M.D. UNIVERSITY, ROHTAK

SCHEME OF STUDIES AND EXAMINATION

(Under NEP-2020)

BACHELOR of TECHNOLOGY

(MINING ENGINEERING)

SEMESTER 3rd & 4th

Scheme effective from academic session 2026-27

'H' Scheme (Under NEP-2020)

1. Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credits
2 Hours Practical (Lab) per week	1 credit

2. Structure of Undergraduate Engineering program:

Sr No	Category
1	Humanities and Social Sciences including Management courses
2	Basic Science Courses
3	Engineering Science courses
4	Program Core Courses (Branch specific)
5	Professional Elective courses relevant to chosen specialization/branch
6	Open Elective Courses (from Humanities, Technical Emerging or other Subjects)
7	Project work, Seminar and Internship in Industry or elsewhere
8	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition] etc. (non-credit)

3. Course code and definition:

Course Code	**Definition**
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional Core Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
PEC	Professional Elective courses
OEC	Open Elective courses
S	Seminar

PROGRAM OUTCOMES (PO)

Engineering Graduates will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, 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.

PO4. 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.

PO5. 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.

PO6. 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.

PO7. 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.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. 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.

PO11. 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.

PO12. 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.

Semester- 3

Sr. No.	Course Code	Course Title	Hours per week			Total Contact Hrs.	Credit	Examination Scheme (Marks)				Duration of Exam (Hours)
			L	T	P			Internal awards	Theory	Practical	Total	
1	26PCC-MN-201-H	Mining Geology - I	3	0	0	3	**3**	25	50		75	3
2	26PCC-MN-203-H	Elements of Mining	3	0	0	3	**3**	25	50		75	3
3	26PCC-MN-205-H	Mechanics of Solids	3	0	0	3	**3**	25	50		75	3
4	26PCC-MN-207-H	Surveying-I	3	0	0	3	**3**	25	50		75	3
5	26ESC-MN-209-H	Applied Mechanics	3	0	0	3	**3**	25	50		75	3
6	26BSC-MATHME-203-H	Mathematics III (PDE, Probability & Hypothesis Testing)	3	0	0	3	**3**	25	50		75	3
7	26LC-MN- 211-H	Mining Geology - I Lab	0	0	2	2	**1**	5		20	25	3
8	26LC-MN- 213H	Surveying Lab-I	0	0	2	2	**1**	5		20	25	3
9	26LC-MN- 215H	Mechanics of Solids Lab	0	0	2	2	**1**	5		20	25	3
10	26LC-MN- 217H	Engineering Mechanics Lab	0	0	2	2	**1**	5		20	25	3
11	*26AU-ENV-202-H	Environmental Science	2	0	1	3	0					
					Total	29	22				550	
For Honors course												
1	26PCC-MN-219-H	Mine ventilation	3	0	0	3	**3**	25	50		75	3
2	26LC-MN- 221-H	Mine ventilation Lab	0	0	2	2	**1**	5		20	25	3
					Total	**5**	4				100	

*26AU-ENV-202-H is a mandatory non –credit course in which the students will be required passing marks in theory.

Semester 4

Sr. No.	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit	Examination Scheme (Marks)				Duration of Exam (Hours)
			L	T	P			Internal awards	Theory	Practical	Total	
1	26PCC-MN-202-H	Mining Geology- II	3	1	0	4	**4**	30	70		100	3
2	26PCC-MN-204-H	Mineral Processing Technology	3	0	0	3	**3**	25	50		75	3
3	26PCC-MN-206-H	Surveying-II	3	1	0	4	**4**	30	70		100	3
4	26PCC-MN-208-H	Applied Thermodynamics	3	0	0	3	**3**	25	50		75	3
5	26PCC-MN-210-H	Fluid Dynamics	3	0	0	3	**3**	25	50		75	3
6	26PEC-MN-212-H	Industrial Electronics	3	0	0	3	**3**	25	50		75	3
7	26LC-MN-214-H	Mining Geology- II Lab	0	0	2	2	**1**	5		20	25	3
8	26LC-MN-216-H	Fluid Dynamics Lab	0	0	2	2	**1**	5		20	25	3
9	26LC-MN-218-H	Surveying-II Lab	0	0	2	2	**1**	5		20	25	3
10	26LC-MN-220-H	Mineral Processing Technology Laboratory	0	0	2	2	**1**	5		20	25	3
		Total				28	24				600	
For Honors course												
1	26PCC-MN-222-H	ROCK ENGINEERING and GROUND CONTROL	3	0	0	3	**3**	25	50		75	3
2	26LC-MN-224-H	ROCK ENGINEERING and GROUND CONTROL Lab	0	0	2	2	**1**	5		20	25	3
		Total				**5**	4				100	

NOTE: At the end of the 4th semester, each student has to undergo Practical Training of 4/6 weeks in an Industry/ Institute/ Professional organization/ Research Laboratory/ training centre, etc., and submit a typed report along with a certificate from the organization & its evaluation shall be carried out in the 5th Semester.

Course code	**26PCC-MN-201-H**				
Category	Professional core courses				
Course title	**Mining Geology - I**				
Scheme and Credits	L	T	P	**Credits**	Semester-III
	3	0	0	3	
Objectives:	1. **Understanding Earth Materials** – To study minerals, rocks, and their physical and chemical properties related to mining. 2. **Basics of Geology** – To learn fundamental geological concepts such as structure of the Earth, geological processes, and rock formation. 3. **Mineral Identification** – To identify common ore and gangue minerals using physical properties and simple tests. 4. **Rock Types and Formation** – To understand igneous, sedimentary, and metamorphic rocks and their importance in mining. 5. **Structural Geology** – To study folds, faults, joints, and other geological structures that affect mineral deposits and mining operations.				
Class work	25 Marks				
Exam	50 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set 9 questions in all. Q1 is compulsory and of short answer type covering all the four units. Remaining eight questions are to be set by taking two questions from each unit. Each question carries equal marks (10 marks). Examinee has to attempt 5 questions in total selecting at least one from each unit.

UNIT-I

Introduction Branches and scope of geology in mining; weathering of rocks, geological time scale; plate tectonics Mineralogy; physical, chemical and optical properties of minerals; polymorphism, isomorphism and crystallography.

UNIT-II

Petrology; formation, texture, structure and classification of various types of rocks;

UNIT-III

Structural Geology Structural features of rocks; folds, faults, joints and unconformities;

UNIT-IV

Remote Sensing; nature of electromagnetic radiation, electromagnetic spectrum and energy; Remote sensing platforms and sensor's characteristics, advantages and limitations of remote sensing in various fields of mining engineering.

Course Outcomes – Mining Geology I

CO1 Understand basic geology concepts – Explain the origin of the Earth, structure of the Earth, and geological processes such as weathering, erosion, and deposition.
CO2 Identify minerals and rocks – Recognize common rock-forming minerals and classify rocks into igneous, sedimentary, and metamorphic based on their properties and formation.
CO3 Understand geological structures – Describe folds, faults, joints, and unconformities and explain their importance in mining and exploration.

CO4 Apply stratigraphy and geological time scale – Understand geological time, rock succession, and correlate rock layers for mineral exploration.
CO5 Understand ore genesis – Explain the formation and occurrence of mineral deposits and basic principles of economic geology.

References:

1. A Text Book of Engineering and General Geology. Singh Parbin. 3rd Ed. Katson publisher, Ludhiana.
2. A Text Book of Applied Engineering Geology. Maruthesha Reddy M T. New Age International. 2013.
3. A Text Book of Geology, Mukherjee P K. The World Press Pvt. Ltd. Calcutta. 2010.
4. Principles of Engineering Geology. Bangar K.M. Standard Publishers. Delhi, 1995.

Course code	**26PCC-MN-203-H**				
Category	Professional core courses				
Course title	**Elements of Mining**				
Scheme and Credits	L	T	P	**Credits**	Semester-III
	3	0	0	3	
Objectives:	1. **Understand Basic Concepts** – To introduce the fundamental principles of mining engineering and the role of mining in the economy and industry. 2. **Knowledge of Mineral Resources** – To study types, occurrence, and distribution of minerals and fuels. 3. **Mining Methods** – To learn basic surface mining and underground mining methods and their applications. 4. **Mining Machinery & Tools** – To gain knowledge of common mining equipment, drilling, blasting, and material handling systems. 5. **Mine Safety & Health** – To understand safety measures, hazards in mines, and methods for accident prevention.				
Class work	25 Marks				
Exam	50 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set 9 questions in all. Q1 is compulsory and of short answer type covering all the four units. Remaining eight questions are to be set by taking two questions from each unit. Each question carries equal marks (10 marks). Examinee has to attempt 5 questions in total selecting at least one from each unit.

UNIT-I

Introduction

Mineral resources of Rajasthan, India and World; Mining of important economic minerals in India; Various terms used in mining; Stages in the life of the mine, Introduction to unit operations, Economic, Social, Environmental and Health impacts of Mining.

Fundamentals of Prospecting

Prospecting: Reconnaissance; principles and methods of prospecting - pit, shaft, trench and boreholes; Principle, method, Work schedule and application of Geologic, Geophysical, Geochemical, Electrical, Electromagnetic, Gravity methods of prospecting, Sampling techniques; planning a prospecting Programme Application of Remote Sensing and GIS in mineral prospecting.

Unit-II

Fundamentals of Exploration

Exploration: Boring, Principles of boring, Selection of sites for boreholes; Surface layout of boring; Details of equipment, Core recovery, Borehole logging; Maintenance of records; Deflection of boreholes; Difficulties in boring; Fishing tools and their uses; Methods of exploratory drilling for oil; Interpretation of borehole data

Unit--III

Explosives & Blasting

Explosives: Classification and comparative properties of explosive; Modern explosives, Mechanisms of rock blasting; Blasting devices; Electric and non -electric methods; Delay blasting techniques; Priming; Charge distribution; Blasting with cut and solid blasting, General application and uses; Safety considerations.

Unit--IV

Development of Deposits

Pre mining, mining and post-mining: ancillary mining operation, Types of entries to mineral deposits – Shaft, Incline, Adit –applicable conditions- limitations. Basic concepts of surface and underground mining, Comparison of underground and surface mining.

Course Outcomes – Elements of Mining

CO1 Identify different types of minerals and rocks and their occurrence in nature.

CO2 Explain various mining methods such as surface mining and underground mining.

CO3 Understand drilling, blasting, and excavation techniques used in mining operations.

CO4 Describe mine supports, ventilation, and safety measures required in mines.

CO5 Know the transportation and handling of minerals from mine to processing site.

References:

1. High Technology in Drilling and Exploration. Chugh C. P. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
2. Diamond Drilling. Chugh C.P. Oxford & IBH Publisher.
3. Introductory Mining Engineering. Howard & Hartman L. John Willey & Sons
4. Engineering Rock Blasting Operations. Bhandari S. A .A. Balkema Publisher. USA
5. Principles & Practices of Modern Coal Mining. Singh R. D. New Age International Pvt. Ltd. New Delhi.

Course code	**26PCC-MN-205-H**				
Category	Professional core courses				
Course title	**Mechanics of Solids**				
Scheme and Credits	L	T	P	**Credits**	Semester-III
	3	0	0	3	
Objectives:	1. To analyse simple and complex structures for strength and safety. 2. To calculate deformation (elongation, shortening, deflection) in structural members. 3. To understand bending moment, shear force, and torsion in beams and shafts. 4. To learn failure theories and design components to avoid failure. 5. To determine safe load-carrying capacity of materials and structures.				
Class work	25 Marks				
Exam	50 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set 9 questions in all. Q1 is compulsory and of short answer type covering all the four units. Remaining eight questions are to be set by taking two questions from each unit. Each question carries equal marks (10 marks). Examinee has to attempt 5 questions in total selecting at least one from each unit.

UNIT-I

Shear Force and Bending Moment in Beams:

Introduction to types of beams, supports and loadings. Definition of bending moment and shear force, Sign conventions, relationship between load intensity, bending moment and shear force. Shear force and bending moment diagrams for statically determinate beams subjected to points load, uniformly distributed loads, uniformly varying loads, couple and their combinations.

Shear Stress in Beams: Distribution of shear stress, across plane sections used commonly for structural purposes, shear connectors.

UNIT-II

Torsion:

Torsion of circular shafts- solid and hollow, stresses in shafts when transmitting power, shafts in series and parallel. Strain Energy: Resilience, Proof Resilience, strain energy stored in the member due to gradual, sudden and impact loads, Strain energy due to shear, bending and torsion.

UNIT-III

Moment of Inertia

Area moment of Inertia, Principal Axes and Principal Moment of Inertia, Parallel Axis theorem, Polar moment of Inertia. Stresses and Strains: Definition – Stress, Strain, Hooke's law, elastic limit, uni-axial, bi-axial and tri-axial stresses, tensile & compressive stresses,

shear stress, Principal stresses and strains, Mohr's circle. Elastic Constants: Poisson's ratio, Modulus of elasticity, Modulus of rigidity, Bulk Modulus, yield stress, Ultimate stress. Factor of safety, state of simple shear, relation between elastic constants, volumetric strain, volumetric strain for tri-axial loading, deformation of tapering members, deformation due to self –weight, bars of varying sections, composite sections, thermal stress and strain.

UNIT-IV

Thin and Thick Cylinders:

Introduction, Thin cylinders subjected to internal pressure; Hoop stresses, Longitudinal stress and change in volume. Thick cylinders subjected to both internal and external pressure; Lame's equation, radial and hoop stress distribution.

Columns and Struts:

Introduction, short and long columns. Euler's theory; Assumptions, Derivation for Euler's Buckling load for different end conditions, Limitations of Euler's theory. Rankine-Gordon's formula for columns.

Course Outcomes – Strength of Materials

CO1 Understand basic concepts Students will understand stress, strain, elasticity, plasticity, and mechanical properties of materials.
CO2 Analyse simple stresses and strains Students will be able to calculate normal stress, shear stress, and deformation in bars and members under load.
CO3 Bending and Shear in Beams Students will learn to find shear force, bending moment, and bending stress in different types of beams.
CO4 Torsion of Shafts Students will understand torsional stress and angle of twist in circular shafts and solve related numerical problems.
CO5 Column and Strut Analysis Students will learn buckling and critical load of columns using Euler's and Rankine's formulas.

References:

1. Strength of Materials. R. Subramanian, Oxford University Press. 3rd Ed 2016
2. Strength of Materials. Ryder, Macmillan
3. Mechanics of Materials. James M. Gere and Barry J. Goodno, Cengage Learning, 6th Ed, 2009
4. Mechanics of Materials. Gere and Timoshenko, 2nd Ed CBS

Course code	**26PCC-MN-207-H**				
Category	Professional core courses				
Course title	**Surveying-I**				
Scheme and Credits	L	T	P	**Credits**	Semester-III
	3	0	0	3	
Objectives:	1. To understand the basic principles and importance of surveying in mining engineering. 2. To learn about linear and angular measurements used for determining distances, directions, and elevations. 3. To gain knowledge of surveying instruments such as chain, compass, level, theodolite, and their proper use. 4. To understand plane surveying methods like chain surveying, compass surveying, and levelling. 5. To learn how to prepare and read maps, plans, and field notes for mining operations.				
Class work	25 Marks				
Exam	50 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set 9 questions in all. Q1 is compulsory and of short answer type covering all the four units. Remaining eight questions are to be set by taking two questions from each unit. Each question carries equal marks (10 marks). Examinee has to attempt 5 questions in total selecting at least one from each unit.

UNIT-I

Introduction

Definition, principles, objectives, classification, technical terms, uses and necessity of surveying. Units of measurement, surveying measurement and errors, type of errors and their corrections (including numerical), corrections for wrong scales, accuracy and precision, stages of survey operations. Chaining, Ranging and offsetting: Definitions, Principles, Types, Instruments required, methods, obstacles (including numerical), sources of errors, conventional signs and symbols. Electronic Distance Measurement: Working Principles, types, applications in surveying

UNIT-II

Measurement of Directions and Angles

Basic definitions, meridians, bearings, magnetic and true bearings, compasses, prismatic and surveyor's, temporary adjustments, declination, dip, local attraction Types of traverse, procedures, control establishments, Conversion of WCB into RB and vice-versa, Traverse Survey and Computations of interior angles of a closed Traverse. Adjustment of closing error, correction for local attraction.

Levelling and its application

Introduction to levelling, basic terms and definitions, types of instruments, construction and use of dumpy level, auto level, digital level and laser level in construction industry, principle axes of dumpy level, temporary and permanent adjustments

Booking and reduction of levels, plane of collimation (HI) and rise-fall methods, computation of

missing data, distance to the visible horizon, corrections due to curvature and refraction, reciprocal levelling, Numerical problems Differential levelling, profile levelling, fly levelling, check levelling, precise levelling, sources of errors, difficulties in levelling work, corrections and precautions in levelling work.

UNIT-III

Plane Tabling, Contouring, Area and Volume

Plane Table Surveying: Definition, principles, accessories required for plane table surveying, merits and demerits, temporary adjustments, Different methods of plane table surveying, Errors in plane table surveying, Use of telescopic alidade. Contouring: definitions, contour interval, equivalent, uses and characteristics of contour lines, direct and indirect methods of contouring. Grade contour: definition and use. Area: Area of an irregular figure by trapezoidal rule, average ordinate rule, Simpson's 1/3 rule, various coordinate methods. Planimeter: types including digital planimeter, area of zero circle, uses of planimeter. Volume: Computation of volume by trapezoidal and prismoidal formula, volume from spot levels, volume from contour plans.

UNIT-IV

Theodolite Traversing

Various parts and axis of transit, technical terms, temporary and permanent adjustments of a transit, horizontal and vertical angles, methods of repetition and reiteration. Different methods of running a theodolite traverse, Latitudes and departures, rectangular coordinates, traverse adjustments by Bowditch's, transit and modified transit rules, Gales Traverse Table, Numerical Problems. Use of theodolite for various works such as prolongation of a straight line, setting out an angle, bearing measurements. Omitted measurements, Problems in using theodolite traversing, errors in theodolite traversing; Trigonometrical Levelling: Problems on one plane and two plane methods,

Tachometric surveying

Principle, purpose, uses, advantages and suitability of tacheometry, different methods of tacheometry, stadia formula, Stadia diagram and tables. Sub-tense bar method. Application in plane table and curve setting. Radial Contouring.

Course Outcomes – Surveying-I

CO1 Understand basic principles of surveying and its importance in mining engineering for measurement and mapping of mine areas.
CO2 Use surveying instruments such as chain, tape, compass, level, and theodolite for linear and angular measurements with proper accuracy.
CO3 Conduct chain surveying and compass surveying to prepare plans and maps of small mining areas and surface features.
CO4 Apply levelling techniques to determine elevations, reduced levels, contours, and gradients required in mining projects.
CO5 Perform theodolite surveying for measurement of horizontal and vertical angles and for traversing in mining fields.

References:

1. Surveying & Leveling. Vol. I & Vol. II. Kanetkar T.P. & Kulkarni S.V. Pune Vidyarthi Griha Prakshan. Latest edition
2. Surveying. Vol. I & Vol. II. Punmia B.C. & Jain A.K. Laxmi Publication. Latest edition
3. Remote Sensing & Image Interpretation. Lillesand T.M. & Kiefer R.W. John Wiley & Sons. Latest edition

Course code	**26ESC-MN-209-H**				
Category	Engineering Science Courses				
Course title	**Applied Mechanics**				
Scheme and Credits	L	T	P	**Credits**	Semester-III
	3	0	0	3	
Objectives:	1. To understand the basic force system. 2. To learn about Applying principles of particle kinematics. 3. To understand the concepts of particle dynamics. 4. To Learn energy methods & momentum methods.				
Class work	25 Marks				
Exam	50 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set 9 questions in all. Q1 is compulsory and of short answer type covering all the four units. Remaining eight questions are to be set by taking two questions from each unit. Each question carries equal marks (10 marks). Examinee has to attempt 5 questions in total selecting at least one from each unit.

UNIT-I

Engineering Mechanics: Force system, dimensions and units in mechanics, laws of mechanics, vector algebra, addition and subtraction of forces, cross and dot products of vectors, moment of a force about a point and axis, couple and couple moment, transfer of a force to a parallel position, resultant of a force system using vector method, Problems involving vector application

Equilibrium: Static and dynamic equilibrium, static in determinacy, general equations of equilibrium, Varingnon's theorem, Lami's theorem, equilibrium of bodies under a force system, Problems.

UNIT-II

Principles of Lifting Machines: Introduction: Simple Machine, Compound Machine, Lifting , Mechanical Advantage, Input of a Machine , Output of a Machine , Efficiency of a Machine, Ideal Machine, Velocity Ratio, Relation Between Efficiency, Mechanical Advantage and Velocity Ratio of a Lifting Machine, Reversibility of a Machine, Condition for the Reversibility of a Machine, Self-locking Machine, Friction in a Machine, Law of a Machine, Maximum Mechanical Advantage of a Lifting Machine, Maximum Efficiency of a Lifting Machine.

Simple Lifting Machines: Introduction :Types of Lifting Machines, Simple Wheel and Axle, Differential Wheel and Axle, Weston's Differential Pulley Block, Geared Pulley Block, Worm and Worm Wheel, Worm Geared Pulley Block, Single Purchase Crab Winch, Double Purchase Crab Winch, Simple Pulley, First System of Pulleys, Second System of Pulleys, Third System of Pulleys, Simple Screw Jack, Differential Screw Jack , Worm Geared Screw Jack.

UNIT-III

Centroid , Centre of mass and Centre of gravity, Determination of centroid, centre of mass and centre of gravity by integration method of regular and composite figures and solid objects, Problems.

Moment of Inertia: Area moment of inertia, mass moment of inertia, parallel axis and perpendicular axis theorems, radius of gyration, polar moment of inertia, product of inertia, principle axis, problem based on composite figures and solid objects.

UNIT-IV

Truss and Frame: Truss, classification of truss, assumptions in truss analysis, perfect truss.

Applications of Friction: Introduction: Ladder Friction, Wedge Friction, . Screw Friction, Relation Between Effort and Weight Lifted by a Screw Jack, Relation Between Effort and Weight Lowered by a Screw Jack, Efficiency of a Screw Jack.

Particle Dynamics: Energy methods and momentum methods, Newton's second law of motion; dynamic equilibrium and D'Alembert's principle.

Course Outcomes - Engineering Mechanics

CO1 Understand and apply the fundamental principles of engineering mechanics including force systems, equilibrium, and free body diagrams relevant to mining structures and equipment.
CO2 Analyse coplanar and non-coplanar force systems and determine resultant forces and moments in mining-related problems.
CO3 Apply the principles of friction to solve practical problems involving mine haulage systems, conveyors, and lifting equipment.
CO4 Determine centroid, centre of gravity, and moment of inertia of different sections used in mining structures and support systems.
CO5 Analyse kinematics and kinetics of particles and rigid bodies applicable to mining machinery and material handling systems.

Recommended Books: -

Engineering Mechanics – Irving H. Shames, PHI Publication
Engineering Mechanics – U.C.Jindal, Galgotia Publication
Engineering Mechanics – A.K.Tayal, Umesh Publication

Course code	26BSC-MATHME-203-H				
Category	Basic Science course				
Course title	**Mathematics III (PDE, Probability & Hypothesis Testing)**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Semester-III
	3	0	**0**	**3**	
Branch	Mechanical Engineering				
Classwork	25 Marks				
Examination	50 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

COURSE OBJECTIVES:

1. Formulation, Classification and solution methodologies for first (linear and non-linear, both) and second order PDE with applications in engineering.
2. Understand the concept of probability, random variable and some specific Probability distribution like binomial, Poison, Exponential and normal distributions and their applications in different engineering, science
3. Understand the concept of bivariate random variable and bivariate distribution. Also analyze the correlation and regression problems.
4. Understanding the concept of curve fitting and sampling, hypothesis, and hypothesis testing using various statistical technique like z, t-test and chi square distribution etc.

COURSE OUTCOMES (CO):

By the end of the Course, Students will be able to:

CO1: **To define** the concepts and terminology of Partial differential equation (PDE) including formulation, classification and solution methodologies for first (linear and non-linear, both) and second order PDE with applications in engineering.

CO2: Understand the concept of Methods of Separation of variables with applications in real world problems.

CO3: **Understand** the concepts and related terminology of probability and statistics including conditional probability, Baye's rule, random variables, expectation, probability distributions, Bivariate distribution and conditional probability density, correlation, regression, tests etc.

CO4: **Apply** the knowledge & ideas of method of least square and standard probability distributions (Binomial, Poisson, Normal, Exponential) in modelling and analysis of real-world problems.

CO5: **Analyze** and **classify various** statistical tests, and justify their selection for solving given engineering and real-world problems.

CO - PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**1**	**1**	-	-	-	-	-	-	-	-
CO2	**3**	**3**	**2**	**1**			-	-	-	-	-	**1**
CO3	**3**	**3**	**2**	**1**			-	-	-	-	-	**1**
CO4	**3**	**3**	**2**	**2**			-	-	-	-	-	**1**
CO5	**3**	**3**	**2**	**2**								

Note: Examiner will set nine (09) questions in all with two questions from each unit and Q.1 is compulsory and covering all Units. This Q1 is compulsory and of short answer type. Each question

carries equal marks (10 marks). Examinee have to attempt 5 questions in total selecting at least one from each unit.

UNIT-I

Formulation of PDE, Lagrange's linear PDEs; First order non-linear PDEs, Charpit's Method. Second-order linear PDE equations and their classification, Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method.

UNIT-II

Initial and boundary conditions, D'Alembert's solution of the wave equation, Separation of variables method to simple problems in Cartesian coordinates. Methods of Separation of variable's applications to one dimensional Heat and Wave Equations, Two-dimensional Heat flow and Laplace equation.

UNIT-III

Probability spaces, conditional probability, Bayes' rule, Discrete random variables, Bernoulli, Binomial, Poisson Probability Distribution. Expectation of Discrete Random Variables, Moments, Correlation coefficient, Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, conditional densities,

UNIT-IV

Co-efficient of Correlation and Rank Correlation, Lines of Regression, Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, Small samples: Tests for single mean, difference of means, Chi-square test for goodness of fit and independence of attributes.

Textbooks/References:

1. Reena Garg, Engineering Mathematics, Khanna Book Publishing Company, 2022.
2. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
5. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
6. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi Reprint 2013.

Course code	**26PCC-MN-219-H**				
Category	Professional core courses				
Course title	**MINE VENTILATION**				
Scheme and Credits	L	T	P	**Credits**	Semester-III
	3	0	0	3	
Objectives:	1. Understand the basics of mine ventilation to study the purpose, principles, and importance of ventilation in underground mines for maintaining a safe and healthy working environment. 2. Knowledge of mine gases and dust to identify different mine gases (like methane, CO, CO_2, etc.), dust hazards, and their effects on workers' health and mine safety. 3. Airflow measurement and control To learn methods of measuring air quantity, air velocity, and pressure, and understand techniques to control and regulate airflow in mines.				
Class work	25 Marks				
Exam	50 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set 9 questions in all. Q1 is compulsory and of short answer type covering all the four units. Remaining eight questions are to be set by taking two questions from each unit. Each question carries equal marks (10 marks). Examinee has to attempt 5 questions in total selecting at least one from each unit.

UNIT -1

Different Gases / Damps found in mines, Definition of damps, their threshold limits, physiological effects, source of production and detection, Degree of gassiness of seam. Flame safety lamps, its principle, construction, safety features, and comparison. Detection of Methane by flame safety lamp. Methano-meter its principle of working, construction. Principle of other method of detection of methane (description of equipment not required)

UNIT -2

Purpose and standards of ventilation, standards for minimum & maximum velocity of air for different locations. Pressure, ventilating press, waterguage. Temperature, sources of heat in mines. Moisture content of mine air relative humidity, wet bulb temperature, measurement of relative humidity. Cooling power of mine air, determination of coiling power, methods of improving cooling power of mine air, effect of heat and humidity on miners

UNIT -3

Natural ventilation Pressure, geothermic gradient, Factors causing NVP, Effect of seasonal changes on direction of Natural ventilation, limitation of Natural ventilation. Motive column, calculation of natural ventilation pressure. **ARTIFICIAL VENTILATION** Different types of fans used in mines: centrifugal & axial flow, their principle of working, Exhaust & forcing type. Purposes of evasee & volute casing. Reversal of air current, and characteristics curves of fans. Fans in series and parallel, Comparison between axial flow &Centrifugal fan; exhaust & forcing Fan. Fan laws, Mano-metric efficiency overall efficiency, theoretical depression produced by

fan. Numerical on fan laws.

UNIT -4

Laws of air flow in Mines, Atkinson's formula splitting, advantages & disadvantages, Numerical on splitting, equivalent orifice. Numerical on equivalent orifice. Ventilation appliances, Auxiliary ventilation: Different methods, advantages & disadvantages, hazards associated with auxiliary ventilation, precautions required. Booster fan: purpose, dangers associated, Precautions before installation. Numerical on Booster fan, Ascensional and Descensional ventilation, Advantages and disadvantages.

Course outcomes - MINE VENTILATION

CO1 Take measurement of quantity of air, pressure, humidity and cooling power of the mine air, and take corrective action if these do not meet the desired standards.

CO2 Detect presence of inflammable and toxic/noxious gases in the mine and take precautions to remove the some and make the working places safe.

CO3 Provide and maintain ventilation appliances in their districts so as to ensure compliance with standards of ventilation prescribed.

CO4 Generally, appreciate the ventilation system of a mine as a whole and importance of maintaining safe and comfortable working conditions inside the mine.

REFERENCE BOOKS:

Author	Title	Publisher
D.J. Deshmukh	Elements of Mining Technology Vol II	Central techno publication, Nagpur
G.B. Misra	Mine Environment & Ventilation	Oxford University Press, Calcutta
M.A. Ramlu	Mine Disaster & Mine Rescue	Oxford University Press, Calcutta

ENVIRONMENTAL SCIENCE			
Course Code	**26AU-ENV-202-H**	**External marks:**	**70**
Credits	**1**	**Internal marks:**	**30**
L-T-P	**2-0-1**	**Total marks:**	**100**
		Duration of Examination:	**3 hrs**

COURSE OBJECTIVES:

- People working in industries or elsewhere essentially require the knowledge of environmental science so as to enable them to work and produce most efficient, economical and eco-friendly finished product. It will guide the students living in a historic transitional period of burgeoning awareness of the conflict between human activities and environmental constraints to help and save the fragile and endangered planet with the natural resources already overexploited

COURSE OUTCOMES (CO):

By the end of the Course, Students will be able to:

CO1: Solve various engineering problems applying environmentally sustainable approach to produce eco-friendly products.

CO2: Use relevant pollution control methods to solve domestic and industrial problems.

CO3: To recognize eco-friendly and sustainable energy resources for combating global problems like climate change, acid rain and resource depletion etc.

CO4: To solve local solid hazardous and e-waste problems.

CO - PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										
CO2		3										
CO3	2	3										
CO4			3				1					

26AU-ENV-202-H: (ENVIRONMENTAL SCIENCE)

Theory 70 Marks Field Work 30 Marks (Practical/Field visit)

Unit-1 The Multidisciplinary nature of environmental studies. Definition, scope and importance. Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere. Interaction between earth, man and environment.

(2 lectures)

Unit-2 Natural Resources:

Renewable and non-renewable resources: Natural resources and associated problems.

a) Forest resources: Use and over-exploitation; deforestation, case studies. Timber extraction, mining dams and their effects on forests and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams- benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes, caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, Water logging, salinity, case studies.

e) Energy resources: Growing energy needs; renewable and non- renewable energy source, use of alternate sources, case studies.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

* Role of an individual in conservation of natural resources.

* Equitable use of resources for sustainable lifestyles.

5 lectures)

Unit-3 Ecosystem and biodiversity conservation

* Structure of ecosystem, Biotic and Abiotic components

* Energy flow in the ecosystem.

* Ecological succession.

* Food chains, food webs and ecological pyramids.

* Aquatic and terrestrial ecosystems

* Different level of biodiversity: Genetic, Species and ecosystem diversity.

* Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.

* Biodiversity at global, National and local levels.

* India as a mega-diversity nation.

* Hot-spots of biodiversity.

* Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.

* Endangered and endemic species of India.

* Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

(6 lecture)

Unit-4 Environmental Assessment and Management:

Aims and objectives of environmental impact assessment (EIA), Environmental Impact Statement (EIS) and environment management plan (EMP). Structure and role of central and state pollution control board, ISO14000: implementation in industries benefit.

* Environment Protection Act.

* Air (Prevention and Control of pollution) Act.

* Water (Prevention and Control of pollution) Act.

* Wildlife Protection Act.

* Forest Conservation Act.

* Issues involved in enforcement of environmental legislation.

* Public awareness.

(4 lectures)

Unit-5 Environmental pollution:

Definition, causes, effects and control measures of :

a) Air pollution.

b) Water pollution c) Soil pollution
d) Marine pollution e) Noise pollution
f) Thermal pollution g) Nuclear hazards

* Bag filters, cyclone separator, electrostatic precipitator, catalytic converter.
* Role of an individual in prevention of pollution.
* Pollution case studies.
* Disaster management: floods, earthquake, cyclone and landslides.

(5 lectures)

Unit-6 Contemporary environmental issues :

* From unsustainable to sustainable development.
* Urban problems related to energy, National solar mission.
* Water conservation, rain water harvesting, watershed management, Namami Gange and Yamuna action plan.
* Resettlement and rehabilitation of people: its problems and concerns case studies.
* Environmental ethics: Issues and possible solutions.
* Climate change, global warming, acid rain, ozone layer depletion, sea level rise, nuclear accidents and holocaust. Case studies.
* Wasteland reclamation.
* Carbon sequestration and carbon credits, carbon foot print
* Waste management- Swachha Bharat Abhiyan
* Consumerism and waste products.

(4 lectures)

Unit-7 Human population and the Environment. Population growth, variation among nations. Population explosion- Family Welfare Programme. Environment and human health. Epidemiological issues: Fluorosis, Arsenocosis, Goitre, Dengue. Human Rights, Value Education, HIV/AIDS. Woman and Child Welfare. Role of Information Technology in Environment and human health. Case Studies. (4 lectures)

Unit-8 Field Work:

* Visit to a local area to document environmental assets - river/forest/grassland/hill/mountain.
* Visit to a local polluted site-urban/Rural/ Industrial/ Agricultural.
* Study of water polluted site
* Study of common plants, insects, birds.
* Study of simple ecosystems- pond, river, hill slopes, etc.

(Field work equal to 15 lecture hours).

Suggested Text Books / Reference Books:

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Pub. Ltd. Bikaner.
2. Bharucha, Frach, The Biodiversity of India, MApin Publishing Pvt. Ltd. Ahmedabad-380013, India, E-mail : mapin@icenet.net (R).
3. Brunner R.C. 1989, Hazardous Waste Incineration, Mc. Graw Hill Inc. 480p.
4. Clark R.S., Marine pollution, Slanderson Press Oxford (TB).
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Pub. House, Mumbai 1196 p.
6. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
7. Down to Earth, Centre for Science and Environment (R).
8. Gleick, H.P., 1993. Water in crisis, Pacific Institute for Studies in Dev. Environment & Security Stockholm Env. Institute, Oxford Univ. Press, 473p.
9. Hawkins R.E. Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R).
10. Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge Uni. Press 1140p.
11. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p.
12. Mackinney, M.L. & Schoch, RM 1996, Environmental Science systems & solutions, Web enhanced edition. 639p.
13. Mhaskar A.K., Mayyer Hazardous, Tekchno-Science Publications (TB).
14. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. TB).
15. Odum, E.P. 1971, Fundamentals of Ecology. W.B. Saunders Co. USA, 574p.
16. Rao M.N. & Datta, A.K. 1987 Waste Water Treatment. Oxford & TBH Publ. Co. Pvt. Ltd. 345p.
17. Sharma, B.K. 2001, Environmental Chemistry, Goal Publ. House, Meerut.
18. Survey of the Environment, The Hindu (M).
19. Townsend C., Harper J. and Michael Begon. Essentials of Ecology, Blackwell Science (TB).
20. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Comliances and Standards, Vol. I and II Enviro Media (R).
21. Tridevi R.K. and P.K. Goal, Introduction to air pollution, Techno Science Publications (TR).
22. Wagner K.D., 1998, Environmental Management, W.B. Saunders co. Philadelphia, USA 499p.

23. A text book environmental education G.V.S. Publishers by Dr. J.P. Yadav.

(M) Magazine (R) Reference (TB) extbook

The scheme of the paper will be as under :

The subject of Environmental Science will be included as a qualifying paper in all UG Courses and the students will be required to qualify the same. The duration of the course will be 45 lectures. The examination will be conducted along with the semester examinations.

Exam. Pattern : In case of awarding the marks, the paper will carry 100 marks.

Theory : 70 marks, Practical/ Field visit : 30 marks.

The structure of the question paper will be :

Part- A : Short Answer Pattern	:	10 marks
Part- B : Essay Type with inbuilt choice	:	60 marks
Part-C :		
Field Work (Practical)	:	30 marks

Instructions for Examiners :

Part- A : Question No. 1 is compulsory and will contain five short- answer type questions of 2 marks each covering the entire syllabus.

Part-B : Eight essay type questions (with inbuilt choice) will be set from the entire syllabus and the candidate will be required to answer any four of them. Each essay type question will be of 15 marks.

The examination of the regular students will be conducted by the concerned college/Institute. Each student will be required to score minimum 40% marks separately in theory and practical/Field visit. The marks in this qualifying paper will not be included in determining the percentage of marks obtained for the award of degree. However, these marks will be shown in the detailed marks certificate of the students.

Course code	**26LC-MN-211-H**				
Category	Professional Core courses				
Course title	**Mining Geology – I Lab**				
Scheme and Credits	L	T	P	**Credits**	Semester-III
	0	0	2	1	
Objectives:	1. To learn the principles of mechanics of solid and various properties of materials. 2. Able to understand the concepts of stress, strain of materials and ability to interpret the data from the experiments.				
Class work mark	5 Marks				
Practical mark	20 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

List of Experiments

1. Study of Physical properties of minerals

2. Identification of rocks forming silicate and ore minerals

3. Recognition of rocks

4. Use of clinometers compass and Burton compass for measurement dip and strike of formations.

5. Geological cross sections and study of geological maps.

6. Study of models of geological structures and out crops patterns of different types of rocks and landforms

7. Earthquake Seismograms

Course Outcome - Engineering Geology Lab

CO1 To understand the role of geology in the design and construction process of underground openings in rock.

CO2 To apply geologic concepts and approaches on rock engineering projects.

CO3 To use the geologic literature to establish the geotechnical framework needed to properly design and construct heavy civil works rock projects.

CO4 To identify and classify rock using basic geologic classification system

CO5 To identify and characterize intact rock/rock mass properties.

Course code	**26LC-MN-213-H**				
Category	Professional Core courses				
Course title	**Surveying Lab - I**				
Scheme and Credits	L	T	P	**Credits**	Semester-III
	0	0	2	1	
Objectives:	1. To learn the principles of mechanics of solid and various properties of materials. 2. Able to understand the concepts of stress, strain of materials and ability to interpret the data from the experiments.				
Class work mark	5 Marks				
Practical mark	20 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

List of Experiments:

1. Measurement of distance by Ranging and Chaining.
2. Locating various object by chain & cross staff survey
3. Measurement of bearings of sides of traverse with prismatic compass and computation of correct included angle
4. To find the difference in elevation between two points using Differential or Fly leveling.
5. Calculation of R.L. for different points involving 2 instrument stations & reduction by Height of Instrument & Rise and Fall methods.
6. To study different parts of a Transit Theodolite and Temporary Adjustments.
7. To measure a horizontal angle by repetition method.

COURSE OUTCOME - Surveying Lab - I

CO1 Focus on enabling students to operate basic surveying tools (chain, compass, level, plane table), apply field procedures for measurements, work in teams, plot survey data (traverses, contours, areas, elevations) to create maps, and understand error adjustment

Course code	**26LC-MN-215-H**				
Category	Professional Core courses				
Course title	**Mechanics of Solids Lab**				
Scheme and Credits	L	T	P	**Credits**	Semester-III
	0	0	2	1	
Objectives:	1. To learn the principles of mechanics of solid and various properties of materials. 2. Able to understand the concepts of stress, strain of materials and ability to interpret the data from the experiments.				
Class work mark	5 Marks				
Practical mark	20 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

List of Experiments:

1. To study the Brinell hardness testing machine & perform the Brinell hardnesstest.
2. To study the Rockwell hardness testing machine & perform the Rockwellhardness test.
3. To study the Vickers hardness testing machine & perform the Vickers hardnesstest.
4. To study the Erichsen sheet metal testing machine & perform the Erichsensheet metal test.
5. To study the Impact testing machine and perform the Impact tests (Izod &Charpy).
6. To study the Universal testing machine and perform the tensile test.
7. To perform compression & bending tests on UTM.
8. To perform the sheer test on UTM.
9. To study the torsion testing machine and perform the torsion test.

Course Outcomes - Strength of Materials Lab

CO1 Learn the principles of mechanics of solid and engineering.

CO2 Preparation of formal laboratory reports describing the results of experiments.

CO3 Acquire to operate basic instruments in mechanics of materials lab.

CO4 Able to understand the concepts of stress, strain of materials and ability to interpret the data from the experiments.

Note:

1. At least Seven experiments are to be performed in the semester.

Course code	**26LC-MN-217-H**				
Category	Engineering Science courses				
Course title	**Engineering Mechanics Lab**				
Scheme and Credits	L	T	P	**Credits**	Semester-III
	0	0	2	1	
Objectives:	To understand various basic issues of Engineering Mechanics**.**				
Class work mark	5 Marks				
Practical mark	20 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

List of Experiments

1. To calculate the Mechanical Advantage, Velocity Ratio and Efficiency of single start, Double start and Triple start worm & Worm Wheel.
2. To find the Mechanical Advantage, velocity Ratio and Efficiency of a Differential Wheel and Axle.
3. To find Moment of Inertia of a Fly Wheel.
4. Verification of reciprocal theorem of deflection using a simply supported beam.
5. Verification of moment area theorem for slopes and deflections of the beam.
6. Experimental and analytical study of 3 hinged arch and influence line for horizontal thrust.
7. Experimental and analytical study of behavior of struts with various end conditions.
8. To study theory of friction.
9. Experiment on a two-hinged arch for horizontal thrust & influence line for Horizontal thrust.
10. Experimental and analytical study of a 3 bar pin jointed Truss.
11. Experimental and analytical study of deflections for unsymmetrical bending of a Cantilever beam.

Course Outcomes - Strength of Materials Lab

CO1 The students who have undergone the course will be able to understand working of IC engines, types of boilers and accessories and understand the basic mechanics.

Note: 1. At least eight experiments are to be performed in the Semester.

Course code	**26LC-MN-221-H**				
Category	Professional core courses				
Course title	**MINE VENTILATION LAB**				
Scheme and Credits	L	T	P	**Credits**	Semester-III
	0	0	2	1	
Class work	5 Marks				
Practical mark	20 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

LIST OF EXPERIMENTS:

1. Demonstration of co-detector and measurement of carbon monoxide using Co-detector.

2. Demonstration of Methanometer and measurement of methane using Methanometer.

3. Dismantling & assembling of different types of Flame safety lamps.

4. Detection of Methane using flame safety lamp

5. Demonstration of whirling hygrometer and determination of relative humidity using whirling hygrometer.

6. Demonstration of Kata thermometer and determination of cooling power by Kata thermometer.
7. Demonstration of water gauge and measurement of fan water gauge.

8. Demonstration of centrifugal mine fan.

9. Demonstration of Reversal arrangement of centrifugal mine

fan. 10.Demonstration of Axial flow fan.

11. Demonstration of various ventilation devices.

12. Demonstration of vane Anemometer and determination of quantity by Anemometer. 13.Demonstration of velometer and measurement of air velocity by velometer.

14. Demonstration of Inclined manometer and pitot static tube and determination of velocity pressure.

15. Study of ventilation plan and conventional signs used in it.

Course Outcomes - Mine Ventilation Lab

CO1 The students who have undergone the course will be able to understand working of IC engines, types of boilers and accessories and understand the basic mechanics.

Note: At least eight experiments are to be performed in the Semester.

SEMESTER-IV

SYLLABUS

Course code	**26PCC-MN-202-H**				
Category	Professional Core courses				
Course title	**Mining Geology- II**				
Scheme and Credits	L	T	P	**Credits**	Semester-IV
	3	1	0	4	
Objectives:	1. **Understanding Earth Materials** – To study minerals, rocks, and their physical and chemical properties related to mining. 2. **Basics of Geology** – To learn fundamental geological concepts such as structure of the Earth, geological processes, and rock formation. 3. **Mineral Identification** – To identify common ore and gangue minerals using physical properties and simple tests. 4. **Rock Types and Formation** – To understand igneous, sedimentary, and metamorphic rocks and their importance in mining. 5. **Structural Geology** – To study folds, faults, joints, and other geological structures that affect mineral deposits and mining operations				
Class work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set 9 questions in all. Q1 is compulsory and of short answer type covering all the four units. Remaining eight questions are to be set by taking two questions from each unit. Each question carries equal marks (10 marks). Examinee has to attempt 5 questions in total selecting at least one from each unit.

UNIT-I

Stratigraphy & Indian Geology

Stratigraphy; its introduction, standard stratigraphic scale, principle of stratigraphic correction; geology of India in brief; fossil fuels;

UNIT-II

Economic Geology

Economic geology; ore, gangue, tenore and grade; classification of mineral deposits; occurrence, shape, form, size, mineral composition and texture of various process generated mineral deposits;

UNIT-III

Hydrogeology & Maps

Hydrogeology and its impact on mining; geological mapping, topographic maps; effects of topography on outcrops, computer based geological data plotting and preparation of map;

UNIT-IV

Sampling

Sampling and reserves estimation; mine sample reduction; **Prospecting and Exploration**
Prospecting and exploration definition kind and degree of exploration; geological, geophysical, geo-chemical and remote sensing methods.

Course Outcomes – Mining Geology II

CO1 Understand basic geology concepts – Explain the origin of the Earth, structure of the Earth, and geological processes such as weathering, erosion, and deposition.

CO2 Identify minerals and rocks – Recognize common rock-forming minerals and classify rocks into igneous, sedimentary, and metamorphic based on their properties and formation.

CO3 Understand geological structures – Describe folds, faults, joints, and unconformities and explain their importance in mining and exploration.

CO4 Apply stratigraphy and geological time scale – Understand geological time, rock succession, and correlate rock layers for mineral exploration.

CO5 Understand ore genesis – Explain the formation and occurrence of mineral deposits and basic principles of economic geology.

References:

1. A Text Book of Engineering and General Geology. Singh Parbin. Latest Ed. Katson publisher, Ludhiana.
2. A Text Book of Applied Engineering Geology. Maruthesha Reddy M T. New Age International. Latest edition
3. A Text Book of Geology. Mukherjee P K. The World Press Pvt. Ltd. Calcutta. Latest edition Principles of Engineering Geology. Bangar K.M. Standard Publishers, Delhi, Latest edition

Course code	**26PCC-MN-204-H**				
Category	Professional core courses				
Course title	**Mineral Processing Technology**				
Scheme and Credits	L	T	P	**Credits**	Semester-IV
	3	0	0	3	
Objectives:	1. To understand the fundamental principles of mineral processing and the role of beneficiation in the mining industry. 2. To study the physical and physicochemical properties of minerals relevant to separation processes. 3. To learn various comminution techniques such as crushing and grinding and their operational parameters.				
Class work	25 Marks				
Exam	50 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set 9 questions in all. Q1 is compulsory and of short answer type covering all the four units. Remaining eight questions are to be set by taking two questions from each unit. Each question carries equal marks (10 marks). Examinee has to attempt 5 questions in total selecting at least one from each unit.

Unit-I

General Principle: Mineral Beneficiation and its role in mineral exploitation. ; Comminution and Liberation : Theory and practice of crushing and grinding, performance and choice of crushers and grinding mills. Laboratory techniques, interpretation and plotting of date, Industrial screens and screening efficiency; concentration.

Unit-II

Theory and practice of classification, classifiers- Their performance and choice, Picking and washing techniques. Theory and application of sink and float, jigging and flowing film concentration.

Unit-III

methods and equipment used; Froth Flotation: Physicochemical principles, flotation reagents, flotation machines and circuits, application to common sulphides, oxides and oxidized minerals. Electrostatic and Electro-Magnetic Separation - Principles, operations and fields of applications.

Unit-IV

Flow Sheets: Simplified flow sheets for the beneficiation of beach sand, coal and typical ores of copper, lead, zinc and manganese with special reference to Indian deposits.

Course Outcomes (COs) – Mineral Processing Technology

CO1 Understand fundamentals: Explain the principles of mineral processing, ore characteristics, and the importance of beneficiation in mining operations.

CO2 Comminution knowledge: Describe and analyze crushing and grinding processes, equipment, and energy requirements.

CO3 Size separation: Apply concepts of screening, classification, and size analysis for efficient mineral separation.

CO4 Concentration techniques: Explain and select suitable methods such as gravity separation, magnetic separation, electrostatic separation, and flotation for different ores.

CO5 Dewatering operations: Understand and evaluate thickening, filtration, and drying processes used in mineral processing plants.

Essential Reading: 1. A. M. Gaudin, Principles of Mineral Dressing, Tata McGraw & Hill,1939
2. R. H. Richard and C. E. Locky, A text Book on Ore Dressing, A A Balkema,2004
Supplementary Reading: 1. A. F. Taggart, Mineral Dressing Handbook,P&H,2000

2. B.A. Wills, Mineral Processing Technology, Willy & Sons,2005
3. G. C. Lowrison, Crushing & Grinding, Maxwell and MacMillan,2002
4. L. Svalovsky, Solid Liquid Separation, Tata McGraw & Hill Inc., 2003

Course code	**26PCC-MN-206-H**				
Category	Professional Core courses				
Course title	**Surveying - II**				
Scheme and Credits	L	T	P	**Credits**	Semester-IV
	3	1	0	4	
Objectives:	1. Understanding Earth Materials – To study minerals, rocks, and their physical and chemical properties related to mining. 2. Basics of Geology – To learn fundamental geological concepts such as structure of the Earth, geological processes, and rock formation. 3. Mineral Identification – To identify common ore and gangue minerals using physical properties and simple tests. 4. Rock Types and Formation – To understand igneous, sedimentary, and metamorphic rocks and their importance in mining. 5. Structural Geology – To study folds, faults, joints, and other geological structures that affect mineral deposits and mining operations				
Class work	30 Marks				
Exam	70 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set 9 questions in all. Q1 is compulsory and of short answer type covering all the four units. Remaining eight questions are to be set by taking two questions from each unit. Each question carries equal marks (10 marks). Examinee has to attempt 5 questions in total selecting at least one from each unit.

UNIT-I

Curves-Horizontal

Definitions of different terms, necessity of curves and types of curves Simple circular curves and compound curves, office and field work, linear methods of setting out curves, Angular methods of setting out curves, two theodolites and Rankine deflection angle method. Reverse and transition curves, their properties and advantages, design of transition curves, shift, spiral angle. Composite curves office and field level. Setting out of curves by angular method, composite curves problems. Difficulties in setting out curves and solution for the same.

Curves-Vertical Sight distance on a vertical curve Tangent correction and chord gradient methods.

Sight distance on a vertical curve

UNIT-II

Setting out works

General horizontal and vertical control, setting out of foundation plan for load bearing and framed structure, batter board, slope and grade stakes, setting out with theodolite, setting out a foundation plans for building, sewer line, culvert, and use of laser for works; Setting out centre line for tunnel, transfer of levels for underground works. Project/route survey for bridge, dam and canal; Checking verticality of high-rise structures.

UNIT-III

Special Survey Instruments

Electronic Theodolite, Total Station: Principles, Types, Applications, Topographical Survey and Stake-out, Transferring data to and from other software's for further processing, advantages and limitations. Introduction to Site square, Penta Graph, Auto-set Level, Transit level, Special

Compasses, Brunton Universal Pocket Transit, Mountain Compass Transit

UNIT-IV

Modern Methods of Surveying

Global Positioning System (GPS): Basic principles, GPS segments, receivers, computations of coordinates, Applications in surveying Remote Sensing: Definition, basic concepts, electromagnetic radiation and spectrum, energy source and its characteristics, image acquisition and image interpretation. Application of remote sensing. Global Information System (GIS): Geographical concepts and terminology, advantages, basic components of GIS, data types, GIS analysis, Applications of GIS. Field Astronomy: Introduction, purposes, astronomical terms, determination of azimuth, latitude, longitude and time corrections to the observations. Aerial photogrammetry: Introduction, Principle, Uses, Aerial camera, Aerial photographs, Definitions, Scale of vertical and tilted photograph, Ground Co-ordinates, Displacements and errors, ground control, Procedure of aerial survey, Photomaps and mosaics, Stereoscopes, Parallax bar Hydrographic Survey: Introduction, Organizations, National and International Maritime Hydrography, Hydrographic survey Methods, Lead lines, sounding poles, and single-beam, echo sounders. Interpreting and advising on boundary locations, on the status of land ownership and on the rights, restrictions and interests in property. Legal requirements relating to property boundary surveys in India. Role of revenue department in maintaining survey records, introduction to local survey terminologies like tehsildar, 7/12, utara, namuna8, etc. Introduction to Survey of India Department; Department of Registration and Stamps of any state of India.

Course Outcomes – Surveying-II (Mining)

CO1 Understand basic principles of surveying and its importance in mining engineering for measurement and mapping of mine areas.
CO2 Use surveying instruments such as chain, tape, compass, level, and theodolite for linear and angular measurements with proper accuracy.
CO3 Conduct chain surveying and compass surveying to prepare plans and maps of small mining areas and surface features.
CO4 Apply levelling techniques to determine elevations, reduced levels, contours, and gradients required in mining projects.
CO5 Perform theodolite surveying for measurement of horizontal and vertical angles and for traversing in mining fields.

References:

1. Surveying & Leveling. Vol. I & Vol. II. Kanetkar T.P. & Kulkarni S.V. Pune Vidyarthi Griha Prakshan. Latest edition
2. Surveying. Vol. I & Vol. II. Punmia B.C. & Jain A.K. Laxmi Publication Pvt. Latest edition
3. Remote Sensing & Image Interpretation. Lillesand T.M. & Kiefer R.W. John Wiley & Sons. Latest edition

Course code	**26PCC-MN-208-H**				
Category	Professional Core courses				
Course title	**Applied Thermodynamics**				
Scheme and Credits	L	T	P	**Credits**	Semester-IV
	3	0	0	3	
Objectives:	1. To understand the basic concepts of system, surroundings, properties, and state of a thermodynamic system. 2. To learn the laws of thermodynamics and their applications in engineering and real-life processes. 3. To study different forms of energy, heat, and work interactions.				
Class work	25 Marks				
Exam	50 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set 9 questions in all. Q1 is compulsory and of short answer type covering all the four units. Remaining eight questions are to be set by taking two questions from each unit. Each question carries equal marks (10 marks). Examinee has to attempt 5 questions in total selecting at least one from each unit.

UNIT-I

Thermodynamics Concepts & Definitions

Thermodynamics and its importance, Macroscopic and Microscopic view point, Concept of Continuum, Thermodynamic System, Surrounding and Boundary, Control Volume approach and Systems approach, Equilibrium – Thermal, Chemical, Mechanical and thermodynamic, Pure Substance, Property – Intensive and Extensive, State, Path, Process and Cycle. Point Function and Path Function, Quasi Static Process and processes like Isobaric, Isochoric, Isothermal, Polytropic Process, Temperature and different scales, Zeroth Law of Thermodynamics, Energy, sources of energy; forms of energy, Energy transfer by work and forms of work ; free Expansion, Energy transfer by heat ; Adiabatic Process, Equations of state, Ideal gas Equation-; Specific gas constant and Universal Gas Constant

UNIT-II

Law of Thermodynamics

Relation between Heat and Work- Joules Constant, First law of thermodynamics for a cyclic process, First law of thermodynamics for a closed system undergoing a process, Conservation principle, First Law of Thermodynamics applied to open system – Steady Flow Energy Equation, Perpetual motion Machine of First kind, Application of first law of thermodynamics to closed system or Non flow Process, Application of first law of thermodynamics to Open Systems like Steam Nozzle, Boiler, Steam Turbine, Pump, Heat Exchanger, Throttling Process – Joules Thompson Coefficient and its significance, Limitations of first law of thermodynamics, Thermal Reservoir - Source and Sink, Concept of Heat Engine, Heat Pump and Refrigerator.

Second law of thermodynamics – Kelvin Planck and Clausius Statements. Equivalence of Clausius

and Kelvin Planck Statement, Reversible and Irreversible Process. Causes of Irreversibility, Perpetual Motion Machine of Second Kind, Need of Carnot theorem and its corollaries, Carnot cycle, Thermodynamic Temperature Scale and its equivalence with Ideal Gas Scale Entropy: Clausius Inequality, Clausius Theorem,

UNIT-III

Thermodynamic Relations

Reciprocal Relation, Cyclic Relation Property relations, Maxwell Relations, TdS equations, Heat capacity relations, Volume Expansivity, Isothermal Compressibility, Clausius-Clapeyron Equation

Availability: High grade and Low Grade Energy, Available and Unavailable Energy, Dead State, Available energy with respect to a process and a cycle, Decrease of Available Energy When heat is transferred through a finite temperature Difference, Second Law efficiency Properties of Pure Substance:Pure substance and Phase changes: Phase change processes of pure substance, Property diagrams for phase change process (T-v, T-s and p-h diagrams), Understanding of Steam Table and Mollier chart with suitable examples.

UNIT-IV

Compressors

Reciprocating Air Compressor: Single stage compressor – computation of work done, isothermal efficiency, effect of clearance volume, volumetric efficiency, Free air delivery, Theoretical and actual indicator diagram Multistage compressors: Constructional details of multistage compressors, Need of multistage, Computation of work done, volumetric efficiency, Condition for maximum efficiency, Inter cooling and after cooling (numerical), Theoretical and actual indicator diagram for multi stage compressors Rotary Air Compressors: Classification, Difference between compressors and blowers, Working and constructional details of roots blower, Screw type and vane type compressors

Power cycles

Vapour Power cycle:Carnot cycle and its limitations as a vapour cycle, Rankine cycle with different turbine inlet conditions, Mean temperature of heat addition, Methods to improve thermal efficiency of Rankine cycle – Reheat cycle and Regeneration Cycle. Gas Power cycles:Assumptions of Air Standard Cycle, Otto cycle, Diesel Cycle and Dual cycle, Brayton Cycle, Sterling Cycle and Ericsson Cycle and Lenoir cycle and Atkinson cycle

Course Outcomes – Thermodynamics (Subject)

CO1 Understand Basic Concepts – Explain fundamental concepts such as system, surroundings, properties, state, process, and thermodynamic equilibrium.
CO2 Apply Laws of Thermodynamics – Apply the Zeroth, First, and Second Laws of Thermodynamics to engineering problems.
CO3 Energy Analysis – Analyze heat, work, and energy transfer in closed and open systems.

CO4 Properties of Pure Substances – Use steam tables and thermodynamic charts to evaluate properties of pure substances.

References:

1. Thermodynamics: An Engineering Approach. Yunus A. Cengel and Michael A Boles, 7th Ed. TMH
2. Basic Engineering Thermodynamics by Rayner Joel, Longman Publishers Engineering
3. Engineering Thermodynamics. P Chattopadhyay, 2nd Ed. Oxford University Press India
4. Thermodynamics. P K Nag. 5th Ed, TMH
5. Thermodynamics. Onkar Singh, New Age International
6. Thermodynamics. C P Arora, TMH

Course code	**26PCC-MN-210-H**				
Category	Professional Core courses				
Course title	**Fluid Dynamics**				
Scheme and Credits	L	T	P	**Credits**	Semester-IV
	3	0	0	3	
Objectives:	1. To understand the basic properties of fluids such as density, viscosity, surface tension, and compressibility. 2. To study fluid statics and analyze pressure measurement, manometers, and forces on submerged surfaces. 3. To learn the kinematics of fluid flow including types of flow, streamlines, pathlines, and continuity equation.				
Class work	25 Marks				
Exam	50 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set 9 questions in all. Q1 is compulsory and of short answer type covering all the four units. Remaining eight questions are to be set by taking two questions from each unit. Each question carries equal marks (10 marks). Examinee has to attempt 5 questions in total selecting at least one from each unit.

UNIT-I

Fluid Dynamics

Integral equations for the control volume: Reynold's Transport theorem, equations for conservation of mass, energy and momentum, Bernoulli's equation and its application in flow measurement, pitot tube, venture, orifice and nozzle meters. Differential equations for the control volume: Mass conservation in 2 and 3 dimension in rectangular, Euler's equations in 2,3 dimensions and subsequent derivation of Bernoulli's equation; Navier-Stokes equations (without proof) in rectangular Cartesian co-ordinates; Exact solutions of Navier-Stokes Equations to viscous laminar flow between two parallel planes (Couette flow and plane Poiseuille flow)

UNIT-II

Fluid properties and fluid statics

Fluid Definition and properties, Newton's law of viscosity concept of continuum, Classification of fluids Fluid Statics: Definition of body and surface forces, Pascal's law, Basic hydrostatic equation, Forces on surfaces due to hydrostatic pressure, Buoyancy and Archimedes' principle.

Fluid Kinematics

Eulerian and Lagrangian approach to solutions; Velocity and acceleration in an Eulerian flow field; Definition of streamlines, path lines and streak lines; Definition of steady/unsteady, uniform/non-uniform, one-two and three dimensional flows; Definition of control volume and control surface, Understanding of differential and integral methods of analysis. Definition and equations for stream function, velocity potential function in rectangular and cylindrical co-ordinates, rotational and irrotational flows; Definition and equations for source, sink, irrotational vortex, circulation

UNIT-III

Real fluid flows

Definition of Reynold's number, Laminar flow through a pipe (Hagen-Poiseuille flow), velocity profile and head loss; Turbulent flows and theories of turbulence-Statistical theory, Eddy viscosity theory and Prandtl mixing length theory; velocity profiles for turbulent flows-universal velocity profile, 1/7th power law; Velocity profiles for smooth and rough pipes. Darcy's equation for head loss in pipe (no derivation),Moody's diagram, pipes in series and parallel, major and minor losses in pipes.

UNIT-IV

Boundary Layer Flows

Concept of boundary layer and definition of boundary layer thickness, displacement, momentum and energy thickness; Growth of boundary layer, laminar and turbulent boundary layers, laminar sub-layer; Von Karman Momentum Integral equation for boundary layers (without proof), analysis of laminar and turbulent boundary layers, drag, boundary layer separation and methods to control it, streamlined and bluff bodies.

Compressible Fluid flow

Propagation of sound waves through compressible fluids, Sonic velocity and Mach number; Application of continuity , momentum and energy equations for steady state conditions; steady flow through nozzle, isentropic flow through ducts of varying cross-sectional area, Effect of varying back pressure on nozzle performance, Critical pressure ratio, Normal shocks, basic equations of normal shock, change of properties across normal shock

Course Outcomes – Fluid Mechanics

CO1: Explain the basic properties of fluids and understand fluid behavior under different conditions.

CO2: Apply principles of fluid statics to calculate pressure, forces on submerged surfaces, and buoyancy.

CO3: Analyze fluid kinematics and identify different types of fluid flow using continuity equation.

CO4: Apply Bernoulli's equation, momentum, and energy principles to solve problems in fluid dynamics.

Reference:

1. Fluid Mechanics. Yunus A Cengel and John M Cimbala. Latest Ed. McGraw Hill.
2. Fluid Mechanics and Machinery. C S P Ojha, Chandramouli and R Berndtsson. Oxford University Press.
3. Introduction to Fluid Mechanics. Fox and McDonald.
4. Fluid Mechanics. R K Bansal.
5. Fluid Mechanics. Victor Streeter, Benjamin Wylie and K W Bedford. Latest Ed. McGraw Hill.
6. Fluid Mechanics. K. L. Kumar.
7. Introduction to Fluid Mechanics. James A. Fay.
8. Fluid Mechanics. B. M. Massey.
9. Mechanics of Fluids. Irving Shames.
10. Fluid Mechanics and Hydraulics. S. K. Ukarande. Ane Books Pvt. Ltd.

Course code	**26PEC-MN-212-H**				
Category	Professional Elective Courses (PEC)				
Course title	**Industrial Electronics**				
Scheme and Credits	L	T	P	**Credits**	Semester-IV
	3	0	0	3	
Objectives:	1. To understand the basic concepts of electronic devices and circuits used in industrial applications. 2. To study the working principles of power semiconductor devices such as diode, transistor, SCR, TRIAC, DIAC, MOSFET, and IGBT. 3. To learn different power electronic converters like rectifiers, inverters, choppers, and cycloconverters. 4. To understand control techniques used in industrial electronics systems.				
Class work	25 Marks				
Exam	50 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set 9 questions in all. Q1 is compulsory and of short answer type covering all the four units. Remaining eight questions are to be set by taking two questions from each unit. Each question carries equal marks (10 marks). Examinee has to attempt 5 questions in total selecting at least one from each unit.

UNIT-I

Semiconductor Devices

Diodes: Principles V-I characteristics and Application of: rectifier diode, zener diode, LED, photodiode, SCR V-I characteristics, UJT triggering circuit, turning-off of a SCR (preliminary discussion), basics of Gate Turn-off thyristor (GTO). Structure and V-I characteristics of Triac (modes of operation not needed) and Diac, Applications of Triac-Diac circuit. Characteristics and principle of Power BJT, power MOSFET, IGBT, comparison of devices, MOSFET/IGBT Gate driver circuit Comparison of SCR, Triac, Power BJT, power MOSFET, IGBT

Phase controlled rectifiers and Bridge inverters

Full wave controlled rectifier using SCR's(semi controlled, fully controlled) with R load only, Derivation of output voltage, Block diagram of closed loop speed control of DC motors, Necessity of inner current control loop, Basic principle of single phase and three phase bridge inverters , block diagrams including rectifier and inverter for speed control of AC motors (frequency control only).

UNIT-II

Operational amplifiers and 555 Timer

Operational amplifier circuits, Ideal OPAMP behaviour, common OPAMP ICs; Basic OPAMP circuits- Inverting amplifier, Non-inverting amplifier, Voltage follower (Buffer), Instrumentation Amplifier, Active first order filter: Low pass and high pass filter; Power Op Amps, Optical Isolation amplifier; 555 timer-Operating modes: monostable, astable multivibrator.

UNIT-III

Digital logic and logic families

Digital signals, combinational and sequential logic circuits, clock signals, Boolean algebra and logic gates. Integrated circuits and logic families: Logic Levels, Noise Immunity, Fan Out, Propagation Delay, TTL logic family CMOS Logic family, comparison with TTL family,

Flip flops: Set Reset(SR),Trigger(T), clocked F/Fs; Registers, decoders and encoders, Multiplexer and Demultiplexer, applications

UNIT-IV

Microprocessor and Microcontrollers

Overview of generic microprocessor, architecture and functional block diagram, Comparison of microprocessor and microcontroller, MSP430 architecture, assembly language programming, C compiler programming, basics of interfacing with external input / output devices (like reading external analog voltages, digital input output)

Applications of microcontroller: Temperature measurement, Speed Measurement using Proximity Sensor, Piezoelectric Actuator Drive

Motors

Review and comparison of DC motors and AC induction motors, Basic principles of speed control of AC induction motor, Basics of BLDC motor, Linear Actuator motor, Servo Motor, Motor Specifications, suitability of each motor for various industrial applications, Selection and sizing of motors for different applications. Applications for pumps, conveyors, machine tools, Microcontroller based speed control for Induction Motor.

Course Outcomes - Industrial Electronics

CO1 Understand electronic devices – Explain the construction, working, and characteristics of power semiconductor devices such as SCR, TRIAC, DIAC, MOSFET, and IGBT.
CO2 Analyze power electronic circuits – Describe and analyze rectifiers, inverters, choppers, and cycloconverters used in industrial applications.
CO3 Apply control techniques – Understand and apply triggering and control methods used in power electronic systems.
CO4 Understand motor drives – Explain the operation and control of DC and AC motor drives used in industries.
CO5 Use industrial components – Identify and apply sensors, transducers, relays, timers, and other automation devices in industrial systems.

References:

1. Power Electronics. M.H. Rashid. Prentice-Hall of India
2. Power Electronics. P S Bhimbra
3. Power Electronics. Vedam Subramanyam, New Age International
4. Power Electronics. Ned Mohan, Undeland, Robbins, John Wiley Publication
5. Electronic Devices and Circuits. Robert Boylestad and Louis Nashelsky, Prentice-Hall
6. Industrial Electronics and Control. S K Bhattacharya, S Chatterjee, TTTI Chandigarh
7. Modern Digitals Electronic. Jain R P, Tata. McGraw Hill, latest edition
8. Digital principal and Application. Malvino and Leach. Tata McGraw Hill, latest edition
9. Fundamentals of Microcontrollers and Embedded System. Ramesh Gaonkar, PENRAM
10. MSP430 Microcontroller Basics. John H. Davies, Newnes. Latest edition.

Course code	**26LC-MN-214-H**				
Category	Professional Core courses				
Course title	**Mining Geology- II Lab**				
Scheme and Credits	L	T	P	**Credits**	Semester-IV
	0	0	2	2	
Objectives:	1. Understanding Earth Materials – To study minerals, rocks, and their physical and chemical properties related to mining. 2. Basics of Geology – To learn fundamental geological concepts such as structure of the Earth, geological processes, and rock formation. 3. Mineral Identification – To identify common ore and gangue minerals using physical properties and simple tests. 4. Rock Types and Formation – To understand igneous, sedimentary, and metamorphic rocks and their importance in mining. 5. Structural Geology – To study folds, faults, joints, and other geological structures that affect mineral deposits and mining operations				
Class work mark	5 Marks				
Practical mark	20 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

List of Experiment:

1 Study of Geology maps.
2 Study of Contour maps.
3 Study of fold, fault and unconformity.
4 Demonstration of igneous intrusions: Dykes, Sills, & Batholiths
5 Demonstration of streaks in different minerals.

Course Outcomes – Mining Geology II Lab

CO1 Understand basic geology concepts – Explain the origin of the Earth, structure of the Earth, and geological processes such as weathering, erosion, and deposition.
CO2 Identify minerals and rocks – Recognize common rock-forming minerals and classify rocks into igneous, sedimentary, and metamorphic based on their properties and formation.
CO3 Understand geological structures – Describe folds, faults, joints, and unconformities and explain their importance in mining and exploration.
CO4 Apply stratigraphy and geological time scale – Understand geological time, rock succession, and correlate rock layers for mineral exploration.
CO5 Understand ore genesis – Explain the formation and occurrence of mineral deposits and basic principles of economic geology.

Course code	**26LC-MN-216-H**				
Category	Professional Core courses				
Course title	**Fluid Dynamics Lab**				
Scheme and Credits	L	T	P	**Credits**	Semester-IV
	0	0	2	2	
Objectives:	1. To understand the basic properties of fluids such as density, viscosity, surface tension, and compressibility. 2. To study fluid statics and analyze pressure measurement, manometers, and forces on submerged surfaces. 3. To learn the kinematics of fluid flow including types of flow, streamlines, pathlines, and continuity equation.				
Class work mark	5 Marks				
Practical mark	20 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

List of Experiment:

1 To find out Reynolds Number
2 To verify Bernoulli's Theorem
3 To measure the discharge through a venturimeter
4 Orifice Meter
5 Rectangular Notch
6 Friction in Pipe
7 Impact of Jet
8 Meta Centric Height

Course Outcomes (COs) – Fluid Mechanics Lab

CO1: Explain the basic properties of fluids and understand fluid behaviour under different conditions.
CO2: Apply principles of **fluid statics** to calculate pressure, forces on submerged surfaces, and buoyancy.
CO3: Analyze **fluid kinematics** and identify different types of fluid flow using continuity equation.
CO4: Apply **Bernoulli's equation, momentum, and energy principles** to solve problems in fluid dynamics.

Course code	**26LC-MN-218-H**				
Category	Professional Core courses				
Course title	**Surveying Lab – II Lab**				
Scheme and Credits	L	T	P	**Credits**	Semester-IV
	0	0	2	2	
Objectives:	1. Understanding Earth Materials – To study minerals, rocks, and their physical and chemical properties related to mining. 2. Basics of Geology – To learn fundamental geological concepts such as structure of the Earth, geological processes, and rock formation. 3. Mineral Identification – To identify common ore and gangue minerals using physical properties and simple tests. 4. Rock Types and Formation – To understand igneous, sedimentary, and metamorphic rocks and their importance in mining. 5. Structural Geology – To study folds, faults, joints, and other geological structures that affect mineral deposits and mining operations				
Class work mark	5 Marks				
Practical mark	20 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

LIST OF EXPERIMENTS:

1) Study of theodolite in detail – practice for measurement of horizontal and vertical angles.
2) Measurement of horizontal angles by method of repetition and reiteration.
3) Trigonometric leveling –heights and distances problem (Two exercises).
4) Heights and distance using principles of tachometric surveying (Two exercises).
5) Curve setting- different methods. (Two exercises)
6) Setting out works for buildings and pipe lines.
7) Determine of area using total station.
8) Traversing using total station.
9) Contouring using total station.
10) Determination of remote height using total station.
11) Stake out using total station.
12) Distance, gradient, diff, height between two inaccessible points using total station

Course Outcomes – Surveying-II Lab

CO1 Understand basic principles of surveying and its importance in mining engineering for measurement and mapping of mine areas.

CO2 Use surveying instruments such as chain, tape, compass, level, and theodolite for linear and angular measurements with proper accuracy.

CO3 Conduct chain surveying and compass surveying to prepare plans and maps of small mining areas and surface features.

CO4 Apply levelling techniques to determine elevations, reduced levels, contours, and gradients required in mining projects.

CO5 Perform theodolite surveying for measurement of horizontal and vertical angles and for traversing in mining fields.

Course code	**26LC-MN-220-H**				
Category	Professional core courses				
Course title	**Mineral Processing Technology Laboratory**				
Scheme and Credits	L	T	P	**Credits**	Semester-V
	0	0	2	1	
Objectives:	To understand various basic issues of Mineral Processing Technology Laboratory				
Class work mark	5 Marks				
Practical mark	20 Marks				
Total	25 Marks				
Duration of Exam	03 Hours				

Experiments List:

1. Study of Laboratory Equipment
2. Crushing of Ore by Jaw Crusher
3. Grinding of Ore in Ball Mill
4. Sieve Analysis (Particle Size Distribution)
5. Screen Effectiveness Test
6. Determination of Work Index (Bond's Method)**.**
7. Gravity Separation using Wilfley Table
8. Heavy Media Separation Test
9. Froth Flotation Experiment
10. Magnetic Separation Test
11. Electrostatic Separation Test
12. Thickening Test
13. Filtration Test
14. Sampling of Mineral Ore
15. Determination of Pulp Density and % Solids

Course Outcomes (COs) for Mineral Processing Technology Laboratory:

CO1 Understand and identify different mineral processing laboratory equipment such as crushers, grinders, screens, classifiers, flotation cells, and separators.

CO2 Perform crushing, grinding, and sieve analysis experiments and evaluate particle size distribution and reduction ratio.

CO3 Conduct mineral beneficiation experiments such as gravity separation, magnetic separation, electrostatic separation, and froth flotation, and calculate recovery and grade.

Course code	**26PCC-MN-222-H**				
Category	Professional Core courses				
Course title	**ROCK ENGINEERING and GROUND CONTROL**				
Scheme and Credits	L	T	P	**Credits**	Semester-IV
	3	0	0	3	
Objectives:	1. Understand Rock Mass Behavior – To study the physical and mechanical properties of rocks and how rock masses behave under different stress conditions. 2. Knowledge of In-situ Stresses – To understand natural stresses present in rock formations and their effect on underground and surface excavations. 3. Rock Failure Mechanisms – To learn different modes of rock failure such as tensile, shear, and compressive failure in mining and civil engineering works.				
Class work	25 Marks				
Exam	50 Marks				
Total	75 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set 9 questions in all. Q1 is compulsory and of short answer type covering all the four units. Remaining eight questions are to be set by taking two questions from each unit. Each question carries equal marks (10 marks). Examinee has to attempt 5 questions in total selecting at least one from each unit.

Unit – I

ORIGIN of SOIL & ITS FORMATION Weathering, Post Depositional changes, Sediment erosion, Transport and Deposition, Rock and Mineral Stability. SOIL as THREE PHASE SYSTEM Weight and Volume relationship, Inter relationship between three phase elements, Density and unit weight relationship. PERMEABILITY and SEEPAGE Darchy's Law, Effective Permeability, Laboratory determination of permeability (Falling and Constant Head),Seepage force and different heads, Quick Sand condition

Unit – II

Concept of stress and strain in rock, stress due to weight of strata, vertical lateral stresses. Stress due to tectonic and orogenic force, Residual stresses, Induced stresses. Field stresses Introduction to elementary rock mass classification based on strength, hardness, RQD, Bieniawski RMR classification. Strength Properties: Compressive strength, Tensile Strength, Shear Strength, Flexural Strength. Strength Indices- Point Load Strength index, Impact Strength index, Protodykonov strength index. Rebound hardness, insitu stress by flat jack Material Characteristics: Brittle material, Ductile material, Elastic material, Plastic material. Time dependent properties: creep, Creep curve, factors contributing Creep. Deformation, weather ability.

Unit- III

Uniaxial compressive strength, Tensile strength – Brazilian test, Bending test. Shear strength test- punch shear test, Direct shear test on Rock cube, Triaxial method. Determination of strength indices- point load strength index, Protodykonov strength index, impact strength index. Rock burst, Bumps, causes controlling measures, factors affecting proneness to rock burst/Bumps. Pillar Design- factors considered. Pillar design by tributary area approach, determination of factor of safety.

Unit- IV

Classification of field instrumentation for ground control and rock mechanics studies. Closure meters:

Telescopic closure meter, Tape closure meter/ extensometer, and Remote indicating closure meter. Borehole Extensometer: Rod type; Magnetic type. Stress Meter, Bolt meter, Rock Bolt Pull Out Tester, Load Cell.Their application, working principle Construction etc.Theories of mechanics of strata behavior: Dome or arch theory, Beam theory. Function of roof bolts. Principle of Action Roof Bolts. Varieties of Roof Bolts: Slot and Wedge, Expansion shell Grouted Roof Bolts, Resin Roof Bolts. Anchorage Testing of Roof Bolts. Bolt density. Code of practice for roof bolting in underground mines. Roof stitching, Principle of Roof stitching, Cable Bolting

STRATEGY OF IMPLEMENTATION: Conducting theory classes, practical, Industrial visits seminars group discussion, and assignment on different topics shall complete the curriculum for the subject.

Course Outcomes – Rock Engineering and Ground Control

CO1 Understand Rock Mass Properties – Explain physical and mechanical properties of rocks and classify rock masses using standard classification systems (RMR, Q-system, etc.).
CO2 Analyze In-situ Stress Conditions – Describe the state of natural stresses in rock and evaluate their effect on underground and surface excavations.
CO3 Identify Rock Failure Modes – Recognize different types of rock failure (compressive, tensile, shear, and structural failure) and their causes in mining operations.
CO4 Apply Ground Control Techniques – Select suitable ground control methods to maintain stability of tunnels, roadways, stopes, and shafts.
CO5 Design Rock Support Systems – Design and evaluate support systems such as rock bolts, cable bolts, steel arches, props, and shotcrete for safe excavation.

REFERENCE BOOKS:

D.J. Deshmukh	Elements of Mining Technology Vol I	Central techno publication, I Nagpur
S.K. Das	Modern Coal mining Technology	Mintech publication hubaneshwar.
B.S. Verma	The elements of mechanics of mining	Tuhin& Co. Lucknow ground
Dr. B.P. Verma	Rock Mechanics for Engineers.	Khanna Publication Delhi.

<table>
<tr><td>Course code</td><td colspan="5">26LC-MN-224-H</td></tr>
<tr><td>Category</td><td colspan="5">Professional Core courses</td></tr>
<tr><td>Course title</td><td colspan="5">ROCK ENGINEERING and GROUND CONTROL LAB</td></tr>
<tr><td rowspan="2">Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td rowspan="2">Semester-IV</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Objectives:</td><td colspan="5">1. Understanding Earth Materials – To study minerals, rocks, and their physical and chemical properties related to mining.
2. Basics of Geology – To learn fundamental geological concepts such as structure of the Earth, geological processes, and rock formation.
3. Mineral Identification – To identify common ore and gangue minerals using physical properties and simple tests.
4. Rock Types and Formation – To understand igneous, sedimentary, and metamorphic rocks and their importance in mining.
5. Structural Geology – To study folds, faults, joints, and other geological structures that affect mineral deposits and mining operations</td></tr>
<tr><td>Class work mark</td><td colspan="5">5 Marks</td></tr>
<tr><td>Practical mark</td><td colspan="5">20 Marks</td></tr>
<tr><td>Total</td><td colspan="5">25 Marks</td></tr>
<tr><td>Duration of Exam</td><td colspan="5">03 Hours</td></tr>
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PRACTICAL:

1. Sand bottle method of field density and void ratio
2. Determination of Plastic Limit, Liquid Limit and Shrinkage Limit
3. Falling head permeameter for permeability
4. Direct shear test for soil
5. Preparation of rock sample for laboratory testing.
6. Determination of uniaxial compressive strength of a rock sample.
7. Determination of tensile strength (Brazilian test) of a rock sample.
8. Determination of shear strength. of a rock sample.
9. Determination of point load strength index.
10. Determination of Protodykonov strength index.
11. Determination of impact strength index.
12. Demonstration of use of flat jack for in-situ stress determination.
13. Demonstration of Closure Meters, Extensometer, Stress cells and Load Cells
14. Demonstration of various Rock bolts.
15. Study of anchorage testing of rock bolts.
16. Demonstration of cable bolting. STRATEGY OF IMPLEMENTATION: Conducting theory classes, practical, Industrial visits seminars group discussion,

Course Outcomes – Rock Engineering and Ground Control Lab

CO1 Understand Rock Mass Properties – Explain physical and mechanical properties of rocks and classify rock masses using standard classification systems (RMR, Q-system, etc.).
CO2 Analyze In-situ Stress Conditions – Describe the state of natural stresses in rock and evaluate their effect on underground and surface excavations.
CO3 Identify Rock Failure Modes – Recognize different types of rock failure (compressive, tensile, shear, and structural failure) and their causes in mining operations.
CO4 Apply Ground Control Techniques – Select suitable ground control methods to maintain stability of tunnels, roadways, stopes, and shafts.
CO5 Design Rock Support Systems – Design and evaluate support systems such as rock bolts, cable bolts, steel arches, props, and shotcrete for safe excavation.