mine safety 4.10 Risk Management 4.11 Theory and application 4.12 Baseline, continuous and issue based risk assessment	1. Basic causes of accident

SW-4 Suggested Sessional Work (SW):

a.Assignments:

Classify Contribution of human elements in mine safety**.**

b.Mini Project:

Case study

MIN403.5: Comprehend the geological formations in India.

Approximate Hours

Item	Approx. 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 Explain MMDR Act 1957. **SO5.2** Demonstrate Mining Plan Approval procedure. **SO5.3** Indian Bureau of Mines and various duties. **SO5.4** Evaluate Indian Bureau of Mines and various responsibilities. **SO5.5**Describe IBM for Mineral Administration.		**Unit 5: MMDR Act** 5.1 MMDR Act 1957 and Rules made there under. 5.2 Mining Plan Approval procedure 5.3 Indian Bureau of Mines and various duties 5.4 Indian Bureau of Mines and various responsibilities. 5.5 IBM for Mineral Administration 5.6 Risk Management 5.7 Theory and application 5.8 risk management techniques 5.9 means of managing 5.10 computer application and simulations 5.11 manager’s role in risk management 5.12 Occupational Health and safety in mines	i.Mining Plan

SW-5 Suggested Sessional Work(SW):

a.Assignments:

iDemonstrate Mining Plan Approval procedure.

b.Mini Project:

Case study

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (SL)	Total hour (Cl+SW+Sl)
MIN403.1: Explain the various aspects various management principles and branches of management	12	1	2	15
MIN403.2: Describe the Acts and Rules for Health and Safety	12	2	1	15
MIN403.3: Describe the technical circulars and gazette notifications related to Mines Safety**.**	12	2	1	15
MIN403.4: Describe the Acts and Rules for Mineral Conservation and Environmental protection	12	2	1	15
MIN403.5: Comprehend the MMDR Act 1957 and Rules.	12	2	1	15
Total Hours	60	9	6	75

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Management	03	01	01	05
CO-2	Basic Principles of Trade unionism	02	06	02	10
CO-3	Overview of Mines Safety in India	03	07	05	15
CO-4	Accidents and their classification	-	10	05	15
CO-5	MMDR Act	03	02	-	05
Total		11	26	13	50

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

The end of semester assessment for Mine Management General Safety & Mine Legislation 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:

i. Improved Lecture
ii. Tutorial
iii. Case Method
iv. Group Discussion
v. Role Play
vi. Visit to mining industry
vii. Demonstration
viii. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
ix. Brainstorming

Suggested Learning Resources:

(e) Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Engineering Economics and Industrial Organisation	Banga & Sharma	Khana Publishers, New-Delhi,	2006, p-1364.

(f) Web link:

https://archive.nptel.ac.in/Harddisk/Direct_Download.html

https://epathshala.nic.in/

https://swayam.gov.in/

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Cos. Pos and PSOs Mapping

Program Title: B. Tech. Mining Engineering

Course Code: MIN403

Course Title: Mine Management General Safety & Mine Legislation

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2	PSO3	PSO4
	Engineering Knowledge	Problem analysis	Design/ developmentof solutions	Conductinvestigations ofcomplexproblems	Modern Toolusage	Theengineerand society	Environment and sustainability:	Ethics	Individual andteamwork:	Communication	Projectmanagement Andfinance	Life-longlearning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation measures.	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of mining engineering.
CO-1 Explain the various aspects various management principles and branches of management	1	2	1	1	1	2	1	2	2	1	1	2	2	3	2	1
CO-2 Describe the Acts and Rules for Health and Safety.	1	1	2	2	1	2	3	2	1	1	2	2	2	1	2	1
CO- 3 Describe the technical circulars and gazette notifications related to Mines Safety.	1	1	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO-4Identifying Physical and Chemical Properties of Minerals.	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO-5Comprehend the geological formations in India.	1	2	1	1	1	3	3	3	1	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,67,8,9,10,11,12 PSO1,2,3,4	CO-1 Explain the various aspects various management principles and branches of management	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit- 1.0 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9, 1.10,1.11,1.12	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO- 2 Describe the Acts and Rules for Health and Safety.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit- 2 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9, 2.10,2.11,2.12	SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-3 Describe the technical circulars and gazette notifications related to Mines Safety.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit- 3 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9, 3.10,3.11,3.12	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO-4 Identifying Physical and Chemical Properties of Minerals.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4: 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9, 4.10,4.11,4.12	SL 4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO -5 Comprehend the geological formations in India.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit 5: 5.1,5.2,5.3,5.4,5.5, 5.6,5.7,5.8,5.9,5.10,5.11,5.12	SL 5.1

Semester-VIII

Course Code:	**MIN404**
Course Title:	Computer Application in Mining
Pre-requisite:	Student should have the knowledge of computer, computer hardware software and mining software.
Rationale:	The students studying the knowledge of computer hardware, computer software. Also students study the various mining software which is beneficial for mining industries as per requirement.

Course Outcomes:

MIN404.1: Describe about the computer hardware, computer software, importance of artificial intelligence and importance of software in mining.

MIN404.2: Explain about the importance of mining software in various operations in surface mine design

MIN404.3: Discuss about the importance of mining software which is related with environmental issues.

MIN404.4: Illustrate the study about mining project and mine valuation which is related with computer software.

MIN404.5: Discuss about the various mining software which is related with various mining problems.

Scheme of Studies:

Code	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)	**MIN404**	Computer Application in Mining	4	0	1	1	6	4

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

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other 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 plannedandperformedunderthecontinuousguidanceandfeedbackofteacherto ensure outcome of Learning.

Scheme of Assessment:
Theory

Code	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment(PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5number 3 marksea ch (CA)	Class Test2 (2bestout of3) 10 markse ach(CT)	Seminar one (SA)	Class Activity anyone (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+AT)		
PCC	**MIN404**	Computer Application in Mining	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.

MIN404.1: Describe about the computer hardware, computer software, importance of artificial intelligence and importance of software in mining.

Approximate Hours

Item	Appx. Hrs
Cl	12
LI	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1.1 Study about the Importance of computer application in mining. **SO1.2** Describe the Introduction to Computers and hardware for application in mining industry **SO1.3Study about** Internet of Things **SO1.4** Explain Big data Machine Learning, **SO1.**5 Explain the Artificial Intelligence, Robotics. .	.	**Unit-1.0 Application of Computer** 1.9 Importance of computer application in mining. 1.10 Introduction to Computers and hardware for application in mining industry Internet of Things 1.11 Big data 1.12 Machine Learning, 1.13 Artificial Intelligence, 1.14 Robotics. 1.15 Define Mine software 1.16 Importance of Artificial Intelligence 1.17 Importance of software 1.18 AI 1.19 Importance of AI 1.20 Use of AI	1. Computer software 2. Internet of Things.

SW-1Suggested Sessional Work(SW):

d. Assignments:

iii. Artificial Intelligence and Robotics

MIN404.2: Explain about the importance of mining software in various operations in surface mine design

Approximate Hours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	Laborat oryInst ruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 Application of computer in terms of exploration SO2.2Understand the reserve estimation SO2.3Understand the Surface Mining- Bench geometry design SO2.4 To know the Haul road design. SO2.5 Learn about the Introduction of mine planning concept through mining software	.	Unit-2 C**omputer application in open cast mining** 2.1 Basic Introduction for application of Computers in areas of : Exploration-Data generation, collection and analysis through computers for exploration 2.2. Reserve estimation 2.3 Surface Mining- Bench geometry design 2.4 Haul road design, 2.5 Introduction of mine planning concept through mining software 2.6 Drainage, 2.7 Introduction to numerical methods in Mining. 2.8 method of Reserve estimation 2.9 Waste dump design 2.10 Monitoring 2.11 Methods 2.12 umericals	1. Learning about the mining operations 2. Waste dump design

SW-2 Suggested Sessional Work (SW):

a. Assignments:

1.Surface blast design parameters

MIN404.3: Discuss about the importance of mining software which is related with environmental issues.

Approximate Hours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO3.1Able to know Environmental Engineering SO3.2 Importance of environment issues **SO3.3** Explain the ground vibration **SO3.4**Explain the pollution in terms air, water **SO3.**5 Analyze the environment mining system	.	**Unit-3:Environmental Engineering** 3.1 Basic Introduction for application of Computers in areas of : Environmental Engineering 3.2 Basic concept of data generation, collection and analysis 3.3Environment Management system 3.4Environment management plan 3.5Relevant Software 3.6Ground vibration 3.7Air pollution 3.8Water pollution 3.9Problems 3.10 Numerical 3.11 Tutorials 3.12 Numericals	1. Environmental management plan 2. Environment management plan

SW-3Suggested Sessional Work (SW):

a.**Assignments:**

1. Environment software

MIN404.4: Illustrate the study about mining project and mine valuation which is related with computer software.

Approximate Hours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4.1 Explain the mapping, mine plan and section **SO4.**2 Study about the Tonnage calculation **SO4.3** Understand about the project monitoring **SO4.4** Study about the inventory control **SO4.**5 Explain the ore grade	.	**Unit-4: Project Monitoring** 4.1 Mine Surveying : Introduction to mapping, 4.2 Estimation of area 4.3 Estimation of volume, 4.4 Problems of area 4.5 Problems of volume 4.6 Preparation of plans 4.7 Tonnage/ Volume calculation for contractual billing and relevant software application. 4.8 Project Monitoring : Systems & tools of monitoring of different mining operations, data collection, analysis and online monitoring 4.9 Inventory control and management. 4.10 Methods of inventory 4.11 Numerical 4.12 Tutorials	1.Tonnage calculation 2.Project monitoring

SW-4 Suggested Sessional Work (SW):

a.Assignments:

i. Discuss about inventory control and management

MIN404.5: Discuss about the various mining software which is related with various mining problems.

Approximate Hours

Item	AppXHrs
Cl	12
LI	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
SO5.1 Study about the Fragalyst software **SO5.2** Study about Blastware software **SO5.3** Explain the FLAC Software **SO5.4** Discuss the VENTSIM Software **SO5.**5Discuss the GALENA Software		**Unit5: Mining Software** 5.1 Fragalyst software 5.2 Blastware software 5.3 GALENA Software 5.4 FLAC Software 5.5 VENTSIM Software 5.6 SURPAC Software 5.7 DATAMINE Software 5.8 AUTOCAD Software 5.9 GIS Software 5.10 Problems 5.11 Tutorials 1 5.12 Tutorials 2	1. Discuss about the Fragalyst software 2. Discuss about the Blastware software

Suggested Sessional Work (SW):

a.Assignments:

1.BLASTWARE Software and VENTSIM Software

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour(Cl+SW+Sl)
MIN404.1: Describe about the computer hardware, computer software, importance of artificial intelligence and importance of software in mining.	12	1	2	15
MIN404.2: Explain about the importance of mining software in various operations in surface	12	1	2	15
MIN404.3: Discuss about the importance of mining software which is related with environmental issues.	12	1	2	15
MIN404.4: Illustrate the study about mining project and mine valuation which is related with computer software.	12	1	2	15
MIN404.5: Discuss about the various mining software which is related with various mining problems.	12	1	2	15
Total Hours	60	5	10	75

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Describe about the computer hardware, computer software, importance of artificial intelligence and importance of software in mining.	01	01	03	05
CO-2	Explain about the importance of mining software in various operations in surface mine design.	02	04	04	10
CO-3	Discuss about the importance of mining software which is related with environmental issues.	03	05	07	15
CO-4	Illustrate the study about mining project and mine valuation which is related with computer software.	03	04	08	15
CO-5	Discuss about the various mining software	01	01	03	05
Total		14	23	13	50

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

The end of semester assessment for Basic Mining Engineering will be held with writtenexaminationof50 marks.

Note. Detailed Assessmentrubricneedtobepreparedbythecoursewiseteachersforabovetasks. Teacherscanalsodesigndifferenttasksasperrequirement,forendsemesterassessment.

Suggested Learning Resources:

(a)Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Computer Application in Mineral industry	K. K. Rao, P. S. R Reddy & Vibhuti N Misra	Allied Publisher Pvt Ltd	2003
2	Mining Competition Handbook (For GATE, Overman, Mining Sirdar and others competitive exams)	Dr. Sandeep Prasad	Orange Books Publication	1st and 2023
3	Manuals of different software's			

Web Link

http://cimfr.csircentral.net/7/
https://www.3ds.com/products/geovia/surpac
https://www.instantel.com/resource/blastware
https://www.geosocindia.org/index.php/jgsi/article/view/83742

Curriculum Development Team

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<u>**Cos. Pos and PSOs Mapping**</u>

Program Title: B. Tech. Mining Engineering

Course Code: MIN404

Course Title: Computer Application in Mining

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conducting investigations ofcomplex problems	Modern toolusage	The engineer and society	Environment and sustain ability:	Ethics	Individual andteamwork:	Communication:	Project management andfinance:	Life-longlearning	Develop analytical skills in identifying and accordingly take actions for solution of mining problems.	Should develop sufficient knowledge about the economic, environmental and societal impacts of mining and basic concepts of mitigation	Develop sufficient skill in project evaluation techniques, mine management, conflict resolution management and general management and safety in mines.	Development of the base for innovation & research in the field of mining engineering.
CO1: Describe about the computer hardware, computer software, importance of artificial intelligence and importance of software in mining.	1	2	1	1	1	2	1	2	2	1	1	2	2	3	2	1
CO 2 Explain about the importance of mining software in various operations in surface mine	1	1	2	2	1	2	3	2	1	1	2	2	2	1	2	1
CO3 Discuss about the importance of mining software which is related with environmental issues.	1	1	1	1	1	2	2	2	1	2	1	2	1	1	2	2
CO 4: Illustrate the study about mining project and mine valuation which is related with computer software.	2	2	3	2	3	2	3	2	2	1	2	3	3	3	3	2
CO5: Discuss about the various mining software	1	2	1	1	1	3	3	3	-	1	2	2	3	3	1	3

Legend:1–Low,2–Medium,3–High

Course Curriculum Map:

Pos & PSOs No.	Cos No. & Titles	SOsNo.	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self Learning(SL)
PO1,2,3,4,5,6,7,8,9,10,11,12 PSO1,2,3,4	CO1 : Describe about the computer hardware, computer software, importance of artificial intelligence and importance of	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 Application of Computer 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11,1.12	SL 1.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 2 Explain about the importance of mining software in various operations in surface mine design.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2 Computer application in surface mining 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9,2.10,2.11,2.12	SL 2.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO3 Discuss about the importance of mining software which is related with environmental issues.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3 : Environmental Engineering 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8, 3.9,3.10,3.11,3.12	SL 3.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 4: Illustrate the study about mining project and mine valuation which is related with computer software.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4: Project Monitoring 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12	SL 4.1
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4	CO 5: Discuss about the various mining software	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit5: Mining Software 5.1,5.2,5.3,5.4,5.5, 5.6, 5.7, 5.8, 5.9,5.10,5.11,5.12	SL 5.1

Semester VIII

Course Code: PROJ-MIN05

Course Title: Research Project

Pre- requisite: Conduct research to resolving the problem of mining operations like blasting, vibration, safety etc. by applying advanced technology adopted in field of mining industries.

Rationale: The basic purpose of B. Tech research is to understand the application of research methodology tools to do research on particular topic related to mining and follow technical writing skill to design the synopsis, thesis, research paper, abstract, articles, etc as per results obtained during research studies.

Course Outcomes:

PROJ-MIN05 Propose research methodology tools for conducting research on selected topic of mining field and prepare Final manuscript i.e. Thesis

Scheme of Studies:

CODE	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours CI+LI+SW+SL	
PROJ	PROJ-MIN05	Research Project	0	12	0	0	12	0+6 = 6

Legend:

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

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

CODE	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks(PRA + ESA)
			Class/Home Assignment 5 number3 markseach(CA)	ClassTest 2(2 bestout of3)10 marks each(CT)	Seminar one	Class Activity anyone(CAT)	Class Attendance(AT)	Total Marks(CA+CT+SA+CAT+AT)		
PROJ	PROJ-MIN05	Research Project	0	0	0	0	0	0	100	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.

PROJ-MIN05 Propose research methodology tools for conducting research on selected topic of mining field and prepare Final manuscript i.e. Thesis .

Approximate Hours

Item	Approximate Hours
CI	0
LI	12
SW	0
SL	30
Total	42

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1. Choose the topic and objectives for the research. **SO2.** Select the suitable data during the research. **SO3.** Assemble the data taken during the research for interpretation. **SO4.** Arrange the whole work with the interpretate data. **SO5.** Formulate the hypothesis according the final composition.	**1** Perform research work as per their topic by using various tools and production technology methods in particular season of crop. **2**. Collection of data **3**. Analysis and interpretation of data **4**. Submission of final thesis based on the research topic		**1.** Finding of reviews related with the topic of research. **2.** Preparation of manuscripts related to concerned topic.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Lab Instruction (LI)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
PROJ-MIN05 Propose research methodology tools for conducting research on selected topic of mining field and prepare Final manuscript i.e. Thesis .	0	12	30	42
Total	0	12	30	42

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. Group Discussion
3. Demonstration
4. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Research publications			
2	Science direct			
3	Research gate			
5	Academia			
6	Multi authored books			
7	Book chapters			

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Cos, POs and PSOs Mapping

Course Code: PROJ-MIN05

Course Title: -Research Project

	Program Outcomes						Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
Course Outcome	Develop the skilled knowledge of communication in verbal and written forms	Apply the complex systems as part of research projects	Create, select & apply appropriate techniques, resources & modern engineering & IT tools	Understand the impact of professional engineering solutions in societal & environmental practices	Apply ethical principles & commit to professional ethics & responsibilities and norms of the engineering practice	The ability to engage in self-directed, reflective & lifelong learning for the benefit of the society	Dev. Analytical skill for complex mining problems	Specialized in depth knowledge in specific areas of mining	Capability to comprehend articulated needs for mining industry	Research orientation based on articulated needs
CO1- Propose research methodology tools for conducting research on selected topic of mining field and prepare Final manuscript	2	2-	1	1	1	1	2	1	1	1

Legend: 1- Low,2 – Medium, 3- High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO 1,2,3,4,5,6, PSO 1,2, 3, 4,	**PROJ-MIN05** Propose research methodology tools for conducting research on selected topic of mining field and prepare Final manuscript	**SO1.1** **SO1.2** **SO1.3** **SO1.4** **SO1.5**	**1.1**Submission of research proposal consisting concern programme **1.2** Explain definition of the problems reference to topic **1.3** Explanation of results **1.4** Arrange the references of past work of 10 years **1.5** Collection of data by focusing their objectives and observations to be taken mentioned in their synopsis		SL 1.1

Semester VIII

Course Code: PROJ-MIN06

Course Title: Seminar and Viva

Pre- requisite: Conduct research to resolving the problem of mining operations like blasting, vibration, safety etc. by applying advanced technology adopted in field of mining industries.

Rationale: The basic purpose of B. Tech seminar and viva is to understand the application of power point presentation tools to do research on particular topic related to mining and follow technical writing skill to design the synopsis, thesis, research paper, abstract, articles, etc as per results obtained during seminar and viva.

Course Outcomes:

PROJ-MIN06 Propose power point presentation tools for conducting research on selected topic of mining field and prepare for final viva.

Scheme of Studies:

CODE	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours CI+LI+SW+SL	
PROJ	PROJ-MIN06	Seminar and Viva	0	2	0	0	2	0+1 = 1

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.

CODE	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks(PRA + ESA)
			Class/Home Assignment 5 number3 markseach(CA)	ClassTest 2(2 bestout of3)10 marks each(CT)	Seminar one	Class Activity anyone(CAT)	Class Attendance(AT)	Total Marks(CA+CT+SA+CAT+AT)		
PROJ	PROJ-MIN06	Seminar and Viva	0	0	0	0	0	0	100	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.

PROJ-MIN06 Propose power point presentation tools for conducting research on selected topic of mining field and prepare for final viva.

Approximate Hours

Item	Approximate Hours
CI	**0**
LI	**08**
SW	**0**
SL	**30**
Total	**38**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1. Choose the topic and objectives for the research. **SO2.** Select the suitable data during the research. **SO3.** Assemble the data taken during the research for interpretation. **SO4.** Arrange the whole work with the interpretate data. **SO5.** Formulate the hypothesis according the final composition.	**1** Perform research work as per their topic by using various tools and production technology methods in particular season of crop. **2**. Collection of data **3**. Analysis and interpretation of data **4**. Submission of final thesis based on the research topic		**1.** Finding of reviews related with the topic of research. **2.** Preparation of manuscripts related to concerned topic.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Lab Instruction (LI)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
PROJ-MIN06 Propose power point presentation tools for conducting research on selected topic of mining field and prepare for final viva.	0	8	30	38
Total	0	8	30	38

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. Group Discussion
3. Demonstration
4. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Research publications			
2	Science direct			
3	Research gate			
5	Academia			
6	Multi authored books			
7	Book chapters			

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3. Dr. B. K. Mishra, Department of Mining Engineering, AKS University, Satna
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5. Prof S. Dasgupta, Department of Mining Engineering, AKS University, Satna
6. Prof P K Palit, Department of Mining Engineering, AKS University, Satna
7. Prof A K Mittal, Department of Mining Engineering, AKS University, Satna
8. Er. P. S. Tiwari, Department of Mining Engineering, AKS University, Satna
9. Er. P. C. Tiwari, Department of Mining Engineering, AKS University, Satna
10. Er. Ramesh Kant, Department of Mining Engineering, AKS University, Satna

Cos, POs and PSOs Mapping

Course Code: PROJ-MIN06

Course Title: -Seminar and Viva

	Program Outcomes						Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
Course Outcome	Develop the skilled knowledge of communication in verbal and written forms	Apply the complex systems as part of research projects	Create, select & apply appropriate techniques, resources & modern engineering & IT tools	Understand the impact of professional engineering solutions in societal & environmental practices	Apply ethical principles & commit to professional ethics & responsibilities and norms of the engineering practice	The ability to engage in self-directed, reflective & lifelong learning for the benefit of the society	Dev. Analytical skill for complex mining problems	Specialized in depth knowledge in specific areas of mining	Capability to comprehend articulated needs for mining industry	Research orientation based on articulated needs
CO1- Propose power point presentation tools for conducting research on selected topic of mining field and prepare for final viva.	2	2-	1	1	1	1	2	1	1	1

Legend: 1- Low,2 – Medium, 3- High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO 1,2,3,4,5,6, PSO 1,2, 3, 4,	**PROJ-MIN06** Propose power point presentation tools for conducting research on selected topic of mining field and prepare for final viva.	**SO1.1** **SO1.2** **SO1.3** **SO1.4** **SO1.5**	**1.1**Submission of research proposal consisting concern programme **1.2** Explain definition of the problems reference to topic **1.3** Explanation of results **1.4** Arrange the references of past work of 10 years **1.5** Collection of data by focusing their objectives and observations to be taken mentioned in their synopsis		SL 1.1