Scheme of Instruction, Evaluation

and

Syllabi of

B.E. MINING ENGINEERING
BATCH 2021 - 2025
(V & VI Semesters)

With effect from Academic Year 2023-24

DEPARTMENT OF MINING ENGINEERING

Estd.1917

UNIVERSITY COLLEGE OF ENGINEERING
(Autonomous)
Osmania University
Hyderabad – 500 007, TS, INDIA

Estd.1929

Scheme of Instruction for BE (Mining Engineering) - V Semester

S.No.	Course Code	Course Title	Scheme of Instruction			Contact Hrs/ Wk	Scheme of Examination			Credits
			L	T	P		Hrs	CIE	SEE	
THEORY										
1	PC501MN	Drilling and Blasting	3	-	-	3	3	30	70	3
2	PC502MN	Mining Machinery II	3	-	-	3	3	30	70	3
3	PC503MN	Mineral Processing	3	-	-	3	3	30	70	3
4	PC504MN	Mine Economics	3	-	-	3	3	30	70	3
5	PC505MN	Rock Mechanics	3	-	-	3	3	30	70	3
6	HS501 EG	Industrial Management	3	-	-	3	3	30	70	3
PRACTICALS										
7	PC551MN	Mining Machinery Lab	-	-	2	2	3	25	50	1
8	PC552 MN	Mineral Processing Lab	-	-	2	2	3	25	50	1
9	PW941MN	Survey Camp (Report)	-	-	-	-	-	50	-	2
			18	**00**	**04**	**22**	**24**	**280**	**520**	**22**

Note: Evaluation of Survey Camp Grade: Satisfactory/ Good/ Excellent

PC501MN

DRILLING AND BLASTING

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• To familiarize the students with exploratory and production drilling including the factors affecting drilling;
• Various types of the explosives and blasting techniques used in underground and opencast mining are also explained besides blasting in civil constructions projects.

Course Outcomes: After completion of course, the students will be able to	
CO-1	Drilling and blasting is primary operation in any mining organization, student understands various methods of drilling design and selection of drilling methods
CO-2	Knowledge about explosives and blasting techniques, makes student confident in design of blasting operation in the field.

UNIT-I
Exploratory Drilling: Drilling for exploration and other purposes; diamond drilling-equipment and principle of operation, it's merits, demerits and limitations; core recovery — single, double and triple tube core barrels; wire line drilling; directional drilling; fishing tools; borehole surveying; borehole logging; novel and special drilling techniques, Horizontal and directional drilling.

UNIT-II
Production Drilling: Various methods and mechanics of drilling -percussive, rotary and rotary percussive. Jack hammer drilling, Top hammer and Down the Hole (DTH) hammer and rotary drills. Drillability: Drillability studies, Factors affecting drilling- operational parameters (like air pressure, thrust, r.p.m., flushing, bit type and bit geometry etc.) and physico-mechanical properties (like strength properties, hardness, abrasivity etc.) design and selection of drills and drill bits; bit wear and reconditioning of drill bits; drilling economics.

UNIT-III
Explosives: Classification and properties of explosives, Types of explosives – Permitted type and their importance, slurry explosives, SMS, ANFO, LOX, boosters, blasting agents. Mechanics of blasting, alternatives to explosives. Accessories and Tools: Accessories- different types of detonators, safety fuses, detonating cords, relays, NONEL, exploders, sequential blasting machines and other shot firing tools, testing of explosives, storage, transportation and handling and destruction of explosives and accessories.

UNIT-IV
Underground Blasting: Drill patterns for underground excavations (for both coal and metal) and in shafts and tunnels; solid blasting; VCR blasting, smooth blasting, induced blasting, charge ratios, rock fragmentation, dangers associated with underground blasting, gallery blasting, statutory requirements, computer design of underground blast, precautionary measures, misfires, blown out shot and blasting economics.

UNIT – V
Open Pit Blasting: Blasting in opencast mines, blast design, primary and secondary blasting; accidents due to blast in opencast mines and preventive measures; environmental impacts due to blasting- ground vibrations, fly rocks, dust, fumes, water pollution etc. Dimension stone blasting, controlled blasting, computer design of opencast blast; statutory requirements. Introduction to different blasting and fragmentation analysis softwares, blasting economics. Blasting for Civil Constructions and Trenches: Blasting for road constructions, trench cutting in soft and hard rocks, demolition of buildings, underwater blastings etc. Introduction to blasting instruments like VOD probe, vibration etc. And high speed under cover etc.,

Suggested Readings:
1. Roy Piush Pal, Blasting in ground excavations and mines, Oxford and IBH, 1st ed 1993.
2. C.P. Chugh, Drilling technology handbook, Oxford and IBH, 1st edn, 1977.
. Roy Piush Pal, Rock blasting effect and operation, A.A. Balkema, 1st ed, 2005.
2. D.J. Deshmukh, Elements of mining technology, Vol-1, Central techno, 7th ed, 2001.
3. B. Hemphill Gary, Blasting operations, Mc-Graw Hill, 1st ed 1981.
4. R.D. Singh, Principles and practices of modern coal mining, New age International, 1st edn, 1977.

PC502MN

MINING MACHINERY - II

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• To understand the functioning of winding engines and other winding accessories.
• To study surface and pit bottom layouts, various coal face machinery.
• To study the design and construction details of excavating & transporting equipment's used in surface mines.
• To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars related to this course.

Course Outcomes: After completion of course, the students will be able to	
CO-1	Know about Winding engines
CO-2	Know Winding accessories and layouts
CO-3	Know coal drills, coal ploughs, cutter loaders and continuous miners and modern concepts in underground mine mechanization
CO-4	Select the Excavation and loading machinery in surface mines
CO-5	Know Classification of transport equipment's, dumpers, Tractors, trailers, dump trucks,Rippers (types), Motor Graders, Bull Dozers, Rock breakers, Road Compactors, Water Tankers.

UNIT – I
Winding engines:
Winding systems, drum winders, drives, mechanical braking of winders, safety devices in winding, overwind and over speed protection, Koepe and multi-rope friction winding, electrical layouts. Duty cycles of drum winders of different drum cross-sections. Special problems of deep shaft winding

UNIT – II
Winding accessories and layouts :
Head gear and their design, head sheave, cages and skips, suspension gear, shaft fittings and appliances – guides, keps, etc., signalling systems, winding calculations relating to rope size & numbers, capacity & power requirement for cages, skips, drum and Koepe winding systems. Surface and Pit-bottom layouts - Mine car circuits at the surface and pit bottom, creepers, skip winding – loading and discharge arrangements. Case studies, railway sidings and layouts.

UNIT – III
Coal face machinery:
Construction, salient mechanical and electrical features and operations of coal drills and their control panels, different types of mechanical loaders, coal ploughs, and continuous miners. Development with road headers in face mechanization, longwall mining equipment, electrical and hydraulic layouts; condition monitoring of mining machinery for underground, modern concepts in underground mine mechanization.

UNIT – IV
Excavation and loading machinery in surface mines:
Classification. Hydraulic system diagram. Under carriage. Design and Constructional details of Front end loaders, Hydraulic excavators and Electric Rope shovel, Backhoe, Dragline, and Bucket Wheel Excavator. Bucket Chain Excavator and Surface Miners. Condition monitoring of mining machinery for opencast mines and ore handling plants

UNIT – V
Other machinery in surface mines:
Classification of transport equipment; Construction and technical specifications of Dumpers of different types including multi-axial dumpers,, Tractors, trailers, dump trucks, Rippers (types), Motor Graders, Bull Dozers, Rock breakers, Road Compactors, Water Tankers.

TEXT BOOKS:
1. Elements of Mining Technology Vol. I & II, Deshmukh D.J., Denett & Company
2. Pumps Focus Compressors Walkar, winding & Transport, Cherkasky B.M.

REFERENCES:
1. Mine Mechanisation and Automation, Alemgren G, U.Kumar.
2. Coal Mining Series, Ernest Mason, London, 1952.

PC503MN

MINERAL PROCESSING

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• The prime objective of this course is to build the solid foundation on principals and equipment of various mineral beneficiations procedures that would facilitate metal extraction.
• It also focuses on mathematical derivations that are associated with concentration processes.

Course Outcomes: After completion of course, the students will be able to	
CO-1	Understand the importance of mineral processing technology.
CO-2	Understand techniques of mineral processing for concentration of ore minerals economically.
CO-3	Review environment friendly techniques for concentration of sulphide minerals.
CO-4	Compute the recovery of ore mineral after concentration.

UNIT - I
Mineral Processing:
Sampling of ores by different methods; Theory of liberation of minerals; Crushers - Jaw, Gyratory, Cone, Rolls and Toothed Roll crushers; Grinding - Types of grinding operations like Batch and Continuous grinding, Dry and Wet grinding, Open circuit and Closed-circuit grinding, Grinding Mills - Ball mills, Theory of ball mill operation, Rod and Tube mills; Comminution laws - Rittinger's laws, Kick's law and Bond's law.

UNIT - II
Mineral Processing Equipment
Study of laboratory sizing techniques and reporting of sizing data; Industrial sizing units – Types of screen surfaces, Grizzlies, Trommels, Vibrating and Shaking screens; Movement of solids in fluids –Stokes' and Newton's laws, Terminal velocity and its relation with size, Relation between time and velocity, Relation between distance travelled and velocity; Equal settling ratio, Free and hindered settling ratios; Quantifying concentrating operations - Ratio of concentration, Recovery, Selectivity Index and Economic Recovery; Classification – Types of classifiers, Study of Settling Cones, Rake Classifier, Spiral Classifier and Cyclones.

Unit Operations – Mineral Processing

UNIT - III
Jigging & Tabling
Jigging: - Theory of jigging, jigging machines - Harz jig, Denver jig Baum jig, Hancock jig, James coal jig and alkyln jig, Design considerations in a jig. Tabling - Study of stratification on a table. Shaking tables, Wilfley table.

UNIT - IV
Heavy Media, Magnetic and Electrostatic separation
Principles, flow chart, different media used, Heavy Media Separation using heavy liquids and heavy suspensions, Washability curves for easy, normal and difficult coal; Magnetic separation processes and Electrostatic separation process.

UNIT - V
Flotation
Flotation - Principles of flotation, Factors affecting flotation, Classification of Collectors and Frothers, Regulators, and Factors affecting their efficiency, Application of flotation process for Cu, Pb and Zn ores.

TEXT BOOKS:
1. Mineral processing technology - B. A. Wills
2. Principles of Mineral Dressing - A.M. Gaudin
3. Introduction to Mineral Processing by V. Malleswara Rao, Indian Academy of Geoscience

REFERENCE BOOKS:
1. Ore dressing Practices - S. K. Jain
2. Elements of Ore Dressing - A. F. Taggart

PC504MN

MINE ECONOMICS

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• Study of estimation and valuation of mineral deposits
• Study of project appraisal
• Study of finance and accounting

Course Outcomes: After completion of course, the students will be able to	
CO-1	The students will have knowledge on estimation and valuation of mineral deposits.
CO-2	They will possess about project appraisal, finance and accounting.

Course Outcome:

UNIT-I
The Mineral Industry: Economic importance of the mineral industry special features of mineral industry, demand and supply analysis, National Mineral Policy. Mineral resource classification International Monetary system, Factors affecting mineral price, Kinds of price quotation, Mineral Price Index, Mineral Price.

UNIT-II
Sampling: Definition, purpose, scope, common methods of sampling, types of samples, selection of sampling procedure, errors in sampling. **Estimation of reserves:** Classification of reserves, tenor, grade. Preparation of assay plans, various methods of ore reserve estimation and problems on ore reserves

UNIT-III
Mine Valuation: factors affecting mine valuation, life of mine, principles and methods of valuation: Hoskold approach, other approaches; Concepts of cash flow and time value of money; Nominal and effective interest rates, inflation; project evaluation techniques: payback period, Accounting rate of return; Discounted cashflow methods: Net present value (NVP), Internal rate of return, benefit cost ratio, feasibility study, depreciation, problems on mine valuation and depreciation

UNIT-IV
Financial Management: Methods of financing industrial enterprises, structure, formation and capitalization. Sources of finance. **Principles of book keeping** as applied to mining industry and accountancy. Balance sheet, profit and loss accounts, Mineral Taxation

UNIT-V
Cost Accounting: Introduction, need for cost accounting, elements of cost, overheads, allocation of over heads, breakeven analysis. **Budget and Budgetary control**: Definition of budget, Principle of budget and budgetary control, types of budgets.

Suggested text books / Reference:
1.Mine and Mineral Economics by Subhash C. Ray
2.Deshmukh RT "Mineral Economics Meera Publishers, Nagpur
3.Chatterjee KK "Mineral Economics Wiley Estern
4.Rubawsky Mineral Economics Elavier Science Pub
5.Sharma N.L. "Mineral Economics

PC505MN

ROCK MECHANICS

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• To study and understand various aspects of rock mechanics and its application to mining.
• Introducing the various instrumentation and measurement methods.
• To study the theories of failure and approaches used for open pit and underground designs.
• To understand various aspects of supports and their design for various situations.
• To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars related
• to this course.

Course Outcomes: After completion of course, the students will be able to	
CO-1	The students will have knowledge on rock mechanics instrumentation, approach to pit slope stability, theories of subsidence and failure of rocks.
CO-2	They will also know about design of underground openings and methods of stowing.

UNIT I
Physico-mechanical properties of rocks: **Physical properties**: Density, porosity, void ratio, moisture content, permeability. **Mechanical Properties**: Preparation of rock samples, determination of mechanical properties of rocks: compressive strength, tensile strength, shear strength, modulus of elasticity, poisson's ratio, cohesion, angle of internal friction. Protodyaknov`s strength index, longitudinal wave velocity, rock burst ability index, Schmidt rebound hardness number, slake durability index.

UNIT II
Stress strain analysis: Analysis of stress and strain in 2D and 3D dimensions, Principal stress, Determination of principal stress and strain invariants; Compatibility equation of stress and strains, Stress and strain transformation, Plane stress and plane strain condition. Mohr's circle of stress and strain.

UNIT III
Rock mass classification: Core recovery, Rock Quality Designation, Rock Mass Rating, Indian-geo mechanics classification, Q System, Geological strength index, Slope mass rating, Rippability classification, Coal mine roof rating.

UNIT IV
Rock mass behaviour: Confining pressures, effect of water, time, temperature. In-situ stress and their estimation; flat jack method, over coring method and hydro fracturing method; Horizontal and vertical stress, intact rock strength and deformability; measuring devices for load, stress and strain. Dynamic loading of rocks. Time dependent properties of rock, creep, mechanism of creep of rocks – different stages, rheological models.

UNIT V
Rock failure theories: Coulomb, Mohr's – Coulomb, Hoek and Brown, Griffiths and Drucker – Prager and Its related calculations and their applications in design of mining structures.

Text / Reference books:
1. B P Verma, Rock Mechanic for Engineers
2. Deb D and Verma AK, "Fundamental and application of rock mechanics",. PHI publication
3.Debasis Deb, "Finite elemnt method: concepts and application in geo mechanics"
4. V Singh and B P Khare, "Rock Mechanics and ground control"
5. Obert and Duvall, "Rock Mechanics and design of structures in rock"
6. Goodman, "Introduc tion to Rock Mechanics"

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HS501EG

INDUSTRIAL MANAGEMENT

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:	
1	To provide students with a comprehensive understanding of management principles and theories.
2	To introduce students to operations management principles and their role in optimizing organizational processes
3	To equip students with knowledge and skills in work study and statistical quality control for process optimization and quality assurance
4	To explore contemporary management practices and their relevance in modern organizations

Course Outcomes:	
CO-1	Students will be able to explain the functions of management, analyze different management theories, and recognize the importance of leadership and corporate social responsibility
CO-2	Students will be able to differentiate between different organizational structures, evaluate their advantages and disadvantages, and assess their applicability in modern organizations
CO-3	Students will be able to understand the process of product design, different production systems, factors affecting plant location, and principles of plant layout. They will also be able to apply line balancing techniques and value analysis to improve efficiency
CO-4	tudents will be able to conduct work study and method study, apply work measurement techniques, and understand the principles of statistical quality control. They will also be able to construct and interpret control charts for variables and attributes

UNIT I - Introduction to Management
Entrepreneurship and organization, Concepts of Management, nature, importance and Functions of Management, Taylor's Scientific Management Theory, Systems Approach to Management, Fayol's Principles of Management: Mayo's Hawthorne Experiments. Management Theories: Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Leadership Styles, Corporate Social responsibility.

UNIT II - Organizational Structures and Types
Organizational Structures: Basic concepts related to Organization - Departmentation and Decentralization, Types of mechanistic and organic structures of organization. Types of Organizations: Line organization, Line and staff organization, functional organization, committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat Organization structure.

UNIT III - Operations Management
Operations Management: Objectives- product design process- Process Selection-Types of production system (Job, batch and Mass Production), Plant location-factors- Urban-Rural sites comparison. Plant layout: Types of Plant Layouts- Design of product layout- Line balancing (RPW method) Value analysis-Definition-types of values- Objectives- Phases of value analysis- Fast diagram

UNIT IV - Work Study and Statistical Quality Control
Work Study: Introduction, definition, objectives, steps in work study, Method study, definition, objectives, and steps of method study. Work Measurement, purpose, types of study, stop watch methods, steps, key rating, allowances, standard time calculations, work sampling. Statistical Quality Control: variables-attributes, Shewart control charts for variables- chart, R chart, – Attributes-Defective-Defect- Charts for attributes-p-chart -c chart (simple Problems), acceptance Sampling-Single sampling- Double sampling plans-OC curves, Deming's contribution to quality.

UNIT V - Project Management and contemporary practices
Project Management (PERT/CPM): Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of completing the project within given time, Project Cost Analysis, Project Crashing. (Simple problems). Contemporary Management Practices: Basic concepts of ERP, Just-In-Time (JIT) System, Total Quality Management (TQM), Six sigma, Capability Maturity Model (CMM), Bench marking, Balanced Score card.

Text / Reference books:
Aryasri: Management Science, 4th edition, TMH, 2004.(UNITS I,II,III,IV,V)
Stoner, Freeman, Gilbert, Management, 6th Ed, Pearson Education, New Delhi, 2004. (UNITS I,II)
Kotler Philip & Keller Kevin Lane, "Marketing Management", PHI, 12th edition, 2005
Koontz & Weihrich, "Essentials of Management", TMH, 6th edition, 2005.
Panneerselvam " Production and Operations Management" PHI,2012.
Memoria & S.V. Gauker, "Personnel Management", Himalaya, 25th edition, 2005
Samuel C. Certo, "Modern Management", PHI, 9th edition, 2005.

PC551MN

MINING MACHINERY LAB

Instruction	*2* periods per week
Duration of Semester End Examination	*2 hours*
CEE	*25 marks*
SEE	*50 marks*
Credits	*1*

Course Objectives:
• To study the various machineries, ropes, conveyors and different types of loading machines.

Course Outcomes: After completion of course, the students will be able to	
CO-1	At the end of the course, students will be able to
CO-2	Understand the safety and efficiency of various haulage layouts and devices
CO-3	Understand the safety and efficiency of various Winding arrangements and devices
CO-4	Understand the safety and efficiency of various Pit top layouts and devices
CO-5	Understand the safety and efficiency of various Pit bottom layouts and devices
CO-6	Understand the safety and efficiency of various machineries used at coal faces.

List of Experiments:
1. Study of jack Hammer, lubricator and air leg.
2. Study of construction of different types of wire ropes.
3. Study of safety hooks used in winding.
4. Study of different types of haulage systems and attachment of tubs to the rope.
5. Study of tensioning arrangement in endless haulage and different types of haulage clips.
6. Study of haulage track, curves, diamond crossing.
7. Study of construction of mine tubs and cars along with their couplings.
8. Study of safety devices provided of haulage roads
9. Study of submersible pumps.
10. Study of Electrical and hydraulic layouts for longwall faces
11. Study of aerial rope ways.
12. Study of various types of head gear-fleet angle, Study of shaft fittings-signal systems, guides,
safety dogs and protective roofing, study of guides– methods of support and tensioning
arrangements.

PC552MN

MINERAL PROCESSING LAB

Instruction	*2* periods per week
Duration of Semester End Examination	*2 hours*
CEE	*25 marks*
SEE	*50 marks*
Credits	*1*

Course Objectives:
• To study various mineral processing techniques to enrich minerals

Course Outcomes: After completion of course, the students will be able to	
CO-1	Know different sample division techniques.
CO-2	Determine the grinding and crushing characteristics of a given mineral sample.
CO-3	Know the washability characteristic of a coal sample.
CO-4	Determine the moisture content by drying of mineral sample.
CO-5	Determine the average size of samples.

LIST OF EXPERIMENTS:
1) Sampling by coning and quartering, riffle sampling techniques, etc.
2) Determination of average particle size by sieve analysis
3) Determination of optimum time of sieving
4) Studies on size reduction using laboratory Jaw crusher
5) Studies on size reduction using laboratory Roller crusher
6) Studies on size reduction using laboratory Ball crusher
7) Heavy media separations (sink and float experiment)
8) Laboratory experimentation Froth Flotation.
9) Determination of grindability of coal.
10) Concentration of a given mineral using magnetic separator.

PW941MN

SURVEY CAMP

CIE : *50 marks*
Credits : *2*

Course Objectives:
• Know the importance of Theodolite, Total station and their practical applications
• Analyze the horizontal and vertical curves for survey work related to Buildings
• Study the various applications of GPS, GIS and remote sensing for field work.

Course Outcomes: After completion of course, the students will be able to	
CO-1	Understand use Total station to calculate linear measurements of structures
CO-2	Apply corrections to the measured values
CO-3	Ability to Compute omitted measurements and areas

The students will be given basic training of handling various survey instruments including the Total stations. The students are given certain tasks on all the instruments and equipments to solve the real practical problems in the vicinity of campus which enables them to learn and apply to the real life survey problems.
After the completion of the survey camp, students need to submit a brief technical report on the project executed and present the work through a seminar talk to be organized by the Department. Award of sessional are based on the performance of the student at the work place and will be judged by internal guide (s) (25 Marks) followed by presentation before the committee constituted by the Department (25 Marks). One faculty member will coordinate the overall activity of Survey camp.

***Students have to undergo Survey camp for 1 or 2 Weeks duration at the end of semester IV and the credits will be awarded after evaluation in V semester.**

Scheme of Instruction for BE (Mining Engineering) – VI Semester

S. No	Course Code	Course Title	Scheme of Instruction			Cont Hrs/ Wk	Scheme of Examination			Credits
			L	T	P		Hrs	CIE	SEE	
THEORY										
1	PC601 MN	Mine Ground Control	3		-	3	3	30	70	3
2	PC602 MN	Underground Metal Mining	3	-	-	3	3	30	70	3
3	PC603 MN	Mine Planning and Design	3	-	-	3	3	30	70	3
4	PC604 MN	Computer Applications in Mining	3	-	-	3	3	30	70	3
5	PE 631 MN	IoT Applications in Mining	3	-	-	3	3	30	70	3
	PE 632 MN	Material Management in Mines								
	PE633 MN	Coal Bed Methane and Coal Gasification								
6	OE-I	Open Elective I	3	-	-	3	3	30	70	3
PRACTICALS										
7	PC651 MN	Computer Applications in Mining Lab	-	-	2	2	3	25	50	1
8	PC652 MN	Rock Mechanics Lab	-	-	2	2	3	25	50	1
9	PW653MN	Mini Project	-	-	6	6	-	50	-	2
			18	**0**	**10**	**28**	**24**	**280**	**520**	**22**
* At the end of VI semester students should undergo Internship-II (OC Mines) (Coal/Metal). Marks will be awarded in VII semester.										

CODE	OPEN ELECTIVE-I
OE611MN	Impact of Mining on National Economics and Environment

PC601MN

MINE GROUND CONTROL

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• To Identify and understand the factors contributing to strata control problems in mines,
• Analyze &design requirement of support system in different workings of mine,
• To Apply different instruments for evaluation of strata condition and organization of strata control in mines

Course Outcomes: After completion of course, the students will be able to	
CO-1	Understand Pit slope stability & subsidence
CO-2	Understand Pillar design and rock burst
CO-3	Understand various types of Underground supports
CO-4	Understand different types of Instruments used for strata monitoring
CO-5	Understand Stowing / filling

UNIT-I
PILLAR DESIGN AND SUBSIDENCE
Definition and concept of ground control in mines, Strength of pillars, barrier and shaft pillar design – load estimation, factor of safety, various formulae, rock burst and bumps — phenomena, causes, prediction, monitoring and control, gas outbursts Theories of subsidence, factors affecting subsidence, subsidence surveys, subsidence prediction techniques, subsidence control – surface and underground measures, pseudo- mining damage.

UNIT -II
UNDERGROUND SUPPORTS
Various methods of roof examination, objectives and limitations of supports, ground forces and in situ stresses, pressure arch theory, evolution of supports, conventional supports — timber and steel supports, arches, yielding supports. Rock and cable bolting, shotcreting, roof stitching, support of shaft bottoms, galleries, junctions and places of roof falls, freshly exposed roof supports, design of supports, longwall powered supports. Design of SCAMP (Strata Control and Management Plan) for B & P and longwall - development, depillaring, etc.

UNIT -III:
PIT SLOPE STABILITY
Approach to slope stability, slope parameters, different types of slope failures, factors affecting slope stability, introduction to methods of failure, analysis, determination of factor of safety, Introduction to different rock slope stabilization techniques.

UNIT -IV:
INSTRUMENTATION
Convergence indicators, load cells, strain gauges, flat jacks, LVDT, dial gauges, pressure cells and recorder, anchorage testing equipment, laboratory and in situ measurements, hydraulic fracturing rock mechanics instrumentation for B & P and longwall workings.

UNIT -V
STOWING / FILLING
Selection and preparation of stowing materials, principal methods of stowing, collection, fields of application and limitations, preparation and transport of materials, surface, underground and face arrangements, design of stowing plants.

TEXT BOOKS:
1. Strata Control in Mineral Engineering, T. Bieniawski Ziti, John Wiley & Sons.

REFERENCES:
1. Underground winning of Coal, T.N. Singh, Oxford and IBH New Delhi.
2. Engineering Rock Mass Classifications, Bieniawski Z.T. 1989, Wiley, New York
3. Longwall mining, Peng S S and Chiang HS, Wiley, New York, 708p.

E RESOURCES
1. http//www.undergroundcoal.com.au/fundamentals/15_general.aspx
2. http//www.icevirtuallibrary.com/doi/abs/10.1680/ijoti.1939.14545

PC602MN

UNDERGROUND METAL MINING

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• To introduce concepts of metal mining and metal mining terminology.
• To study development and operations of metal mines.
• To study about special methods of metal mining methods.
• To know the various statutory aspects like MMR and the relevant DGMS circulars related to this course.

Course Outcomes: After completion of course, the students will be able to	
CO-1	The students will have basic concept on metal mining methods, mine design, development and operations of metal mines.
CO-2	They will also know about novel methods of metal mining and its applications.

UNIT - I
Basics: Metal Mining Terminology; Typical modern metal mine features; exploration, estimation of block wise and mine wise reserves and actual production, typical pre-stoping ore block constructional features; classification of mining/ stoping methods.

UNIT - II
General Mine Design: Mode of mine and stope entry; Layouts; Determination of optimum production level; sequence of extraction, production scheduling; Basic design – Level Intervals, ore pass, common ore pass, size of blocks ore handling in stope and other openings, overview of constructional features – X cuts, Raises, Winzes etc.

UNIT - III
Stoping – General Concepts: Techno-economic characteristics impacting choice of method; typical unit cost parameters; optimum size of a mine and stope. stope layout, design, equipment selection; preparing a stoping block; sequence of stoping; organization; production cycle; unit cost calculation; comparison of methods and costs

UNIT - IV
Stoping Methods: Unsupported methods – Stope and pillar, room and pillar, shrinkage, sublevel stoping etc. Supported stoping– cut and fill, stull, square set, rill, etc. Caving methods – Top slicing, sublevel caving, block caving. Case studies of Indian and foreign underground metal mines. Comparison of various methods of stoping and costs.

UNIT - V
Novel & Innovative Techniques and Special Applications: Hydraulic mining, slurry mining, solution mining, nuclear mining; Rapid excavation; Radial – axial splitter; Thermal fragmentation; shock wave breaking; Deep mining; narrow contiguous veins; shaft and remnant pillars; VCR; Ring drilling; Large Blast hole stoping.

TEXT BOOKS:
1. Hartman, H.L., Introductory Mining Engineering, John Wiley and Sons, New York, 1987.
2. Hustrulid, W.A. Ed., Underground Mining Methods Handbook Society of Mining Engineering
AMIE, New York, 1990.

PC603MN

MINE PLANNING AND DESIGN

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• To introduce the various techniques for mine planning, geotechnical investigation and equipment management.
• To appreciate the modern trends in opencast mines, safety and environment

Course Outcomes: After completion of course, the students will be able to	
CO-1	Understand Pit Planning and related concepts
CO-2	Understand the fundamentals of open pit planning
CO-3	Understand the fundamentals of underground planning
CO-4	Understand the fundamentals of equipment planning
CO-5	Understand the fundamentals of project implementation and monitoring

UNIT I
Introduction: Technical factors in mine planning, methodology of mine planning, short range & long range, mine modeling, mine simulation systems approach to mine planning based on mine subsystems and their elements, mine plan generation.

UNIT II
Open Pit Mining: Selection of initial mine cuts, location of surface structures, division of mining area into blocks, mine design, bench drainage, geometry, haul roads, slope stability; open pit limits and optimization, calendar plan, production planning, production scheduling, economic productivity indices.

UNIT III
Underground Mining: Location of mine entries, mine and auxiliary, optimization of mine parameters, design of shaft pillars and protective pillars, planning of production capacity, layout of development drives/raises/winzes etc, length of faces, size of panels, etc planning of support systems, ventilation, layout of drainage system, planning production scheduling and monitoring, selection of depillaring/stopping method, manpower management, economic/productivity indices, techno economic analysis, mine reclamation design

UNIT IV
Equipment Planning: Latest technological developments in increase in both types and capacities of equipment used in mining operations. Planning and selection of equipment for different mining conditions. Equipment design for optimum drilling and blasting operations. Equipment information, performance, monitoring and expert systems; Innovative mining systems

UNIT V
Project Implementation and Monitoring:
Pre-project activities feasibility report, environmental clearance, detailed project report, sources of funds, import of technology, selection of contracts and contract administration, time management, cost control material management system, project quality assurance, social responsibility, government orders and guidelines. Environmental impact assessment and preparation of environmental management plan. Mine closure plan.

Text / Reference books:
1. Jayanth Bhattacharya, Principles of Mine Planning-Allied Publishers, Delhi 2003.
2. Hustrulid, W. and Kuchta, M., (eds)., Fundamentals of Open pit Mine Planning and Design, Elsevier, 1995
3. Ehrenburger, V and Fajkos, A., Mining Modeling, Elsevier, 1995.Bawden, W.F., and Archibald. J.F., Innovative Mine Design for the 21st Century Elsevier, 1993.

PC604MN

COMPUTER APPLICATION IN MINING

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• To impart knowledge on hardware and software issues concerned with computers in mining industry.
• To develop algorithms and programs on various mining related problems
• To impart knowledge on high-end simulation methodologies
• To study modern techniques on solving mining problems.

Course Outcomes: After completion of course, the students will be able to	
CO-1	The students will have basic programming knowledge and its applications on various mining related problems and familiarity with hardware and software issues during development of programs.
CO-2	They will also have a perspective on high-end simulation methodologies and modern techniques to solve mining problems.

UNIT - I
Introduction to Computers: Configuration of computers and servers, evolution of operating systems; Networking Concepts, MIS Concepts – Cloud computing / grid computing in mining, Big Data analytics.

UNIT - II
Programming & DBMS Concepts: Algorithm, flow charts and Programming of mining application like pillar design, blast design, subsidence, - Database and Relational database - development of software packages for mining companies – forms, queries and reports, Enterprise resource planning for material managements

UNIT - III
Computerised Mine Planning: Introduction of Geostatistics, Reserve Estimation, kriging, block modelling and orebody modelling, Optimization and mine design, mine scheduling.

UNIT - IV
Problem Solving – Applications in Mining: Ventilation network analysis; support design, Applications of CAD in mining, GIS in Mining, online and offline monitoring and control, TDS, FEM and CFD Concepts and basics of modeling and simulation.

UNIT - V
Recent Trends & Mining Software: Artificial intelligence, expert system, neural networks, robotics and their applications in mining Functionalities of mine planning software, fragmentation software, and numerical software applicable to mining. Case studies of mining applications

TEXT BOOKS:
1. Kadri Dagdelen, Editor, Computer Applications in the Minerals Industries, Colorado School of Mines, 1999.
2. Ramani R.V., et al. Computers in Mineral Industry, Oxford and IBH Publishers, 1994.

REFERENCE BOOKS:
1. R.V. Ramani – Editor, APCOM Proceedings Application of Computers and Operations Research in the Mineral Industry, The Society of Mining, Metallurgy and Exploration, Inc., 1996
2. Fytas, K. and Singhal, R.K. Computers Applications in Mineral Industry, A. A. Balkema Publication, 1988.
3. E Balagurusamy , Fundamentals of Computers , Mc Graw Hills Publication, 2009
4. Basandra S K, Computers Today Fourth Edition, Galgotia Publications Pvt. Ltd, 2004

PE631MN

IOT APPLICATIONS IN MINING

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives
• To provide students with a comprehensive understanding of the Internet of Things (IoT) technology and its relevance in the mining industry
• To equip students with the knowledge of IoT data collection, communication, and edge computing techniques specific to mining environments

Course Outcomes: After completion of course, the students will be able to	
CO-1	to explain the fundamental concepts of IoT and its potential benefits and challenges in mining operations
CO-2	students will be proficient in implementing IoT-enabled devices, sensors, and communication protocols to collect and transmit data in mining scenarios

UNIT I
Introduction to Internet of Things (IoT) in mining
Understanding the concept of the Internet of Things (IoT) and its relevance in the mining industry, Overview of IoT architecture and components, IoT-enabled devices and sensors in the mining environment, Benefits and challenges of implementing IoT in mining operations

UNIT II
IoT Data Collection and Communication in Mining
Data acquisition and collection techniques in mining using IoT sensors, Communication protocols and networks for IoT in mining, Edge computing and fog computing in mining IoT systems, Security and privacy considerations in IoT data transmission in mining

UNIT III
Smart Mining Operations with IoT
Real-time monitoring and control of mining equipment through IoT, Predictive maintenance and condition monitoring using IoT data, Autonomous mining vehicles and robotics in IoT-driven mining operations, Environmental monitoring and sustainability through IoT in mining

UNIT IV
IoT and Safety in Mining
IoT applications for enhancing safety and reducing accidents in mining, Wearable devices and smart personal protective equipment (PPE) for miners, Emergency response systems and remote monitoring in hazardous areas, Risk assessment and management with IoT data analytics in mining

UNIT V
IoT Practical Applications with Arduino Boards in Mining
Introduction to Arduino boards and their capabilities for IoT applications, Selection and integration of sensors relevant to mining scenarios (e.g., temperature, humidity, gas), Hands-on experience with Arduino programming for data acquisition and control, Design and implementation of a mining-specific IoT application using Arduino boards, Troubleshooting and optimization of the IoT system for mining operations

REFERENCE BOOKS
1. Internet of Things for Architects" by Perry Lea
2. IoT Solutions in Microsoft's Azure IoT Suite" by Scott Klein and Paolo Patierno
3. Smart Mining: Resources for a Connected World" by William M. Bajjali
4. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" by David Hanes and Gonzalo Salgueiro
5. IoT for Intelligent Mining and Agriculture" edited by Saraju P. Mohanty, Elias Kougianos, and Sudip Misra
6. Industrial Internet of Things: Cyber-Manufacturing Systems" by Sabina Jeschke, Christian Brecher, Houbing Song, and Danda B. Rawat
7. Mining Equipment Reliability, Maintainability, and Safety" by Balbir S. Dhillon
8. IoT Projects with Arduino" by Marco Schwartz and Olivier Engler

PE632MN

MATERIAL MANAGEMENT IN MINES

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• To teach the students on various aspects of materials management like purchasing procedures, and management etc.
• To teach students on store management and inventory, etc.

Course Outcomes: After completion of course, the students will be able to	
CO-1	List out the various items to be purchase and procurement methods.
CO-2	Organize the consumption and inventory of materials at regular intervals, etc.
CO-3	Plan store house management for smooth inflow and outflow of the materials.

UNIT – I
Introduction: Introduction to material management, importance of integrated materials management, need for integrated materials management concept, definition, scope and advantage – an overview, A-B-C analysis, codification, variety reduction, standardisation.

UNIT – II
Purchasing Management: Material planning and purchase, purchase system, procedures, price forecasting, purchasing of capital equipment, vendor development, account procedure, purchasing decisions, procurement policies.

UNIT – III
Warehousing and Store Management: Store keeping principles – past and latest techniques, stores – general layout, cost aspect and productivity, problems and development, store system procedures, incoming material control, store accounting and stock incoming material control, store accounting and stock verification, value analysis.

UNIT – IV
Inventory Management: Introduction, basic models, definitions of commonly used terms, replenishment model, choice of systems, etc., inventory work in progress, safety stock, computerisation in materials management, control, information to materials management case study, spare parts management.

UNIT – V
Material Procurement Procedures: Arbitration Act – Octroi, central and local sales tax, excise duties – customs tariff, import control policies, procurement from govt, agencies and international market - insurance, DGS and D tariff.

TEXT BOOKS:
1. Goplakrishnan, P, and Sundaresan, M. Material Management: An Integrated Approach, Prentice Hall of India Pvt Ltd., New Delhi, 1982.
2. Datta, A.K., Materials Management procedure, Test and cases, Prentice Hall of India Pvt Ltd., New Delhi 1984.

REFERENCE BOOKS:
1. Peckam, H.H., Effective Materials Management, prentice Hall Of India Pvt Ltd., 1984.
2. Prichard, J.W., and Eagle, R.H. Modern Inventory Management, N,Y., Wiley and Breach Science Publishers, 1972.

PE633MN

COAL BED METHANE AND COAL GASIFICATION

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• To make the students familiar about extraction of methane and its importance.

Course Outcomes: After completion of course, the students will be able to	
CO-1	Understand Basic concept of Coal Bed Methane.
CO-2	Understand Basic concept of methods of exploration and exploitation of CBM.
CO-3	Understand Basic concept of Underground Coal Gasification(UCG)
CO-4	Know Mining methods of UCG
CO-5	Understand Merits and Demerits of Underground coal gasification.

UNIT- I
Formation of Methane:
Coalification process and coal grades. Methane generation and storage in coal beds.

UNIT- II:
Exploration CBM:
Geological control in Coal Bed Methane (CBM) exploration; Methane adsorption, desorption in coal.
Coal as CBM reservoir

UNIT- III:
Exploitation of CBM:
In-place methane estimation; Transport of methane in coal-bed. Drilling & Completion of a CBM hole/well. Identification and characterization of coal beds by hole/well logs. Hydraulic fracturing in coal beds. Production performance of a CBM hole/well; Water drainage & gas-water separation.

UNIT- IV:
Measurement & Transportation of Methane:
Gas volume measurement. Compression & transport; Liquefaction and utilization. Enhanced recovery by CO_2 and N_2 adsorption methods.

UNIT- V:
Underground Coal Gasification (UCG) Concept:
Conditions suitable for UCG, Principles of UCG. UCG Process Component factors: Technology of UCG, opening up of coal seam for UCG. Underground Coal Gasification at Great Depth, Merits and Demerits of Underground coal gasification.

TEXT BOOKS:
1. Coal Bed Methane - 1st Edition - Elsevier
2. A guide to Coal bed methane reservoir engineering". Society of Petroleum engineers ,
published by Gas research institute, Chicago, Illinois.

3. Fundamentals of Coal bed Methane Reservoir Engineering, John Seidle, PennWell Books (15 September 2011)
4. Principles and Practices of Modern Coal Mining – R.D. Singh, New Age International

REFERENCES:
1. Underground Coal Mining Methods – J.G. Singh, Braj-Kalpa Publishers.
2. Winning and Working Coal in India Vol.II- R.T. Deshmukh and D.J.Deshmukh., Dhanbad Publishers

E- RESOURCES
1. http//www.gasification-syngas.org/technology/underground-coal-gasification
2. http//www.sciencedirect.com/science/article/pii/S0360128512000573
3. https//www.sciencedirect.com/science/article/pii/S2213397613000165
4. http//www.dghindia.org/index.php/page?pageId=38

OE611MN

IMPACTS OF MINING ON NATIONAL ECONOMICS AND ENVIRONMENT

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• To understand the economic implications of mining in India
• To assess the environmental impact of mining and mitigation measures
• To explore social and human rights issues in mining
• To comprehend the government policies and regulations governing mining in India
• To examine the future outlook and sustainability of mining in India

Course Outcomes:	
CO-1	Students will be able to analyze the contribution of mining to India's GDP
CO-2	Students will understand the importance of environmental impact assessment (EIA)
CO-3	Students will understand the social and community impacts of mining, analyze human rights considerations, evaluate corporate social responsibility initiatives in the mining sector.
CO-4	Students will gain knowledge about mining policies and the regulatory framework in India,
CO-5	Students will analyze technological advancements and innovation in the Indian mining industry, evaluate sustainable mining practices and initiatives.

Unit 1:
Economic Implications of Mining in India
Overview of the mining sector in India: Key minerals, production, and reserves, Economic contributions of mining to India's GDP and employment, Case studies of successful mining projects in India, Challenges and opportunities for sustainable economic growth through mining

Unit 2:
Environmental Impact Assessment and Mitigation
Environmental impact assessment (EIA) process and its importance, Assessment of environmental impacts: Air, water, and land pollution, Mitigation measures and best practices in the mining industry, Case studies of successful environmental management in mining operations

Unit 3:
Social and Human Rights Issues in Mining
Social and community impacts of mining: Displacement, resettlement, and social conflict, Human rights considerations in mining activities, Corporate social responsibility (CSR) initiatives in the mining sector, Stakeholder engagement and community development programs

Unit 4:
Government Policies and Regulations
Overview of mining policies and regulatory framework in India, Mining lease and licensing procedures in India, Environmental clearance and consent mechanisms for mining projects, Initiatives to promote responsible mining practices and sustainable development in India

Unit 5:
Future Outlook and Sustainable Mining in India
Technological advancements and innovation in the Indian mining industry Sustainable mining practices and initiatives in India Role of renewable energy in reducing the environmental impact of mining Future challenges and opportunities for the Indian mining sector

Reference books
1. Mining Economics and Strategy" by Ian C. Runge
2. Sustainable Mining Practices: A Global Perspective" by Reddy, G.V.R., et al.
3. Environmental Impact Assessment: Theory and Practice" by Peter Wathern
4. Social and Environmental Impacts in the Mining Sectors: Lessons from Africa" by Shingirirai Savious Mutanga
5. Mining, Society, and a Sustainable World" edited by John Strongman and Heikki S. Tuunanen

PC651MN

COMPUTER APPLICATIONS IN MINING LAB

Instruction	*2* periods per week
Duration of Semester End Examination	*2 hours*
CEE	*25 marks*
SEE	*50 marks*
Credits	*1*

Course Objectives:
• To design the mining equipment's, Blast design, Fragmentation Analysis and Mine ventilation network analysis.

Course Outcomes: After completion of course, the students will be able to	
CO-1	At the end of the course, students will be able to
CO-2	Design the Mining Equipment's
CO-3	Design the Blast design
CO-4	Analysis the fragmentation
CO-5	Analysis of mine ventilation network analysis

LIST OF EXPERIMENTS:
1. Prediction of surface subsidence over underground coal mining workings.
2. Stress analysis in stability of pillar in coal mines
3. Study of strata and support behavior in underground mine
4. Behavior of shield supports in long wall mining.
5. Slope stability analysis
6. Performance of explosive impact on mine production.
7. Identification of most influencing blast design parameters using IBM SPSS.
8. Regression analysis in excel.
9. Prediction of subsidence in underground metal mining.
10. Optimization of ventilation system.
11. Design of new pollution systems in mines.
12. Study of blast parameters using XLSTAT/STRAYOS/OPITBLAST

PC652MN

ROCK MECHANICS LAB

Instruction	*2* periods per week
Duration of Semester End Examination	*2 hours*
CEE	*25 marks*
SEE	*50 marks*
Credits	*1*

Course Objectives:
• To study the various of methods to determine the properties of rocks.
• To study the operation of various instruments and equipment.

Course Outcomes: After completion of course, the students will be able to	
CO-1	At the end of the course, students will be able to
CO-2	Determine the properties of rocks
CO-3	Knowledge of various instruments and equipment.
CO-4	Design the supports for mine openings.
CO-5	Design mine pillars.
CO-6	Knowledge of various equipment.

LIST OF EXPERIMENTS:
1) Determination of RQD of rocks.
2) Determination of Protodyaknov index of a given rock sample
3) Determination of point load index strength of a given rock sample
4) Determination of porosity of rocks.
5) Determination of hardness of rocks
6) Determination of uniaxial compressive strength of a given rock sample
7) Determination of tensile strength of a given rock sample using Brazilian method
8) Determination of shear strength of rocks
9) Determination of modulus of elasticity of given rock sample using strain gauge.
10) Determination of triaxial strength of rock and drawing of Mohr‘s envelope
11) Study of different types of supports used in mines
12) Study of design of mine pillars.

PW653MN

MINI PROJECT

Instruction	*2* periods per week
Duration of Semester End Examination	*2 hours*
CEE	*25 marks*
SEE	*50 marks*
Credits	*1*

Course Outcomes: At the end of the course, students will demonstrate the ability to:	
1	Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.
2	Design, implement and test the prototype/algorithm in order to solve the conceived problem.
3	Write comprehensive report on mini project work.

Guidelines:
1. The mini-project is a team activity having 3-4 students in a team.
2. The mini project may be a complete hardware or a combination of hardware and software with a focus on mining engineering or industry. The software part in mini project should be less than 50% of the total work.
3. Mini Project should cater to a small system required in laboratory or real life.
4. It should encompass components, devices, with which functional familiarity is introduced.
5. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of mini-project.
6. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
7. The student is expected to exert on design, development and testing of the proposed work as per the schedule.
8. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester

Scheme of Instruction, Evaluation

and

Syllabi of

B.E. MINING ENGINEERING
BATCH 2021 - 2025
(VII & VIII Semesters)

With effect from Academic Year 2023-24

DEPARTMENT OF MINING ENGINEERING

UNIVERSITY COLLEGE OF ENGINEERING
(Autonomous)
Osmania University
Hyderabad – 500 007, TS, INDIA

Estd.1917

Estd.1929

Scheme of Instruction for BE (Mining Engg) - VII Semester

S.No.	Course Code	Course Title	Scheme of Instruction			Contact Hrs/ Wk	Scheme of Examination			Credits
			L	T	P		Hrs	CIE	SEE	
THEORY										
1	PC701 MN	Mine Legislation	3	-	-	3	3	30	70	3
2	PE I	Professional Elective-I	3	-	-	3	3	30	70	3
3	PE II	Professional Elective-II	3	-	-	3	3	30	70	3
4	PE III	Professional Elective-III	3	-	-	3	3	30	70	3
5	PE IV	Professional Elective-IV	3	-	-	3	3	30	70	3
6	OE-II	OE II	3	-	-	3	3	30	70	3
7	Mandatory Course I	Constitution of India	3	-	-	3	3	30	70	0
PRACTICALS										
8	PC751MN	Seminar	-	-	2	2	3	50	-	1
9	PC752MN	Comprehension	2	-	-	2	2	50	-	1
10	PW761MN	Project Work-I	-	-	6	6	3	50	-	2
11	PW961MN	Internship-II						50	-	1
			23	**0**	**8**	**31**	**26**	**330**	**420**	**23**

Evaluation of Summer Internship-II Grade: Satisfactory/ Good/ Excellent

Sl No	Course Code	Course Title
PROFESSIONAL ELECTIVE-I		
1	PE711MN	Mine Surface Environment Management
2	PE712MN	Mine Disasters & Rescue
3	PE713MN	Rock Excavation Engineering
PROFESSIONAL ELECTIVE-II		
1	PE721MN	Numerical Modelling In Mining
2	PE722MN	Sustainable Mineral Industry
3	PE723MN	Mineral Exploration
PROFESSIONAL ELECTIVE-III		
1	PE731MN	Rock Slope Engineering
2	PE732MN	Mine System Engineering
3	PE733MN	Surface Coal mining and Mechanization
PROFESSIONAL ELECTIVE-IV		
1	PE741MN	Advanced Surveying Techniques
2	PE742MN	Geo-Statistics
3	PE743MN	Deep Sea Mining

CODE	OPEN ELECTIVE-II
OE721MN	Rock Reinforcement Engineering

PC701MN

MINE LEGISLATION

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• Introduces mining laws and legislation to the students with basic knowledge on mining engineering aspects.
• The students will be explained about the provisions of Indian electricity rules, vocational training rules, The Mines rescue rules, The Mines and Minerals (Development and Regulation) Act etc.

Course Outcomes: After completion of course, the students will be able to	
CO-1	As the outgoing student's career is mainly dependent on mining industry, exposure to state and central laws related to mining are highly solicited.
CO-2	This course gives an opportunity for the students to understand the statutions requirement for coal/metal mining by opencast/underground methods.

UNIT- I
Introduction to mining laws and legislation, General principles of mining laws, development of mining legislation in India. The Mines Act, 1952, Bye-laws, Circulars, and standing orders (in brief).

UNIT- II
The Mines Rules, 1955; The Mines Vocational Training Rules, 1966; The Mines Rescue Rules, 1985. The Mines Crèche rules,1966; The Mines Maternity benefit Act, 1961; Payment of Wages Act, 2005; The Employee's (Workmen's) Compensation Act, 2010; NCWB agreement (in brief).

UNIT- III
Coal Mines Regulations, 2017; Metalliferous Mines Regulations, 1961, and the associated technical circulars.

UNIT- IV
Central Electricity Authority of Regulations 2010; General provisions of Mines and Minerals (Regulation and Development) Act 1957; The Mineral Concession Rules, 1960; The Mineral Conservation and Development Rules, 1988.

UNIT - V
General cases of accidents in mines and their prevention. Classification of accidents, accident enquiry reports, cost of accidents, occupational diseases. Safety management in mines, role of management, labour, union and government, safety audit, risk identification and management, safety conferences.

TEXT BOOKS
1. The Mines Act, 1952
2. The Mines Rules, 1955
3. The Mines Vocational Training Rules, 1966
4. The Employee's (Workmen's) Compensation Act, 2010
5. Central Electricity Authority of Regulations 2010
6. Coal Mines Regulations, 2017
7. Metalliferous Mines Regulations, 1961
8. Mines and Minerals (Regulation and Development) Act 1957

REFERENCE BOOKS:
1. Legislation in Indian Mines: A Critical Appraisal vol. 1&2 – Rakesh and Prasad.
2. The Mineral Concession Rules, 1960
3. The Mineral Conservation and Development Rules, 1988.

PE711MN

MINE SURFACE ENVIRONMENT MANAGEMENT

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:	
1	Understand the environmental problems caused by surface mining activities.
2	Identify the sources and classifications of pollutants, including dust, and their effects on human health.
3	Learn about control and preventive measures for air, water, and noise pollution in the context of mining.
4	Explore the framework and methodologies for Environmental Impact Assessment (EIA) and understand their applicability
5	Familiarize with environmental legislation related to mining, including environmental acts, regulations, and the process of obtaining environmental clearances for mining projects

Course Outcomes: After completion of course, the students will be able to	
CO-1	Analyze and evaluate the environmental problems associated with surface mining activities
CO-2	Apply knowledge of pollutant sources, classifications, and their effects on human health to assess and address environmental challenges in mining operations
CO-3	Develop strategies and measures to control and prevent air, water, and noise pollution in the context of mining activities
CO-4	apply the principles and methodologies of Environmental Impact Assessment (EIA) to assess the potential environmental impacts of mining projects
CO-5	Demonstrate an understanding of environmental legislation, acts, regulations, and procedures relevant to mining, including the process of obtaining environmental clearances, and effectively apply them in practical situations

UNIT – I
Introduction:
Environmental Pollutants due to surface Mining – Air, Water, Noise; impact of men on the extent of environmental problem; Nature and extent of environmental problems due to mining.

UNIT – II
Air Pollution:
Sources and Classification of pollutants including dust and their effect on human health, Sources, hazards, sampling and analysis, standards, instrumentation and measurement of pollutants including dust. Control and preventive measures for air pollution including dust

UNIT – III
Water & Noise Pollution:
Environmental Pollution due to Water - Sources and Classification of pollutants and their effect on human health, hazards, sampling and analysis, Water pollution standards. Noise standards – Measurement – Noise Impact Index assessment, Control and preventive measures for water, noise pollution due to vibrations, their monitoring, prevention and control

UNIT – IV
Land effects & EIA:
Reclamation Planning, land use analysis, monitoring and maintenance, reclamation equipment and techniques, acid and alkaline drainage, control measures Framework for EIA, EIA methodologies and their applicability; Uncertainties in EIA

UNIT - V
Environmental legislation:
Environmental laws, the Environmental (Protective) Act, 2004, The Water Act (1974), The Air act (1981), The Forest Act 1927, The forest conservation act 1980, Power and responsibilities of regularity agencies and occupation consent to establish and operate wild life protection act and rules, Environmental clearance procedure for a mining Project. Frame work of EMP, Legislative requirements of EMP; Preparation and appraisal of EMP report.

TEXTBOOK:

1. Environmental Impact of Mining C.G Down and J Stock Applied Science Publishers Ltd. London, Second Edition, 1980
2. Mining and Environment B.B.Dhar Ashish Publishing House, New Delhi, 1986.

PE712MN

MINE DISASTER AND RESCUE

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• To provide students an exposure to disasters, their significance and types.
• To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
• To gain a preliminary understanding of approaches of Disaster Risk Reduction in mines.
• To enhance awareness of Legislation on Mine Disaster dealing and conduct of rescue recovery.

Course Outcomes: After completion of course, the students will be able to	
CO-1	Know various aspects of Disasters.
CO-2	Know the concept of Risk Reduction.
CO-3	Know the preparations and Equipment requirement in mines
CO-4	Know various aspects involved in Rescue and Recovery In Mines:
CO-5	What went right or wrong in past case studies and how this helped mining industry.

UNIT I
Introduction to Disasters
Definition: Vulnerability, Hazard, Resilience, and Risks – Disasters: Types of disasters – Classification, Causes, Impacts- - urban disasters, Climate change - Dos and Don'ts during various types of Disasters.

UNIT II
Approaches to Disaster Risk Reduction
Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness. Risk Assessment, how legislation helps in reducing risks in mines, Concept of factor of Safety, Concept of Early Warning Systems in all activities in mines. Flow of information in the disaster management framework, Stakeholders, Rescue recovery setup in mines.

UNIT III
Preparations and Equipment in Mines
Rescue preparedness in mines. Rescue trained persons. Roles of different responsible persons. Response and Recovery Phases of Disaster. Disaster Management Plans (Emergency Plan) for mines, Standard procedures for rescue and recovery in various situations in mines.
Rescue Equipment: Two hour self-contained breathing apparatus, short duration self-contained breathing apparatus, Self-Rescuers, Resuscitating Apparatus, first aid and immediate Medical treatments required.

UNIT IV
Conduct of Rescue and Recovery In Mines:
Leadership in the event of Disaster, Response time, Response logistics, Recovery, Post Disaster Damage Assessment, Public Participation, Courts of Enquiries, Rescue by Drilling large dia hole.

UNIT V
Case Studies of Jitpur Methane explosion, Dhori Coal Dust Explosion Disasters, Bumps Disaster in Kolar Gold Fields at Great depth, Chasnulla inundation disaster. How these Disasters effected the legislation in Indian mines.

TEXTBOOK:
1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
3. Mines Disasters in India Vol – I and Vol II

REFERENCES:
1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

E RESOURCES:
1.https://www.researchgate.net/publication/318339409_Mining_Disasters_-_What_lessons_can_be_learnt
2. https://www.researchgate.net/...Disaster...Management/.../279804770_Disaster_Prevention

PE713MN

ROCK EXCAVATION ENGINEERING

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
This course introduces
• Rock excavation engineering, physico-mechanical and geotechnical properties, selection of excavation method.
• Mechanics of rock drilling and rock fragmentation by explosives, selection of explosives for rock excavation.
• Advances in blast design for underground excavation, Tunnel boring machines.

Course Outcomes: After completion of course, the students will be able to	
CO-1	Understand Physico-mechanical and geotechnical properties of rocks Vis-à-vis excavation method
CO-2	Understand Mechanics of rock drilling, problems of drilling, economics of drilling.
CO-3	Understand Mechanics of rock fragmentation by explosives and Advanced blast initiation systems
CO-4	Understand Design of Blasting
CO-5	Understand Theories of rock tool interaction for surface excavation machinery.

UNIT -I:
INTRODUCTION
Scope and importance, Rock excavation engineering in mining and construction industries; Physico-mechanical and geotechnical properties of rocks Vis-à-vis excavation methods; selection of excavation methods.

UNIT -II:
MECHANICS OF DRILLING
Mechanics of rock drilling, design and operating parameters of surface and underground drilling, evaluation of drill performance, mechanism of bit Wear, bit selection, problems of drilling, economics of drilling.

UNIT -III:
MECHANICS OF BLASTING
Mechanics of rock fragmentation by explosives; advances in explosives and their selection criteria for rock excavation, blast design for surface excavations and optimization. Advanced blast initiation systems, cast blasting, techno - economic and safety aspects of surface and underground blasting.

UNIT -IV:
DESIGN OF BLASTING
Advances in blast design for underground excavations, contour blasting, computer aided blast designs, review of tunnel blasting techniques in recent advances.

UNIT-V: **ROCK CUTTING**
Theories of rock tool interaction for surface excavation machinery – rippers, bucket wheel excavators, continuous surface miners; theories of rock tool interaction for underground excavation machinery- Ploughs, Shearers, road headers, continuous miners. Selection criteria for cutting tools; advanced rock cutting techniques – high pressure water jet assisted cutting.

TEXT BOOKS:
1. Principles of Rock fragmentation, Cark G.B—John Wiley & Sons
2. Rock fragmentation by blasting- Pradeep K.Singh et.al

REFERENCES:
1. Diamond Drilling, Chugh C.P.- Oxford Publication
2. Blasting in ground excavation & mines- B. Singh et.al

E RESOURCES
1. http//technology.infomine.com/reviews/Blasting/welcome.asp?view=full
2. https//link.springer.com/chapter/10.1007/978-981-10-1989-0_16

PE721MN

NUMERICAL MODELLING IN MINING

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• Understand the concepts and principles of elastic and plastic models, including their applications in mining excavations
• Gain proficiency in numerical simulation methods for excavations in mining, such as finite difference methods
• Learn the principles and techniques of finite element methods for structural analysis in mining, including linear and non-linear analysis
• Familiarize with the boundary element method and its applications in mining, including the design of underground structures and prediction of subsidence
• Develop practical skills in utilizing numerical modeling software packages, such as FLAC and ANSYS, for solving engineering problems in mining excavation design and performance analysis

Course Outcomes: After completion of course, the students will be able to	
CO-1	Analyze and evaluate the behavior of elastic and plastic models in the context of mining excavations
CO-2	Apply numerical simulation methods, specifically finite difference methods, to model and analyze excavations in mining
CO-3	Utilize finite element methods to solve structural analysis problems in mining, including linear and non-linear analysis
CO-4	Apply the boundary element method to solve problems related to isotropic and infinite media in the mining industry
CO-5	Demonstrate proficiency in utilizing numerical modeling software packages, such as FLAC and ANSYS, to design and analyze mining excavations and predict subsidence

UNIT I
Introduction to elastic and plastic models: Fundamentals, elastic, plastic, homogeneous and isotropic, non-linear elastic and elastoplastic models Need for numerical modelling in design of excavations in mines; Domain and boundary conditions; Discretisation of domain and boundary; Methods of numerical simulation for excavations in mining

UNIT II
Finite difference methods: Concept, formation of mesh element, finite difference patterns, solutions, application to mining Explicit finite difference method; Finite difference equation; Mechanical damping, mechanical time-step determination, solution stability, advantages and their limitations; Non-linear solution methods Introduction to Numerical Modelling Packages: FLAC.

UNIT III
Finite element methods: Concept, discretisation, element configuration, element stiffness, Assembling elements to form a structural stiffness matrix; Imposing boundary conditions and solving structural equations Elements on assumed displacements, constant strain triangle, isoparametric formulation, advantages and their limitations., two and three dimensional solutions, linear and non-linear analysis, applications in : ANSYS.

UNIT IV
Boundary element method:
Concept, discretisation, formulation, merits, demerits and limitations, different methods of solution for isotropic and infinite media. Commercial Soft Boundary Element Method: Introduction, formulation, advantages and their limitations.

UNIT V
Applications in mines:
Design of underground structures such as accesses of the deposit, pillar during development and depillaring operations, barrier pillar and panel. Performance of longwall powered support. Design of pit and dump in opencast mines. Prediction of subsidence

Suggested Reading:

1	Desai, C.S. and Abel, J.F., Introduction to the finite Element Method, Van NostrandRiehokl Co., New York, 1983.
2	Zienkiewicz, O.C., The Finite Element Method in Engineering Science, Tata McGraw Hill 1972.
3	Segerlind, L.J., Applied Finite Element Analysis, John Wiley and Sons, New York, 1987.
4	Mukhopadyay, M., Matrix Finite Element – Computer and Structural Analysis, Oxford and IBH Publishing co., 1984
5	Brown, E.T., (Ed) Analytical and Computational Methods in Engineering and Rock Mechanics, Allen and Unwin, London, 1987.

PE722MN

SUSTAINABLE MINERAL INDUSTRY

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• Understand the principles and importance of sustainable development in the mining industry from the perspective of mineral professionals
• Familiarize with international sustainability reporting and measurement tools used in the mining sector
• Gain knowledge of legislative measures and regulations, such as the MMRD Act and star rating of Indian mines, pertaining to sustainable development in the mining industry
• Analyze the impact of current mining practices on sustainability and explore national mineral policies in mineral-based countries
• Learn about innovative mining practices and technologies aimed at achieving sustainability, including clean coal technologies, waste management methods, and water and air pollution control measures
• Analyze case studies of successful sustainable mining practices and understand the benefits and significance of sustainability in the mining industry

Course Outcomes: After completion of course, the students will be able to	
CO-1	Assess the importance of sustainable development in the mining industry and its relevance to mineral professionals
CO-2	Apply international sustainability reporting and measurement tools to evaluate and monitor sustainability in mining operations
CO-3	Analyze the impact of legislative measures and regulations on sustainable development in the mining industry
CO-4	Evaluate the current mining practices and their effects on sustainability, and understand the significance of national mineral policies
CO-5	Apply knowledge of innovative mining practices and technologies for achieving sustainability, and understand their benefits and advantages

UNIT I
Concept of Sustainable development for mining industry-Sustainable development –a perspective of mineral professional community. International sustainability reporting and tools for measurement of sustainability. Milos statement on Sustainable mineral industry. Legislative measures for sustainable development- MMRD Act- star rating of Indian mines (Non-coal), Environmental responsibility – Corporate social responsibility. District mineral fund, its collection, utilisation etc.

UNIT II
Current status of mining practices and their impact on sustainability. Mining and environmental frame work, National mineral policies in mineral based countries. Indian national mineral policy, its historical development with the changing goals and sustainable practices. Issues of leases, auctions for mineral development in India.

UNIT III
Clean coal technologies, Coal bed methane, abandoned coal mine methane, Underground gasification of coal. Leaching of old dumps and recovery of metals. Recycling of metals. Application of new techniques for sustainable development.

UNIT IV
Mine water- Water conservation Acts and rules in India. New Initiatives in mines. Underground mine water, Water pollution and control measures, Phyto-remediation, Sewage and effluent treatment plants, their use and benfits. Waste management- processing of overburden material for underground stowing and innovative methods for utilisation of waste from mines.
Air quality in open pit mines, dust control measures, noise levels- pollution, monitoring and control.
Bio-divrsity- Land reclamation and plantation. Mine closure plan- Collection and disbursement of Mine closure fund for both open pit and underground mines in India.

UNIT V
Best mining practices for Sustainable mining. - Case studies. Innovative practices for achievement of sustainability. Benefits of sustainability.

REFERENCES
MMRD Act 2015 and amendments, Ministry of Mines
Mineral concession Rules
Guidelines of MOEF and Climate change.
Annual reports of MOEF&CC.
Guidelines of Ministry of Coal in India,
Sustainable mining practices –A global perspective by Vasudevan Rajaram, Subijoy Dutta, Krishna Paremeswaran, ISBN-90-5809-689-0

PE723MN

MINERAL EXPLORATION

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• Understand the principles and methods of mineral exploration, including various criteria and techniques used for identifying and evaluating mineral resources
• Develop proficiency in estimating reserves through drilling, sample logging, data compilation, and interpretation of geological cross-sections
• Acquire knowledge and skills in sampling theory and methods for evaluating orebodies, including exploration drilling, core logging, and sampling techniques
• Analyze exploration data to estimate reserves and assess the potential of mineral resources, considering factors such as cut-off grades and resource classification
• Gain familiarity with geochemical and geophysical exploration methods, including the analysis of element distribution in rocks, chemical weathering processes, and the utilization of remote sensing tools

Course Outcomes: After completion of course, the students will be able to	
CO-1	Understand and apply various criteria and methods for mineral exploration, including physiographic, stratigraphic, lithographic, structural, mineralogical, geochemical, geobotanical, and hydrogeological techniques
CO-2	Develop skills in reserve estimation through drilling, core sample logging, litholog preparation, and interpretation of geological cross-sections for mining and exploration purposes
CO-3	Apply sampling theory and methods for orebody evaluation, including exploration drilling, core logging, and sampling techniques
CO-4	Analyze and interpret exploration data to estimate reserves and assess the potential of mineral resources, considering factors such as cut-off grades and resource classification
CO-5	Gain knowledge of geochemical and geophysical exploration methods, including the distribution of elements in rocks, chemical weathering, and the application of remote sensing techniques for mineral exploration

UNIT - I
Introduction:
Definition, objectives and criteria for mineral exploration, guides for ore search: Physiographic, stratigraphic, lithographical, structural mineralogical, geochemical, geobotanical and hydro geological

UNIT - II
Reserve Estimation: Types of drilling, drill core sample logging, data compilation, preparation of litholog of the bore hole – isocore and isopatch maps preparation of geological cross sections, interpretation of the coalmining and exploration deposit reserve estimation.

UNIT - III
Exploration: Introduction to important mineral resources in India and worldwide, surface and aerial prospecting, reconnaissance, application of exploration methods Preliminary and detailed exploration by boring, exploratory mining by shafts, drifts, cross-cuts, collection and compilation of data for computer processing

UNIT - IV
Sampling: theory and methods; Geological plans and sections for orebody evaluation; Exploration drilling, drill core logging and sampling Cut-off grade concepts and applications; Resources and Reserves. Estimation of reserves – methods and practice.

UNIT - V
Geological Exploration: Geochemistry, geochemical exploration; distribution of elements in igneous rocks and minerals, primary haloes and primary dispersion; chemical weathering, mobility in secondary environment, displaced anomalies, pathfinders and their application
Geo Physcial Exploration: Basic concepts of geophysical exploration, Methods of geophysical exploration: Gravity, Seismic, electrical. Remote Sensing, Application of remote sensing in mineral exploration, visual image & satellite data interpretation,

Text / Reference books
1. M S Krishnaswamy," Mineral Deposits"
2. Arogyaswamy , "A Text book of Mining Geology"
3. William l Smith, " Remote sensing application in mineral exploration"

PE731MN

ROCK SLOPE ENGINEERING

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• Understand the fundamental principles of rock slope stability and the factors that influence slope failure, including geological parameters, rock strength properties, and groundwater flow
• Develop skills in analyzing and designing slopes, considering factors such as slope height, slope angle, and water pressure
• Acquire knowledge and proficiency in analyzing plane failure and wedge failure, including graphical analysis, influence of tension cracks, and the use of rock reinforcement techniques
• Analyze circular failure and toppling failure, including conditions for failure, derivation of failure analysis methods, and the influence of groundwater and slope curvature
• Gain familiarity with rock slope failure monitoring techniques and slope stabilization methods, including surface and sub-surface monitoring, instrumentation, and guidelines for monitoring programs

Course Outcomes: After completion of course, the students will be able to	
CO-1	Apply principles of rock mechanics to assess the stability of rock slopes, considering factors such as slope parameters, water pressure, and geological properties
CO-2	Analyze and interpret data related to geological and rock strength properties to evaluate their impact on slope stability
CO-3	Demonstrate proficiency in analyzing plane failure, wedge failure, circular failure, and toppling failure, including the use of graphical methods and failure analysis techniques
CO-4	Implement monitoring methods for rock slope failure, including surface and sub-surface monitoring techniques, and interpret monitoring data to assess slope stability
CO-5	Develop an understanding of slope stabilization techniques, including rock reinforcement, rock removal, and protection measures against rock falls, and apply them in slope stabilization programs

UNIT - I
Basic Mechanics of Rock Slope Failure: Rock slope economics; continuum mechanics approach to slope stability; slope parameters; effect of water pressure; factor of safety of slopes; slope height vs slope angle; design of slopes.

UNIT - II
Geological and Rock Strength Properties: Geological parameters affecting slope stability; graphical representation of geological data; plotting and analysis of field measurements; physico-mechanical properties affecting slope stability, shearing on incline plane, determination of shear strength of rock and rock discontinuities; Ground water flow in rock masses; field measurement of permeability; measurement of water pressure.

UNIT - III
Plane Failure and Wedge Failure: Plane failure analysis; graphical analysis of stability; influence of ground water on stability; influence of tension crack; analysis of failure on a rough plane; rock reinforcement of slopes; Analysis of wedge failure; wedge analysis including cohesion and water pressure; Wedge stability charts for friction only; case studies. Numerical problems.

UNIT - IV
Circular and Toppling Failure: Conditions for circular failure; derivation of circular failure analysis; effect of ground water; circular failure charts; Bishop's and Janbu's methods of failure analysis; case studies. Types of toppling failure; secondary toppling modes; analysis of toppling failure; limit equilibrium analysis of toppling failures; Influence of slope curvature on stability; slope depressurisation; protection of slopes; control of rock falls; measurement and monitoring and interpretation of slope displacements. Numerical problems.

UNIT - V
Rock Slope Failure Monitoring and Slope Stabilization: Types of slope movement, Surface and Sub-surface monitoring methods inclusing instrumentation and techniques & Guidelines for monitoring programs. Causes of rock falls; Rock slope stabilization programs – stabilization by rock reinforcement & rock removal; protection measures against rock falls.

TEXT BOOKS:
1. Hoek, E and Bray, J.W., Rock Slope Engineering, Institution of Mining and Metallurgy, 1991.
2. Goodman, R.E., Rock Mechanics, John Wiley and Sons, 1989.
3. Singh, R.N. and Ghose, A.K., Engineered Rock Structures in Mining and Civil Construction,
A.A. Balkema, Netherlands, 2006.R18 B.Tech. Mining Engg. Syllabus JNTU HYDERABAD 94

REFERENCE BOOKS:
Duncan C.Wylie and Chris Mah, Rock Slope Engineering, 4th Edition, 4th Edition, CRC Press, 456p, 2004.
John Read and Peter Stacey, Guidelines for Open Pit Slope Design, 1st Edition, CRC Press, 510p, 2009.
William A. Hustrulid (Ed), Michael K. McCarter (Ed) and Dirk J. A. Van Zyl (Ed), Slope stability in Surface Mining, Society for Mining, Metallurgy, and Exploration, 442p, 2001.
John Jaeger, N. G. Cook and Robert Zimmerman, Fundamentals of Rock Mechanics, 4th Edition, Wiley-Blackwell; 4th edition, 488p, 2007.

PE732MN

MINE SYSTEM ENGINEERING

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• The objective of this subject is to provide knowledge of solving the models for their optimal solutions.

Course Outcomes: After completion of course, the students will be able to	
CO-1	Understand optimization techniques, linear programming, graphical solutions
CO-2	Understand Simplex method, Big M method, Duality of linear programming
CO-3	Understand basics of Transportation Problem
CO-4	Understand Inventory and Waiting line problems
CO-5	Understand basic concepts of PERT and CPM

UNIT - I - Introduction
Introduction to optimization techniques, Introduction to linear programming, problem formulations, graphical solutions, unboundedness, infusibility, unique solution, multiple solutions. Mining examples

UNIT - II Linear programming
Simplex method with different combinations of constraints, Big M method, Duality of linear programming, importance of dual problems, interpretations of solutions of primal from dual

UNIT - III - Transportation Problem
Formulation–Optimal solution, unbalanced transportation problem–Degeneracy, variants in assignment problems, mining examples. Assignment problem – Formulation – Optimal solution - Mining examples

UNIT – IV - Inventory and Waiting line
Importance of Inventory, Introduction to inventory, basic assumptions in EOQ model, EOQ (Economic Order Quantity). Introduction to waiting line theory, basic assumptions in waiting line, determination of waiting time in quee, waiting time in system, Single channel quee systems – arrivals Poisson distributed, service time exponential distribution

UNIT - V - PERT and CPM
Introduction to CPM, Importance of CPM, Determination of Early start times, Early finish times, Latest finish times, Critical path, Project duration, Crashing of a network, Importance of PERT, Probability of project completion time, Assumptions in PERT

TEXT BOOKS:
Introduction to O.R /Taha/PHI Publishers
Operations Research / S.D.Sharma/Kedarnath Publisher
Operations Research /A.M.Natarajan, P.Balasubramani,A. Tamilarasi/Pearson Education.
Operations Research: Methods & Problems / Maurice Saseini, ArhurYaspan& Lawrence Friedman/ Literary Licensing
Operations Research / R.Pannerselvam,PHI Publications.

PE733MN

SURFACE COAL MINING AND MECHANIZATION

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• To introduce the various techniques for mine planning, geotechnical investigation and equipment management.
• To appreciate the modern trends in opencast mines, safety and environment

Course Outcomes: After completion of course, the students will be able to	
CO-1	Understand Pit Planning and related concepts
CO-2	Understand Influence of pit slope on mine economics and related concepts
CO-3	Understand Production and Equipment Planning
CO-4	Understand Health, Safety and Environmental Management
CO-5	Understand Modern Trends in Opencast Mines.

UNIT-I
Pit Planning
Development of economic block model; Pit cut-off grade and its estimation; Ultimate pit configuration and its determination – hand method, floating cone technique, Lerchs-Grossmann algorithm, and computer assisted hand method. Addition of haul road on pit plan; Pit layouts. Openpit optimization techniques for mine geometry and output, mine development phases, quality control Output and manpower planning; calendar planning, mine scheduling, production scheduling, truck dispatch system; Feasibility Report, DPR-contents and preparation.

UNIT -II
Geotechnical Parameters
Influence of pit slope on mine economics; High wall slope stability analysis and design methodology; stability analysis and design methodology for waste dumps; Application of geotechnical investigation for design of ultimate pit slope and other design parameters. Numerical problems on slope stability analysis including mine waste rock dumps and tailing dumps.

UNIT -III
Production and Equipment Planning
Determination of mine size and sequencing by nested pits; Cash flow calculations; mine and mill plant sizing; Production scheduling. Stockpiling and blending, Spreaders and Reclaimers; computerized truck dispatch. Selection of mining system vis-à-vis equipment system; Computations for the capacity and number of machines vis-à-vis mine production. Machine availability, productivity, maintenance scheduling, preventive maintenance, control and monitoring inventory. Workshops for HEMM. Power supply arrangements in opencast mines.

UNIT -IV
Health, Safety and Environmental Management
Occupational health hazards due to mine dust, poor lighting and ventilation, noise and vibration, radioactive emission; Impact of surface subsidence; Accidents in Surface mining and their prevention; Sources of water, assessment of drainage requirements, sump design and drainage patterns - pumping systems. Pre-drainage through diversion channels and boreholes; Water pollution, Methods of reclamation of mined out areas, dumps and tailing ponds, environmental audit. Socioeconomic factors in surface mines.

UNIT -V
Modern Trends in Opencast Mines
Recent developments in mining methods and layouts. In pit crushing & conveying, continuous surface mining. Selective extraction and dumping. Extraction of seams developed/extracted by underground methods. Deep Open pit Mining; Placer mining and solution mining – scope of applicability, sequence of development and machinery; Closure of surface mines.

TEXT BOOKS:
1. Hartman, H. L. (Editor), SME Mining Engineering Handbook, 3rd edition, Vol I & II, Society of Mining Engineers, New York, 2011.
2. Hustrulid, W. and Kuchta, M., (eds)., Fundamentals of Open Pit Mine Planning & Design, Elsevier, 1995

REFERENCES:
1. Proceedings of National Seminar on Surface Mining, IME Publications/ Calcutta, 1995
2. Das, S.K., Surface Mining Technology, Lovely Prakashan, Dhanbad, 1994
3. Das, S.K., Modern Coal Mining Technology, Lovely Prakashan, Dhanbad, 1994
4. Kennedy, B.A., Surface Mining – 2nd Edition, SME, New York, 1990

E RESOURCES:
1. www.eolss.net/sample-chapters/c05/e6-37-06-01.
2. https://link.springer.com/book/10.10

PE741MN

ADVANCED SURVEYING TECHNIQUES

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• To understand the working of Total Station equipment and solve the surveying problems.
• To introduce the concepts of Space Borne, Air Borne and Terrestrial LASER
• Scanners for Topographic Mapping

Course Outcomes: After completion of course, the students will be able to	
CO-1	Understand the fundamentals and applications of total station and electromagnetic waves in mine surveying
CO-2	Understand fundamentals and applications the satellite, GPS system and data processing in mine surveying
CO-3	Understand the fundamentals of mine and cadastral surveying
CO-4	Understand the fundamentals and applications of Air borne laser scanners in mine surveying
CO-5	Understand the fundamentals and applications of data acquisition, pre & post data processing in mine surveying

UNIT I
FUNDAMENTALS OF TOTAL STATION AND ELECTROMAGNETIC WAVES
Types and working principles of Machines, Methods of Measuring Distance, Basic Principles of Total Station, Historical Development, Classifications, applications and comparison with conventional surveying. Classification - applications of Electromagnetic waves, Propagation properties, wave propagation at lower and higher frequencies- Refractive index (RI) - factors affecting RI. Care and Maintenance of total stations. Electro-optical system: working principle, Sources of Error, Infrared and Laser Total Station instruments. COGO functions, offsets and stake out-land survey applications.

UNIT II
SATELLITE, GPS SYSTEM AND DATA PROCESSING
Basic concepts of GPS, GNSS, IRNSS and GAGAN - Different segments - space, control and user segments - satellite configuration – GPS signal structure, Anti Spoofing and Selective Availability - GPS receivers. Concepts of rapid, static methods with GPS - semi Kinematic and pure Kinematic methods -satellite geometry & accuracy measures - applications.

UNIT III
MINE AND CADASTRAL SURVEYING
Reconnaissance – Route surveys for highways, railways and tunnels –Mine surveying Equipment – Weisbach triangle – Tunnel alignment and setting out – Transfer of azimuth – Gyro Theodolite – Shafts and audits - Cadastral survey- Legal – Real – Tax cadastre – Land record system – Settlement procedure – deformation studies. Mine plan preparation - mapping process - use of mapping softwares, VAVIks mapping. Route surveys of water ways, Hydrographic survey Tides – MSL – Sounding methods – Three point problem – River surveys – Measurement of current and discharge.

UNIT IV
AIRBORNE LASER SCANNERS
Airborne Topographic Laser Scanner – Ranging Principle – Pulse Laser and Continuous Wave Laser – First Return and Last Return – Ellipsoidal and Geoidal Height - Typical parameters of a Airborne Laser Scanner (ALS) – Specifications of Commercial ALS –- Components of ALS - GPS, IMU, LASER Scanner, Imaging Device, Hardware and Software. Merits of ALS in comparison to Levelling, echo sounding, GPS levelling, Photogrammetry and Interferometry

UNIT V
DATA ACQUISITION, PRE AND POST PROCESSING
Various Scanning Mechanism – Synchronization of GPS, IMU and ALS Data - Reflectivity of terrain objects – Laser Classification – Class I to Class IV Laser – Eye Safety. Ground Point filtering – Digital Surface Model and Digital Elevation Model. Overview of LIDAR Applications in various domains - 3D models – Corridor Mapping Applications – Forestry Applications. Terrestrial Laser Scanners (TLS) – Working Principle – Commercial TLS Specifications – Applications of TLS, Drone based Mapping - derivatives from drone surveying.

TEXTBOOKS:
• Satheesh Gopi, Rasathishkumar, N.Madhu, – Advanced Surveying, Total Station GPS and Remote Sensing – Pearson education, 2007 ISBN: 978-81317 00679 52.
• Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 3rd Edition, 2004.
• Jie Shan and Charles K. Toth, Topographic Laser Ranging and Scanning – Principles and Processing, CRC Press, Taylor & Francis Group, 2009.

REFERENCES:
• Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin, 1996.
• Michael Renslow, Manual of Airborne Topographic LiDAR, The American Society for Photogrammetry and Remote Sensing, 2013.
• R.Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.

PE742MN

GEO-STATISTICS

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course Objectives:
• To make the students familiar with the basics of geostatistics

Course Outcomes: After completion of course, the students will be able to	
CO-1	Understand schools of geostatistics, estimation models for mine evaluation
CO-2	Understand Semi-variogram and Co-variogram
CO-3	Understand Extension variance and estimation variance
CO-4	Understand the Integrated geological-geostatistical system
CO-5	Understand Geostatistical applications

UNIT-I
Introduction to Geostatistics
Definition, schools of geostatistics, estimation models for mine evaluation- average method, polygonal or triangular method, deterministic mathematical model, independent random model, trend with random noise, correlated random model and trend with correlated random residuals.

UNIT-II
Semi-variogram and Co-variogram
Definitions, characteristics and computation in one, two, and three dimensions, mathematical models, associated difficulties i.e. anisotropy, non-stationaries, regularization, presence of nugget effect.

UNIT-III
Extension variance and estimation variance
Calculation of estimation variance, the nugget effect and estimation variance, examples, auxiliary function. Kriging: kriging and optimal valuation, kriging equations in general cases.

UNIT-IV
The Integrated geological-geostatistical system
Statistical analysis, comparative statistical analysis, geostatistical structural analysis, trend analysis, point kriging, cross validation, block kriging, mineral inventory, tonnage relations.

UNIT-V
Geostatistical applications
Optimization of exploration drilling, calculation of mineral inventory, establishment of grade tonnage
relations, misclassified tonnage, grade control plan

TEXT BOOKS:
1. An Introduction to Applied Geostatistics, Issacks and Srivastava Oxford, JBH, 1990

REFERENCES:
1. An Introduction to Geostatistical methods of Mineral Exploration, Rendu J.M John Wiley
and Sons, 1981
2. Geostatistical Ore Reserve Estimation, David, Michel, Mc Graw Hill, 1977

E RESOURCES
1. http//www.springer.com/in/book/9781402093791
2. https//link.springer.com/chapter/10.1007%2F978-3-319-39264-6_17

PE743MN

DEEP SEA MINING

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

Course objectives:
• A part from land mineral resources, the oceans also contains valuable minerals wealth such as petroleum, natural gas, manganese and other sulphide minerals.
• Knowledge of mining of shallow and deep sea mineral resources required good understanding of the nature of continental shelf, slope ad sea floor, ad mining conditions.
• The mining of minerals from sea, is totally a different technology and required special excavation and extraction equipment.
• The production of oil and natural gas from off-shore areas needs more sophisticated technologies for exploration and oil field development.

Course Outcomes: After completion of course, the students will be able to	
CO-1	Know about Marine environment.
CO-2	Know about Profile of Sea.
CO-3	Know the Exploration methods of Oil and Sea.
CO-4	Know about the Economics and Environmental impact of Ocean mining.

UNIT – I
Introduction to Marine environment. Characteristics of the ocean floor.
UNIT - II
Profile of the sea. Shelf, slope and rise Nature of the deposits of environments.
UNIT - III
Exploration and characterization of inland water. Mineralogical studies of marine sediments and continental slope. Continental shelf and deep sea bed mineral resources. Exploration systems of dissolved and undissolved mineral deposits;
UNIT - IV
Off shore exploration of oil and gas and subsea systems.
UNIT - V
Deep sea bed Mining. Wells and algae for extraction of minerals, Economic & Technologies.
UNIT - VI
Environmental impact of ocean mining. Law of the sea, legal considerations in ocean mining. Course outcome: the new technologies for the extraction of oil and gas production, developments in marine technologies for the extraction of deep seated minerals and future

Suggested Text books:
1. Hartman HL "Introductory Mining Engg" Willey Eastern.
2. Issues of "MARINE MINING" Manjula R.Shyam "Metals fom sea bed Prospects of mining poly matallic nodules of India "Oxfod & IBH".

OE721MN

ROCK REINFORCEMENT ENGINEERING

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*3*

COURSE OBJECTIVES:
• To introduce the rockmass classification and mechanism of rock reinforcement
• To learn the typical and special methods of rock reinforcement

COURSE OUTCOMES:	
CO-1	The students will have the concept about the rockmass classification.
CO-2	The students will learn about mechanism of rock reinforcement, grouting, etc.
CO-3	The students will get a basic knowledge on rock bolts and their applications.
CO-4	The students will learn about cable bolts and rock anchors.
CO-5	The students will know about special methods of rock reinforcement.

UNIT I
ROCKMASS CLASSIFICATION
Basic concepts of rockmass classification; Rock Quality Designation (RQD); Norwegian Geomechanics Classification i.e. Q-system; Rock Mass Rating (RMR); CMRI system; Application of rockmass classification in assessing the support requirement for underground caverns

UNIT II
GROUTING, GUNITING AND SHOTCRETING
Mechanisms of rock reinforcement by grouting; selection of optimum pressure and watercement ratio for grouting; layout for grouting, working principle and field of application for grouting; Guniting and shotcreting operations and their field of application; fibre reinforced shotcreting

UNIT III
ROCK BOLTS
Elements of rock bolts; types of rock bolts and their fields of application; rock bolting machines and installation of rock bolts; pre-tensioning of rock bolts; principles of rock bolting; anchorage test and factors affecting anchorage strength of bolts; modes of failure; Design of rock bolting system for underground excavation i.e. determination of bolt length and bolt pattern.

UNIT IV
CABLE BOLTS ANDROCKANCHORS
Classification of cable bolts; installation and testing; modes of failure; different type of grouting materials; types of anchors; use of anchors for stabilising rock slope, dam etc. ; testing of anchors.

UNIT V
SPECIAL METHODS OFROCKREINFORCEMENT
Ground freezing for slope stabilisation; berms for slope stabilisation; fore-poling; resin grouted rock bolts of fibre glass; geo-textiles and it's area of application; water drainage and rock reinforcement; dump stabilisation by vegetation

REFERENCES
1. Brady, B.H.G. and Brown, S.T., Rock Mechanics, Wiley Interscience,1985.
2. Hoek, E and Brown, E.T., Underground Excavations in Rocks, Institute of Mining Metallurgy, London, 1980.
3. Schach, R., Garshael, K. and Heltzen, A. M., Rock Bolting – A Practical Handbook, Pergamon Press,1979
4. Peng, S.S. Ground Control, Wiley Interscience, New York,1987

MC701HS

CONSTITUTION OF INDIA

Instruction	3 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*0*

Course Objectives:	
1	The history of Indian Constitution and its role in the Indian democracy.
2	Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3	Have knowledge of the various Organs of Governance and Local Administration.

Course Outcomes:	
CO-1	Understand the making of the Indian Constitution and its features.
CO-2	Understand the Rights of equality, the Right of freedom and the Right to constitutional remedies.
CO-3	Have an insight into various Organs of Governance - composition and functions.
CO-4	Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.
CO-5	Understand Electoral Process, special provisions.

UNIT-I
History of making of the Indian constitutions: History, Drafting Committee (Composition & Working). Philosophy of the Indian Constitution: Preamble, Salient Features.

UNIT-II
Contours of Constitutional Rights and Duties Fundamental Rights, Right toEquality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT-III
Organs of Governance: Parliament: Composition, Qualifications, Powers andFunctions, Union executives: President, Governor, Council of Ministers, Judiciary, appointment and transfer of judges, qualifications, powers and functions

UNIT-IV
Local Administration – District's Administration head: Role and importance. Municipalities: Introduction, ayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, PRI: Zilla Panchayat, Elected Officials and their roles, CEO Zilla Panchayat: positions and role. Block level: Organizational Hierarchy (Different departments) Village level: role of elected and appointed officials. Importance of grass root democracy.

UNIT-V
Election commission: Election Commission: Role and functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and functioning. Institute and Bodies for the welfare of SC/ST/OBC and women

Suggested Reading:
1. ―The Constitution of India‖, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, ―Framing of Indian Constitution‖, 1st Edition, 2015.
3. M. P. Jain, ―Indian Constitution Law‖, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, ―Introduction to the Constitution of India‖, Lexis Nexis, 2015. Web Resource: 1. http://www.nptel.ac.in/courses/103107084/Script.pdf

PC751MN

SEMINAR

Instruction	*2* periods per week
CIE	*50 marks*
Credits	*1*

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	Identify appropriate topic of relevance.
2	Update literature on technical articles of selected topic and develop comprehension.
3	Prepare a technical report.
4	Deliver presentation on specified technical topic.

Course Outcomes:	
On completion of this course, the student will be able to :	
CO-1	Review literature on technical articles and develop comprehension.
CO-2	Recognize appropriate topic of relevance
CO-3	Prepare review repot of literature studied
CO-4	Write a technical report.
CO-5	Give presentation on specified technical topic

At least two faculty members will be associated with the seminar presentation to evaluate and award marks.

PC752MN

COMPREHENSION

Instruction	2 periods per week
CIE	*50 marks*
Credits	*1*

Course Objectives:	
1	To revise and recall major mining subjects covered in previous semesters
2	To introduce different competitive exams regarding job opportunities in India and abroad
3	To introduce different competitive exams regarding higher studies in Indian and abroad universities

Course Outcomes:	
CO-1	Students will be able to recall the prepare for mining competitive exams
CO-2	Students will be able to review various job opportunities other than mining
CO-3	Students will be able to review various higher studies opportunities in India and Abroad

UNIT-I
Revision of Mining Geology, Mine Development, Surveying

UNIT-II
Revision of Engineering mechanics, Geomechanics, Ground control

UNIT-III
Revision of Mining Methods and Machinery, Surface Environment, Mine Ventilation and Underground Hazards

UNIT-IV
Revision of Mineral Economics, Mine Planning, Systems Engineering

UNIT-V
Introduction of mining competitive exams for higher studies and mining job opportunities in India and abroad, competitive exams for State and Central government jobs other than mining jobs, different carrier opportunities and entrepreneurship.

PW761MN

PROJECT WORK-I

Instruction	4 periods per week
CIE	*50 marks*
Credits	*2*

Course Objectives:	
1	To enhance practical and professional skills.
2	To familiarize tools and techniques of systematic Literature survey and documentation
3	To expose the students to industry practices and team work.
4	To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes:	
CO-1	Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems
CO-2	Evaluate different solutions based on economic and technical feasibility
CO-3	Effectively plan a project and confidently perform all aspects of project management
CO-4	Demonstrate effective written and oral communication skills

Pre requisites:

1. Able to define Problem with specifications
2. Relevant Literature survey, familiarity with research journals
3. Critically evaluate various available techniques to solve a particular problem
4. Able to Plan the work, prepare required graphs, bar (activity) charts and analyse the results and arrive at a solution
5. Prepare and present results in a scientific manner (Presentation - oral and written)
6. The department can initiate the project allotment procedure at the end of VI semester and finalize it in the first two weeks of VII semester.
7. First 4 weeks of VII semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R & D institutions.
8. The objective of these preliminary talks will be to expose the students to real life practical problems and methodology to solve the technical problems.
9. Seminar schedule will be prepared by the co-ordinator for all the students from 5th week to the
10. last week of the semester which should be strictly adhered to.

Each student will be required to:

1. Submit a one-page synopsis before the seminar for display on notice board.
2. Give a 20 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above

PW961MN

INTERNSHIP-II

Instruction	NIL
CIE	*50marks*
Credits	*1*

Course Objectives:	
1	To give an experience to the students in solving real life practical problems with all its constraints.
2	To give an opportunity to integrate different aspects of learning with reference to real life problems.
3	To enhance the confidence of the students while communicating with industry engineers and give an
4	opportunity for useful interaction with them and familiarize with work culture and ethics of the industry.

Course Outcomes: Student will be	
CO-1	Able to design/develop a small and simple product in hardware or software.
CO-2	Able to complete the task or realize a prespecified target, with limited scope, rather than taking up a complex task and leave it.
CO-3	Able to learn to find alternate viable solutions for a given problem and evaluate these alternatives with reference to prespecified criteria.
CO-4	Able to implement the selected solution and document the same.
CO-5	Able to write a technical report and present it to appropriate audience

Summer Internship is introduced as part of the curricula for encouraging students to work on problems of interest to industries. A batch of two or three students will be attached to a person from an Industry / R & D Organization / National Laboratory for a period of 8 weeks.

This will be during the summer vacation following the completion of the VI semester course. One faculty member will act as an internal guide for each batch to monitor the progress and interacts with the Industry guide. After the completion of the project, students will submit a brief technical report on the project executed and present the work through a seminar talk to be organized by the department. Award of sessional marks are based on the performance of the student at the work place and awarded by industry guide and internal guide (25 Marks) followed by presentation before the committee constituted by the department (25 Marks). One faculty member will coordinate the overall activity of Summer Internship.

*Students after undergoing summer internship of 6 Weeks duration at the end of semester VI the grades Excellent, Good, Average will be allotted after evaluation in VII semester

Scheme of Instruction for BE (Mining Engg) – VIII Semester

S.No.	Course Code	Course Title	Scheme of Instruction			Contact Hrs/ Wk	Scheme of Examination			Credits
			L	T	P		Hrs	CIE	SEE	
THEORY										
1	OE III	Open Elective - III	2	-	-	2	3	30	70	2
2	MC II	Artificial Intelligence	2	-	-	2	3	30	70	0
PRACTICALS										
3	PW891MN	Project Work-II	-	-	12	12	-	50	100	6
			4	**0**	**12**	**16**	**6**	**110**	**240**	**8**

CODE	**OPEN ELECTIVE-III**
OE831MN	Environmental Management for Sustainable Mining

OE831MN

ENVIRONMENTAL MANAGEMENT FOR SUSTAINABLE MINING

Instruction	2 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*2*

COURSE OBJECTIVES:
• To study the various environmental pollution occurring in mineral industry.
• To study various methods of managing environmental pollution.
• To study various statute related to environment.

COURSE OUTCOMES	
CO-1	The students will have basic knowledge on concepts of ecology.
CO-2	The students will have knowledge about various pollutants including acid rain, green house gases, etc
CO-3	The students will have knowledge about impacts of pollution.
CO-4	The students will have adequate knowledge on cost benefit analysis, environmental administration, etc.
CO-5	The students will have knowledge on, pollution its control and ecological systems along with related laws

UNIT I
ENVIRONMENT & ECOLOGY
Concept of Ecology, ecological principle, nature of the environment ecology and man. Goals, strategies and tools for environmental management – systems approach to environmental management – environmental guidelines – National Policies on environment with respects to mining activities – Global and Local environmental issues – resource degradation – desertification – Industrialization, Objectives of Sustainable Development.

UNIT II
ENVIRONMENTAL POLLUTION-I
Environmental Pollutants due to surface and underground mining – Air, Water, Noise, Sources and Classification of pollutants including dust and their effect on human health, Sources, hazards, sampling and analysis, standards, instrumentation and measurement of pollutants including dust, Control and preventive measure for air pollution including for dust, Structure of the atmosphere – ozone layer depletion – Acid rain – Green house gases and global warming Ambient Air quality and emission standards, Air quality Sampling and monitoring, Dispersion of air pollutants

UNIT III
ENVIRONMENTAL POLLUTION-II
Environmental Pollution due to Water – Sources, Classification and measurements of pollutants and their effect on human health, hazards, sampling and analysis, Water pollution, measurement standards, Noise standards – Measurement – Noise Impact Index assessment, Control and preventive measures for water, noise pollution. Pollution due to equipment vibrations & their monitoring, prevention and control, Land pollution, land for alternation dealing with mind outland , re-vegetation, land use plan, Textural classification and properties of soil. Impact of pollution on human health,

UNIT IV
ENVIRONMENTAL MANAGEMENT
Environmental quality objectives, Emission and ambient standards – Minimum National standards – International environmental standards – ISO 14000 – EIA Notification – Siting of Industries – Environmental management plans, Environmental impact assessment, Environmental management system audits, Environmental economics – Principles of cost benefit analysis – Valuingthe Environment – Environmental Accounting, Environmental administration- training awareness and competence

UNIT V
ENVIRONMENTAL LEGISLATIONS
Environmental laws, the Environmental (Protective) Act, 2004, The Water Act (1974), The Air act (1981), The Forest Act 1927, The forest conservation act 1980, Power and responsibilities of regularity agencies and occupation consent to establish and operate wild life protection act and rules , Environmental clearance procedure for a mining Project

TEXT BOOKS:
1. Mackenthun, K.M. Basic Concepts in Environmental Management, Lewis Publications, London, 1998
2. Shyam Divan and Armin Rosencranz, Environmental Law and Policy in India, Oxford University Press, New Delhi.(2001)

REFERENCES
1. Hartman, H.L. Mine Ventilation and Air Conditioning, Wiley Interscience publication, 1999.
2. Mishra, G.B. Mine Environment and Ventilation, Oxford University Press,1992.
3. McPherson, M.J. Subsurface Ventilation and Environmental Engineering, Chapman & Hall Publication, London, 1993
4. Manahan S.E. Environmental Science andTechnology
5. Gregor I. Mcgregor. Environmental Law and Enforcement, Lewis Publishers, London,1994
6. Noel de Nevers, Air Pollution Control Engg., McGraw Hill, New York,1995
7. Anjaneyulu,Y. Air Pollution & Control Technologies, Allied Publishers (P) Ltd, India,2002
8. Nick Hanley, Jaison F. Shogren and Ben White.Environmental Economics – In Theory and Practice, Macmillan India Ltd, New Delhi, 1999
9. Roger Perman, Yue Ma and James McGilvray. Natural Resources and Environmental Economics, Second edition, Addision Wesley Longman Ltd, Singapore,1997
10. Christopher Sheldon and Mark Yoxon, Installing Environmental Management System –a step by step guide, Earthsecan Publications Ltd, London,1999
11. Lee Kuhre, ISO 14001 Certification –Environmental Management Systems, Prentice

MC II

ARTIFICIAL INTELLIGENCE

Instruction	2 periods per week
Duration of Semester End Examination	*3 hours*
CIE	*30marks*
SEE	*70 marks*
Credits	*0*

Course Objectives:
• This course enables the students to understand the basic fundamentals of Artificial Intelligence, determine various problem-solving strategies, understand the logic concepts, different approaches to represent the knowledge, develop the expert systems in various phases and its applications, apply the fuzzy logic in various problem-solving techniques.

Course Outcomes: After completion of course, the students will be able to	
CO-1	Describe the key components of the artificial intelligence (AI) field.
CO-2	Classify knowledge representation techniques.
CO-3	Interpret various types of reasoning and processing.
CO-4	Discover game playing and apply knowledge representation.
CO-5	Demonstrate learning and the analyze aspects of leaning.

UNIT I
Introduction
Introduction to artificial intelligence: Introduction, history, intelligent systems, foundations of AI, applications, tic-tac-tie game playing, development of ai languages, current trends in AI

UNIT II
Problem Solving
Problem solving: state-space search and control strategies: Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques, iterative deepening a*, constraint satisfaction Problem reduction and game playing: Introduction, problem reduction, game playing, alpha beta pruning, two-player perfect information games

UNIT III
Logic Concepts and Knowledge Representation
Logic Concepts - Introduction, propositional calculus, proportional logic, natural deduction system, axiomatic system, semantic tableau system in proportional logic, resolution refutation in proportional logic, predicate logic
Knowledge Representation - Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR, knowledge representation using frames advanced knowledge representation techniques: Introduction, conceptual dependency theory, script structure, cyc theory, case grammars, semantic web.

UNIT IV
Expert System and Applications
Introduction phases in building expert systems, expert system versus traditional systems, rule-based expert systems blackboard systems truth maintenance systems, application of expert systems, list of shells and tools

UNIT V
Uncertainty Measure
Uncertainty measure: probability theory: Introduction, probability theory, Bayesian belief networks, certainty factor theory, dempster-shafer theory Fuzzy sets and fuzzy logic: Introduction, fuzzy sets, fuzzy set operations, types of membership functions, multi valued logic, fuzzy logic, linguistic variables and hedges, fuzzy propositions, inference rules for fuzzy propositions, fuzzy systems.

TEXTBOOKS
1. Saroj Kaushik, "**Artificial Intelligence**", CENGAGE Learning,
2. Stuart Russel, Peter Norvig, "**Artificial intelligence, A modern Approach**", 2nd ed, PEA
3. Rich, Kevin Knight, Shiv Shankar B Nair, "**Artificial Intelligence**", 3rd Ed, TMH
4. Patterson,"**Introduction to Artificial Intelligence**", PHI

REFERENCES
1. George F Lugar, **"Atificial intelligence, structures and Strategies for Complex problem solving"**, 5th edition, PEA
2. Ertel, Wolf Gang, "**Introduction to Artificial Intelligence**", Springer
3. Blay WhitBY "**Artificial Intelligence**" Rosen Publishing.

E-RESOURCES
1. https://i4iam.files.wordpress.com/2013/08/artificial-intelligence-by-rich-and-knight.pdf
2. https://books.google.co.in/books?id=pVR9W5LEZUwC&printsec=frontcover&source=gb
s_ge_summary_r&cad=0#v=onepage&q&f=false
3. https://www.journals.elsevier.com/artificial-intelligence/
4. http://www.ceser.in/ceserp/index.php/ijai
5. http://ndl.iitkgp.ac.in/document/yVCWqd6u7wgye1qwH9xY7_M07uyea_7zp_zRG3BvdU
Vy2TIab45fvPeNJfynQsAbmBEgDSUqzidwcse6xwotJA
6. http://ndl.iitkgp.ac.in/document/xttk-4kfhvUwVlXBW-YWRBg_vrHK12-
lgOzTVbb5oZ6eQOBjCWDfRvquHJLEOFENjI5AmOqRc9Ar3eJF4CGFrw

PW891MN

PROJECT WORK-II

Instruction	*2* periods per week
Duration of Semester End Examination	*2 hours*
CEE	*25 marks*
SEE	*50 marks*
Credits	*1*

Course Objectives:	
1	To enhance practical and professional skills
2	To familiarize tools and techniques of systematic Literature survey and documentation
3	To expose the students to industry practices and team work
4	To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes: After completion of course, the students will be able to	
CO-1	demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems
CO-2	evaluate different solutions based on economic and technical feasibility
CO-3	effectively plan a project and confidently perform all aspects of project management
CO-4	Demonstrate effective written and oral communication skills Project work

Prerequisites:

Able to define Problem with specifications
Relevant Literature survey, familiarity with research journals
Critically evaluate various available techniques to solve a particular problem
Able to Plan the work, prepare required graphs, bar (activity) charts and analyse the results and arrive at
a solution
Prepare and present results in a scientific manner (Presentation - oral and written)
The student will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R & D institutions. The
objective of these preliminary talks will be to expose the students to real life practical problems and methodology to solve the technical problems.
Seminar schedule will be prepared by the co-ordinator for all the students from 5th week to the last week of the semester which should be strictly adhered to.
Each student will be required to:
1. Submit a one-page synopsis before the seminar for display on notice board.
2. Give a 20 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write-up on the talk.
At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.