DEPARTMENT OF CIVIL ENGINEERING

Scheme of Instruction and Syllabus of

M.E. (Mining Engineering)

Full Time

(2018-2019)

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

(With effect from the Academic Year 2018-2019)

INSTITUTE

Vision

The Vision of the institute is to generate and disseminate knowledge through harmonious blending of science, engineering and technology. To serve the society by developing a modern technology in students' heightened intellectual, cultural, ethical and humane sensitivities, fostering a scientific temper and promoting professional and technological expertise.

Mission

- To achieve excellence in Teaching and Research
- To generate , disseminate and preserve knowledge
- To enable empowerment through knowledge and information
- Advancement of knowledge in Engineering, Science and Technology
- Promote learning in free thinking and innovative environment
- Cultivate skills, attitudes to promote knowledge creation
- Rendering socially relevant technical services to the community
- To impart new skills of technology development
- To inculcate entrepreneurial talents and technology appreciation programmes
- Technology transfer and incubation

DEPARTMENT

Vision

To be as a leading academic department on pace with global standards and contribute to the development of economic, technically viable and useful to societal problems and challenges of civil engineering profession and also contribute to the regional and country's developmental activities.

Mission

- To train the human resources with knowledge base in the field of Civil Engineering so that they can face the challenges of civil and infrastructural engineering problems to provide viable solutions.
- To integrate their understanding and attainable knowledge on the specializations for effective functioning in their profession and useful to the welfare and safety of mankind.
- To enhance the technical knowledge and research aptitude in the domains of various Civil Engineering specializations to serve the society in highly professional manner.
- Produce highly competent and capable professionals and motivated young academicians to provide solutions to real life problems of Engineering and Technology and has apt for continuous learning and dedication towards societal issues.

Programme Educational Objectives (PEO):

1. Impart and enrich knowledge in the fields of Mining Engineering
2. Exposure to the state-of-art techniques / knowledge of modeling techniques in to be adopted for different Mining Engineering Problems
3. Facilitate the policy makers and administrators to solve issues pertaining to regional Development using Mining Resources
4. Provide continuing education as per the needs of practicing engineers and academician to enhance their technical knowledge

Programme Outcomes (PO):

1.

2.

3.

4.

5.

6.

MAPPING OF PEO'S WITH PO'S

PROGRAMME EDUCATIONAL OBJECTIVES	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6

M. E. CIVIL (MINING ENGINEERING)

w. e. f. 2018-2019

Course Code	Course Title	Contact hours per week	Scheme of Examination		Credits
			CIE	SEE	
Core Subjects:					
CE1701	Hydraulics and Hydraulic Equipment in Mining	3	30	70	3
CE1702	Numerical Modelling in Mining	3	30	70	3
CE1703	Instrumentation in Mining	3	30	70	3
CE1704	Rock Excavation Engineering	3	30	70	3
CE1705	Mine Safety Management	3	30	70	3
CE1706	Mine Economics and Investment	3	30	70	3
Elective Subjects:					
CE 1711	Tunnelling and Underground Space Technology	3	30	70	3
CE 1712	Advanced Rock Mechanics and Ground Control	3	30	70	3
CE 1713	Advanced Surface Mine Planning and Design	3	30	70	3
CE 1714	Surface Mine Environmental Engineering	3	30	70	3
CE 1715	Modern Surveying Techniques	3	30	70	3
CE 1716	Designing of Mining Machines	3	30	70	3
CE 1717	Advanced Exploration Techniques	3	30	70	3
CE 1718	Material Handling	3	30	70	3
CE 1719	Geo-Statistics	3	30	70	3
CE 1720	Finite Element Analysis	3	30	70	3
CE 1721	Reliability Engineering	3	30	70	3
CE 1722	Computational Fluid Dynamics	3	30	70	3
CE 1724	Geo-Environmental Engg.	3	30	70	3
CE 1725	Models of Air & Water Quality	3	30	70	3
CE 1726	Groundwater Engineering	3	30	70	3
CE 1727	Ground Improvement Techniques	3	30	70	3
CE 1728	Mine Systems Engineering	3	30	70	3
CE 0111	Engineering Research Methodology	3	30	70	3

Course Code	Course Title	Contact hours per week	Scheme of Examination		Credits
			CIE	SEE	
Departmental Requirements:					
CE 1731	Mining Engg. Laboratory	3	50	-	2
CE 1732	Computer Applications in Mining	3	50	-	2
CE 1733	Seminar-I	3	50	-	2
CE 1734	Seminar-II	3	50	-	2
CE 1735	Project Seminar	4	100	-	8
CE 1736	Dissertation	6	-	200	16

CIE : Continuous Internal Evaluation SEE : Semester End Examination

NOTE

In addition to the above Electives, the following three Mining Electives are also to be added

1. **Advanced Underground Coal Mine Planning and Design.**
2. **Advanced Underground Metal Mine Planning and Design.**
3. **Longwall Mining**

The Syllabus for the same is also being framed and will be sent to you for approval during this week

HYDRAULICS AND HYDRAULIC EQUIPMENT IN MINING

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

Course Objectives:

- To provide student with knowledge on the application of hydraulic power in process, in mining and construction Industries.
- To provide students with an understanding of the hydraulics and components utilized in modern industrial hydraulic power system.
- To develop a measurable degree of competence in the design, construction and operation• of hydraulic power circuits.
- To impart students on the science, use and application of hydraulics in Industry. Also to impart knowledge on the methodology of basic and advanced design of hydraulics systems.

UNIT I

FLUID POWER PRINICIPLES **9**

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection Different types of fluids used hydraulic systems, Water base Viz. Oil in water, Water in Oil, Water Glycol; Synthetic fluids like Phosphate easter, their properties, merits demerits and suitability.– Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power. Fluid Power ANSI Symbols, Bernoulli's theorem and its applications, Laminar and turbulent flows and their applications.

Unit II

POWER GENERATING ELEMENTS **9**

Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Properties, Characteristics and Performance, specifications, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems. Rotary Actuators – selection, specification and characteristics, Hydrostatic drives, types, selection. Hydraulic power packs.

UNIT III

CYLINDERS, COMPONENTS AND ACCESSORIES **9**

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories : Reservoirs, Pressure Switches – Applications — Accumulators, Intensifiers, Problems.

UNIT IV

HYDRAULIC CIRCUITS AND SYSTEMS **9**

Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits. Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits – industrial circuits - planning, copying, - Power pack circuits, Drilling machines, powered supports, shearer, continuous miner, road headers, drilling machine, forklift, earth mover (shovels, rippers, graders, etc.) circuits design methodology- design and selection of components - safety and emergency mandrels – Cascade method. Use of relays, counters, timers, ladder diagrams, use of microprocessor in circuit design.

UNIT V

TROUBLE SHOOTING AND APPLICATIONS **9**

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic Design of hydraulic circuits for Drilling machines, powered supports, shearer, continuous miner, road headers, drilling machine, forklift, earth mover (shovels, rippers, graders, etc.) applications. Fault finding– application -fault finding - hydro circuits.

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of this course, the students will be able to: Identify hydraulic components and its symbol and usage. Ability to design hydraulic circuits.

It helps students to get knowledge on the need, use and application of hydraulic power and make them familiar to mining equipment design that lead to automation.

TEXT BOOKS:

1. Anthony Esposito, “Fluid Power with Applications”, Prentice Hall, 2009.
2. James A. Sullivan, “Fluid Power Theory and Applications”, Fourth Edition, Prentice Hall, 1997.

REFERENCES:

1. Majumdar, S.R., “Oil Hydraulics Systems – Principles and Maintenance”, Tata McGRaw Hill, 2001.
2. Dudley, A. Pease and John J Pippenger, “Basic Fluid Power”, Prentice Hall, 1987
3. Jagadeesha T, “Pneumatics Concepts, Design and Applications “, Universities Press, 2015.
4. Bolton. W., “Pneumatic and Hydraulic Systems “, Butterworth –Heinemann, 1997.

NUMERICAL MODELLING IN MINING

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

Course Objectives:

1. To study the finite element methods, finite difference methods and boundary element methods
2. To understand the practical applications of numerical methods in mining field

UNIT I
INTRODUCTION TO ELASTIC AND PLASTIC MODELS 9

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 9

Concept, formation of mesh element, finite difference patterns, solutions, application to mining. Commercial Softwares for application in 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: Strand – 7 and FLAC.

UNIT III
FINITE ELEMENT METHODS 9

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 geomechanics; simulation of joints in strata. Commercial Softwares for application in mining.

UNIT IV
BOUNDARY ELEMENT METHOD 9

Concept, discretisation, formulation, merits, demerits and limitations, different methods of solution for isotropic and infinite media. Commercial Softwares for application in mining. Boundary Element Method: Introduction, formulation, advantages and their limitations.

UNIT V

PRACTICAL APPLICATIONS IN MINING AND ROCK MECHANICS 9

Practical Applications in stress analysis, slope and dump stability, subsidence prediction, pillar design, rock burst, different types of mine supports, etc.

Constitutive modeling and their uses: Mohr's Coulomb Plasticity model for simulation of rock failure, Interfaces to simulate the bedding planes, Simulation of support in rock: bolts, props and lining.

TOTAL: 45 PERIODS

OUTCOME: The students will get the concept about finite element models, methods and boundary elements method and its practical applications in mining and rock mechanics.

REFERENCES

1. Desai, C.S. and Abel, J.F., Introduction to the finite Element Method, Van Nostrand Riehokl 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.

INSTRUMENTATION IN MINING

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

Course Objectives: To learn about

- Electrical instruments
- Pressure and flow measurements
- Temperature and Environmental parameters measuring instruments
- Rock mechanics and ground control instruments

UINT I
ELECTRICAL INSTRUMENTS **9**

Basic Concepts: Sensitivity, range, reproducibility and accuracy, drift, absolute and relative measurements, error, environmental factors and planning for instrumentation. Accuracy, precision, resolution, sensitivity, linearity, span and range -Dynamic characteristics. Ammeters (MI & MC), Volt meters, Watt meters (Dynami), Energy Meters, Megger, Power Factor meters, Earth resistance measurement. and thermocouples, Inclinometers

UINT II
PRESSURE MEASUREMENTS AND FLOW MEASUREMENTS **10**

Unit of Pressure – Manometers- Different types, - Elastic type pressure gauges and sensors– Bourdon tube – Bellows – Diaphragm – Elastic elements with LVDT and strain gauge, deformation gauge – Capacitive type pressure gauge – Measurement of vacuum – McLeod gauge – Thermal conductivity gauge – Ionisation gauge. Piezometer, Flow meters – Variable head type flow meter – Orifice plate – Venture tube – Positive displacement flow meter: Nutating disc, Reciprocating piston, oval gear and helix type flow meter – Rotameter – Mass flow meters.

UNIT III
VIBRATION, HUMIDITY, VELOCITY AND LEVEL MEASUREMENTS **9**

Mechanical type vibration measuring instruments – Seismic instruments as an accelerometer – Vibrometers – Geo-phones. Humidity – Hot wire electro type hygrometer – Dew cell – Electrolysis type hygrometer. Anemometer, Velometer, Pitot static tube, Sound level meter, microphone, Lux meter; Level measurements: – Float gauges - Displacer type – D/P methods -Bubbler system-Load cell – Electrical types – Conductivity sensors – Capacitive sensors – Nucleonic gauge - Ultrasonic gauge – Boiler drum level measurement :– Differential pressure method and Hydrastep method -Solid level measurement.

UNIT IV
ANALYSERS **9**

Dissolved Analyzer: Conductivity meter – pH meter – Dissolved oxygen analyser – Sodium analyser – Silica analyser – Turbidity meter – Gas analyser – O_2, NO_x – H_2S analyser – CO

and CO_2 monitor, Dust & Smoke measurement. IR analyzers, thermal conductivity analyzers, analysis based on ionization of gases. hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Calibration methods.

UNIT V

ROCK MECHANICS INSTRUMENTATION 9

Different types of Load cells, stress capsules, Flatjack, tape extensor meters, convergence indicators and recorders, borehole deformation gauges of different types, depth indicators. Seismic measurements, Applications in Mining**:** Coal mining – bord and pillar development, depillaring and Longwall, Metal mining and opencast mining applications, rock slope instrumentation.

TOTAL : 45 PERIODS

OUTCOME: Upon Completion of this subject, the students can able to explain different types of• used in various mining activities

TEXT BOOKS:

1. De, N.K. and Sen, P.K. 'Electric Drives' Prentice Hall of India Private Ltd, 2002.
2. Subramaniam, V. 'Electric Drives' Tata McGraw Hill , New Delhi,2007
3. Dubey, G.K. 'Fundamentals of Electrical Drives' Narosa, Second Edition.
4. Morrris, A.S. Principles of Measurement and Instrumentation, Print ice-Hall of India Pvt., Ltd. New Delhi, 1999.
5. Doeblin, E.O. Measurement Systems Application & Design, Tata McGraw Hill Publishing Co., New. Delhi, 1999.

REFERENCES:

1. Bhattacharya, S.K., Singh, B. 'Control of Electrical Machines', New Age International Publishers,2002.
2. Bird, J. 'Electrical Circuit theory and technology' Elsevier, First Indian Edition, 2006.
3. Murthy, D.V.S. Transducers and Instrument and Instrumentation, Prentice Hall of India Pvt. Ltd. New Delhi.
4. Patranabir, D. Principle of Industrial Instrumentation, Tata McGraw Hill Publishing Co., New Delhi 1999.
5. Jain, R.K. Mechanical and Industrial Measurements, Khanna Publishing, New Delhi, 1999.
6. Liptak, B.G. Instrumentation Engineers Hand Book (Measurement), Chilton Book Co., 1994.
7. Peng, S.S. Longwall Mining.
8. Obert, L and Duvall, W.I., Rock mechanics and the design of structures in rock, John Wiley and Sons, New York, 1967.
9. Hoek, E. and Bray, J., Rock Slope Engineering, Institution of Mining and Metallurgy, New York, 1974.

ROCK EXCAVATION ENGINEERING

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

OBJECTIVES:

To understand the rock mechanics, rock cutting technology, rock cutting tools and rock excavating machine.

UNIT I
INTRODUCTION **9**

Concepts, historical developments in rock excavation, systems, factors affecting the rock fragmentation, mechanism ofrock breakage and fracture; their application to rock fragmentation methods for rock fragmentation – explosive action, cutting, ripping and impacts. Scope and importance of rock excavation engineering in mining and construction industries; physico-mechanical and geotechnical properties of rocks vis-à-vis excavation method; selection of excavation method. Rock breaking processes: Primary, Secondary and Tertiary, Energy consumption computations.

UNIT II
ROCK MECHANICS **9**

Rock properties related to machining process; application of compressive, tensile and multiaxial strengths, index tests and abrasivity, anisotropy, elasticity, porosity, laminations, bedding and jointing in rock fragmentation process.

UNIT III
ROCK CUTTING TECHNOLOGY **9**

Mechanism of drilling – rotary, percussive, rotary, rotary percussive, mechanics of rock machining, theory of single tool rock cutting, crack initiation and propagation, breakage pattern, rock excavation by cutting action – picks, discs, roller cutters water jet cutting, methods of evaluation of drillability and cuttability of rocks. Advances in drilling equipment, pneumatic versus hydraulic, design and operating parameters of surface and underground drilling; evaluation of drill performance; mechanism of bit wear; bit selection; economics of drilling.

UNIT IV
ROCK CUTTING TOOLS **9**

Rock cutting tool materials, different types, relative applications and their choice, tool shape and size, specific energy consumption, tool wear, effect of operational parameters on tool performance, maintenance and replacement of cutting tools of excavating machines.
Theories of rock tool interaction for surface excavation machinery rippers, dozers, scrapers, BWE, continuous surface miners, auger drills; theories of ploughs, shearers,–rock tool

interaction for underground excavation machinery roadheaders, continuous miners and tunnel boring machines; selection criteria for high pressure water jet assisted–cutting tools; advanced rock cutting techniques cutting.

UNIT V

ROCK EXCAVATING MACHINES **9**

Excavating machines, principles, operation, applicability and technical indices of road headers, TBM'S coalface machines and bucket wheel excavators.

Recent Developments in rock excavation machinery.

TOTAL: 45 PERIODS

OUTCOME: The students will get familiarity about rock mechanics properties, rock cutting technology and excavating machines.

REFERENCES

1. Cummings, A.B. and Given, I.V., SME Mining Engg. Vol. I and II, Society of Mining Engineers, America, 1992.
2. Hartman, H.L., Introductory Mining Engineering, John Wiley and Sons, New York, 1987.
3. Chugh, C.P., Diamond Drilling, Oxford-IBH, 1984.
4. Clark, G.B., Principles of Rock Fragmentation, John Wiley and Sons, New York, 1987

MINE SAFETY MANAGEMENT

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

OBJECTIVES: To learn the level of risk associated with mining, risk assessment and management. To know the occupational diseases, mine disasters and mitigation.

UNIT I
MINE ACCIDENTS AND THEIR ANALYSIS 8

Accident in mines;- different types, accident investigations; In-depth study of accidents due to various causes; and Human Behavioural Approach in mine safety, accident prevention and corrective action, accident proneness, creating and maintaining safety awareness, ZAP and MAP, job safety analysis, safety meeting and committee**.**

UNIT II
HEALTH AND MINE SAFETY 8

Definition of health and safety, management's role – function; evolution of management involvement, management's training, responsibility, cost of health and safety, role of labour organizations – Union impact and involvement, role of government – statutory controls and directions, spot and regular inspections, enforcement of standards, penalties for violations, collection and distribution of statistical data. Safety audit methods; Safety records management, Training of Miners. Recent trends of development of safety engineering approaches.

UNIT III
FAULT TREE ANALYSIS 8

Introduction – methodology, symbols and Boolean techniques, qualitative analysis, computerized methods, statistical analysis, safety information, systems design. Appraisal of advance Techniques - fault tree analysis, Failure–Statistical methods of Risk analysis: Appraisal of advanced techniques Mode and Effect Analysis (FMEA); Failure Mode Effect and Critical Analysis (FMECA)

UNIT IV
RISK ASSESSEMENT AND DISASTER MANAGEMENT 13

Principles, risk and hazard control, risk and hazard evaluation and data collection for identified health risks, exposure assessment and risk characterization, probabilistic risk analysis, risk management, safety culture, human factors, reliability evaluation, safety audit. Identification of causes of mine disasters, preventive action.

Risk Management related terms and definitions; Basic concept of risk; Difference between hazards and risks; Risk components and types, Risk management objectives, Risk management process; Risk analysis objectives in hazardous system life cycle; Functions of a risk manager; Hazards Identification and Risk Assessment (HIRA).
Concepts of Disaster, Types of Disaster and Dimensions of Natural and Anthropogenic Disasters (landslide, subsidence, fire and earthquake); Principles and Components of Disaster Management, Organizational Structure for Disaster Management, Disaster Management Schemes; Pre-disaster risk and vulnerability reduction; Post disaster recovery and rehabilitation; Disaster related Infrastructure Development; Disaster Management and Mitigation, typical cases of mine disasters in India.

UNIT V

MINER'S OCCUPATIONAL DISEASES AND ENQUIRYCOMMITTEE 8

Miner's occupational health and diseases, preventive medical examinations, various types of injuries, compensable diseases, medical attention and removable of causative factors in the mines. Recommendations of inquiry committee carried out for safety and health issues in India.

TOTAL :45 PERIODS

OUTCOME: The students will have deep knowledge about the mine accidents, disaster, disease and mine safety with risk assessment, mitigation and management.

REFERENCES

1. Brown, D.B., System Analysis and Design for Safety, Prentice Hall, 1976.
2. Stranks, J., Management Systems for Safety, Pitman Publishing, 1994.
3. DeReamer, R., Modern Safety Practices, John Wiley and Sons.
4. Wahab Khair. A., New Technology in Health and Safety, SMME, 1992.
5. Ericson, C.A. Fault Tree Analysis Primer, CreateSpace Independent Publishing Platform, 2011.
6. Zyl, D.A., Koval, M, Li Ta, M. (Ed.). Risk Assessment / Management Issues in the Environmental Planning in Mines, SMME, 1992.
7. Prasad, S.D. and Rakesh., A Critical Appraisal of Mine Legislations. Lovely Prakashan, 1995. Dhanbad.
8. Mine Disasters of India, NCSM Publication.
9. Kejriwal, B.K., Safety in Mines, Gyan Khan Prakashan, Dhanbad, 1994.

MINE ECONOMICS AND INVESTMENT

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

OBJECTIVES:

- Study of estimation and valuation of mineral deposits
- Study of project appraisal
- Study of finance and accounting

UNIT I INTRODUCTION 9

Mineral industry and its role in national economy; world and national mineral resources; Mining - A unique investment environment; special risk factors in mine investment and evaluation; national mineral policy, International aspects of mineral industry and geopolitics, Export and Import of minerals, Demand and Supply of minerals, Conservation and substitution of minerals, low grade ores, use of scrap, Substitution of minerals, Changing pattern of mineral substitution, mineral and mineral based industries, Conservation of mineral resources.

UNIT II ORE RESERVE ESTIMATION 9

Methods of sampling, sampling frequency; analysis of sampling data, estimation of reserves, Classification of coal and ore reserves, strategic, critical and essential minerals, present and future mineral supplies of the world, Geo-statistical methods,. Grade variation, variogram modelling, Krigging, Application of Remote Sensing in mineral prospecting and ore reserve estimation

UNIT III
MINE VALUATION 9

Approaches to Mine Valuation, Time value of money; annuity; redemption of capital, net present value; selecting a discount rate, depreciation; inflation; rates of return; Hoskold's Two rate method;; cash flows and discounted cash flow; profitability index – their implications in mine economic evaluation.

UNIT IV PROJECT APPRAISAL 9

Methods of project evaluation – pay back, annual value, benefit/cost ratio, ERR and IRR, etc., Mine investment analysis – objectives, criteria, alternatives, handling risk, static and dynamic methods; evaluation of exploratory mining areas and operating mines; mine project financing, its risks and constraints; Royalties, duties and mineral taxation; critical impact of depreciation, depletion, type of funding, reserves, life, etc. on mine profitability, International Investment and Trade in mineral materials and products, Small mines and their socio-economic significance.

UNIT V FINANCE AND ACCOUNTING 9

Sources of mine funds – shares, debentures, fixed deposit, sinking fund, capital gearing, P & L account, balance sheet, Project operating strategy, Project alternatives, Contract mining bidding, Exploration and mine development funding, Operating Mine financing, Mergers and acquisitions, typical case studies of mine feasibility. Cost estimation of individual mining operations and overall mining cost, cost control methods, capital and operating cost of mining projects, including wages, incentives, material, etc.; assets; liabilities, Price forecasting and sensitivity analysis.

TOTAL: 45 PERIODS

OUTCOME: The students will have knowledge on estimation and valuation of mineral deposits.• They will possess about project appraisal, finance and accounting.

REFERENCES

1. Deshmukh, R.T., Mineral and Mine Economics, Mira Publications, Nagpur, 1986.
2. Gentry, D.W.and O'Neil, T.J. Mine Investment Analysis, Society for Mining, Metallurgy and Exploration, Inc., Littleton, Colarado. USA.
3. Sloan, D.A., Mine Management, Chapman and Hall, London, 1983.
4. Hartman, H.L. (Ed.). SME Mining Engineering Handbook, Vol. I, Society for Mining, Metallurgy and Exploration, Inc., Littleton, Colarado.
5. Sharma, N.L. and Sinha, R.K.. Mineral Economics, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
6. Rudawsky, O. Minerals Economics – Development and Management of Natural Resources, Vol 20, Elsevier Publications,
7. Chatterjee, K.K., Mineral Economics, Wiley Eastern, 1992.
8. Indian Minerals Year Book 2017 – MMRD Act and Mineral Concession Rules.
9. Ray, S.C. and Sinha, I.N., Mine and Mineral Economics, Kindle Edition, PHI publications.

w. e. f. 2018-2019

TUNNELLING AND UNDERGROUND SPACE TECHNOLOGY

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

To learn the design of tunnels and underground spaces.
To learn the design and installation of various supports and
To learn various methods of driving tunnels used for various purposes

Objectives

- To study various design methods of tunnels, underground spaces and their supports
- To study various methods of driving tunnels, underground spaces and their surveying related
- To study about various machinery used in driving tunnels and underground spaces.

UNIT I
INTRODUCTION
Congestion in cities and its impact on development of social infrastructure for transport, water and power supply, separation of pedestrian and motorized vehicles and its movements, storage of materials, defence facilities including civil shelters. Parameters influencing location, shape and size; geological aspects; planning and site investigations. Natural caves, archaeological caves and their construction; Scope and application, historical developments, art of tunnelling, tunnel engineering, Tunnels for various purposes like road, rail, hydropower tunnels and caverns, Underground storage for LPG and crude oil, Nuclear waste disposal, Metro tunnels, future tunnelling considerations. Planning and design, Assessment of behaviour of tunnelling media, deformation modulus and rock pressure assessment; determination of appropriate size and shape; Design of openings in rocks with the help of field data; Instrumentation and monitoring; Numerical modelling to assess the stability.

UNIT II
TUNNELLING METHODS
Types and purpose of tunnels; factors affecting choice of excavation techniques; soil and rock sampling and testing, Methods - soft ground tunnelling, hard rock tunnelling, shallow tunnelling, deep tunnelling; Shallow tunnels – cut and cover, cover and cut, pipe jacking, jacked box excavation techniques, methods of muck disposal, supporting, problems encountered and remedial measures.

UNIT III
TUNNELLING BY DRILLING AND BLASTING
Unit operations in conventional tunnelling; Drilling - drilling principles, drilling equipment, drilling tools, drill selection, specific drilling, rock drillability factors; Blasting - explosives, initiators, blasting mechanics, blast holes nomenclature; types of cuts - fan, wedge and others;

blast design, tunnel blast performance - powder factor, parameters influencing, models for prediction; mucking and transportation equipment selection.

UNIT IV

TUNNELLING BY ROADHEADERS, IMPACT HAMMERS AND TUNNEL BORING MACHINES

Cutting principles, method of excavation, selection, performance, limitations and problems. Boring principles, method of excavation, selection, performance, limitations and problems; Road headers, Impact Hammers, Tunnel Boring Machines and applications.

UNIT V

TUNNEL SURVEYING, SUPPORTS AND SERVICES

Surveying in Tunnels: Topographic and geological survey, Methods of surveying and different instruments used for surveying in tunnels, Supports in Tunnels: Principal types of supports, their design and applicability. Steel supports, rock bolts, shotcrete, wire mesh, chain link fabric and fibre reinforced shotcrete and other ground consolidation/grouting techniques. Ground Treatment in Tunnelling: Adverse ground conditions and its effect on tunnelling; introduction to ground control. Supports in Metro tunnels, Tunnel Services and Hazards: Ventilation, drainage and pumping. Explosion, flooding, chimney formation, squeezing ground.

Outcome: The students will acquire knowledge relating to
design of underground tunnels and spaces including their supports.
methods of driving and their comparison
machinery used in underground tunnelling and spaces.

Text Books:

1. Hudson, J.A., Rock Engineering Systems Theory and Practice, Ellis Horwood, England.
2. Clark G.B., (1987), Principles of Rock Fragmentation< john Wiley and Sons, New York.

References:

1. Lohanson, John and Mathiesen, C.F., Modern trends in Tunnelling and Blast Design, AA Balkima, 154 P, 2000.
2. Bickel J.O., Kuesel T.R. and King E.H., Tunnel Engineering Hand Book, Chapmen & Hill Inc., New York and CBS Publishers, New Delhi 2nd addition.

ADVANCED ROCK MECHANICS AND GROUND CONTROL

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

OBJECTIVES:

- To study about application of Rock Mechanics, Physico-Mechanical properties of rocks, non-destructive testing methods, time dependent properties of rocks.
- Design of different types of underground supports, etc.
- To study the theories of failure and approaches used for open pit and underground designs.

UNIT I

STRESS ANALYSIS **9**

Stress analysis in 2D and 3D, equations of equilibrium, Mohr's Circles, plane stress and plane strain condition, stress distribution in simple structures, Flexure of beams and rectangular plates,

UNIT - II

PROPERTIES OF ROCKS **9**

Physico-mechanical properties of rocks including tri-axial strengths and in-situ strengths and their application in the design of different types of excavations, rock indices viz. drillability index, caving index, etc. Time dependent properties of rocks and their application in structural design, static and dynamic elastic constants of rocks, rock mass classification methods. Selection excavator based on rock properties.

UNIT III

IN-SITU STRESSES AND THEORIES OF FAILURE **9**

In-situ stresses and instrumentation, drilling and blasting, measurement of stresses, strains, deformations, in-situ stress determination, strata monitoring in underground and opencast mines, mechanics a of drilling and blasting, blast vibration and its monitoring. Different theories of rock failure and their applications in design of mining structures.

UNIT IV

DESIGN OF UNDERGROUND OPENINGS, SUBSIDENCE, ROCK BURST AND SLOPE STABILITY **9**

Design of single and multiple underground openings, pillars including shaft pillar, scaling factors, mining subsidence, rock burst, design of slopes and spoil banks, slope stability in rock & soil and its analysis, slope monitoring and stabilisation techniques. Design of pillars including barrier and shaft pillars.

UNIT V

DESIGN OF MINE SUPPORTS **9**

Advances of mine supports, supports and bord and pillar and longwall workings, rock load assessment, design of different types of supports like conventional and non-conventional supports like shotcrete, fibre reinforced shotcrete, strata grouting, rock bolting, supports in tunnels and shafts,

OUTCOME:

- The students will have detailed knowledge on application of rock mechanics,
- Design of different types of underground openings and supports.
- Design, stabilisation and monitoring of slopes, theories of subsidence and failure of rocks.

TEXT BOOKS:

1. Obert, L. and Duvall, W.I., Rock Mechanics and Design of Structure in Rock John Wiley and Sons Inc., New York, 1967.
2. Vutukuri, V.S., and Lama, R.D., Handbook on Mechanical Properties of Rocks, Vol. I, II, III and IV, Transtech Publication, Berlin, 1974/78.
3. Peng, S.S., Ground Control, Wiley Interscience, New York, 1987.

REFERENCES:

1. Brady, B.H.G. and Brown, S.T., Rock Mechanics, Wiley Interscience, 1985.
2. Hoek, E., and Brown, S.T., Underground Excavations in Rocks, Institute of Mining Metallurgy, London, 1980.
5. Jumkis, A.R. Rock Mechanics, Transtech Publications, Berlin, 1983.
6. Stacey, T.R. and Page, C.H., Practical Handbook for Underground Rock Mechanics, Transtech Publications, Berlin, 1986.
7. Whittaker, B.N. and Reddish, D.J., Subsidence – Occurrence, Prediction and Control – Elsevier Science Publishers, the Netherlands, 1989.

ADVANCED SURFACE MINE PLANNING AND DESIGN

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

To learn the advancement of surface mining method.

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

UNIT I

PLANNING 10

Open-pit optimization techniques for mine geometry and output, mine development phases, quality control and conservation. Output and manpower planning; calendar planning, mine scheduling, production scheduling, truck dispatch system, design of sumps and pumping systems and drainage. Feasibility Report - Contents and preparation. Introduction: Stages/Phases of mine life; Preliminary evaluation of surface mining prospects; Mine planning and its importance; Mining revenues and costs, and their estimation; Mine planning components, planning steps and planning inputs. 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.

Production planning: Determination of optimum mine size and Taylor's mine life rule; Sequencing by nested pits; Cash flow calculations; Mine and mill plant sizing, Lanes algorithm for estimation of optimum mill cut of grade; Introduction to production scheduling.

EQUIPMENT MANAGEMENT

Selection of mining system vis-à-vis equipment system. Machine availability, productivity, maintenance, maintenance scheduling, preventive maintenance, control and monitoring inventory. Workshops for HEMM. Power supply arrangements in opencast mines.

UNIT II

GEOTECHNICAL PARAMETERS 7

Application of geotechnical investigation for design of ultimate pit slope and other design parameter, slope stability analysis including mine waste rock dumps and tailing dumps. 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 optimisation, calendar plan, production planning, production scheduling, economic productivity indices. Mine Closure plan.

UNIT III

ANALYSIS AND DESIGN OF HIGHWALL SLOPES AND WASTE DUMPS 8

Influence of pit slope on mine economics; Highwall slope stability analysis and design methodology; Stability analysis and design methodology for waste dumps.

Design of haul roads: Design of road cross section; Design of road width, curves and gradient; Haul road safety features and their design. Design of drainage system

UNIT IV

SAFETY AND ENVIRONMENT 10

Safety aspects in opencast mines regarding height, width and slope of benches, drilling and blasting, fly rock, nearby dwellings, mine illumination, gradient and other aspects of haul roads, formation of spoil dumps, tailings management etc. pollution due to noise, vibrations due to machinery and blasting, water pollution, measurement monitoring and control measures for the same, land reclamation and afforestation, environmental audit.

UNIT V

MODERN TRENDS IN OPENCAST MINES 10

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 OCM,

Placer mining and solution mining – scope of applicability, sequence of development and machinery

TOTAL: 45 PERIODS

OUTCOME:

1) The students will have insight about the advanced techniques for mine planning,
2) Geotechnical investigation and equipment management
3) Understand the modern trends in opencast mines safety and environment.

REFERENCES

1. Cummings, A.B. and Given, I.V., SME Mining Engg. Hand book Vol.I and II, New York,1994
2. Proceedings of National Seminar on Surface Mining, IME Publications/ Calcutta, 1995
3. Das, S.K., Surface Mining Technology, Lovely Prakashan, Dhanbad, 1994
4. Das, S.K., Modern Coal Mining Technology, Lovely Prakashan, Dhanbad, 1994
5. Kennedy, B.A., Surface Mining – 2nd Edition, SME, New York, 1990 6. Hustrulid, W. and Kuchta, M., (eds).,
6. Fundamentals of Open Pit Mine Planning & Design, Elsevier, 1995.

SURFACE MINE ENVIRONMENTAL ENGINEERING

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

OBJECTIVES:
1. To study the physics of mechanical ventilators and the parameters governing their performance.
2. To study various methods of ventilation data collection.
3. To study about mine illumination, pollution and ecological systems.

UNIT I
INTRODUCTION 9
Goals, strategies and tools for environmental management – systems approach to environmental management – environmental guideline – National Policies on environment with respects to mining activities – Global and Local environmental issues – resource degradation – desertification – Industrialization, Objectives of Sustainable Development. 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 II
ENVIRONMENTAL POLLUTION - I 9
Environmental Pollutants due to surface – 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, Air born dust modeling, Control and preventive measures for air pollution including for dust, , Water pollution standards, Noise standards – Measurement – Noise Impact Index assessment, Control and preventive measures for water, noise pollution. Pollution due to blast and equipment vibrations their monitoring, prevention and control.

UNIT III
ENVIRONMENTAL POLLUTION - II 9
Land pollution, land for alternation dealing with mind out land , re-vegetation, tailing management, tailing dams, method and construction, land use plan, Mine closure planning. Textural classification and properties of soil. Impact of pollution on human health, miner's diseases and their social impact.

UNIT IV
ENVIRONMENTAL MANAGEMENT 9
Environmental quality objectives, Emission and ambient standards – Minimum National standards – International environmental standards – ISO 14000 – EIA Notification – Sitting of Industries – Environmental management plans, Environmental impact assessment,

Environmental management system audits, Environmental economics – Principles of cost benefit analysis – Valuing the Environment – Environmental Accounting, Environmental administration- training awareness and competence, Mine subsidence, its prediction and control.

UNIT V

ENVIRONMENTAL LEGISLATIONS **9**

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.

TOTAL: 45 PERIODS

OUTCOME: The students will have knowledge on mechanical ventilators, influencing parameters and various methods of data collection. They will also know about illumination, pollution and ecological systems.

TEXT BOOKS:

1. Manahan S.E. Environmental Science and Technology.
2. Mackenthun, K.M. Basic Concepts in Environmental Management, Lewis Publications, London, 1998.

REFERENCES:

1. Noel de Nevers, Air Pollution Control Engg., McGraw Hill, New York, 1995
2. Anjaneyulu,Y. Air Pollution & Control Technologies, Allied Publishers (P) Ltd, India, 2002.
3. Nick Hanley, Jaison F. Shogren and Ben White. Environmental Economics – In Theory and Practice, Macmillan India Ltd, New Delhi, 1999.
4. Roger Perman, Yue Ma and James McGilvray. Natural Resources and Environmental Economics, Second edition, Addision Wesley Longman Ltd, Singapore, 1997.
5. Christopher Sheldon and Mark Yoxon, Installing Environmental Management System – a step by step guide, Earthsecan Publications Ltd, London, 1999.
6. Lee Kuhre, ISO 14001 Certification –Environmental Management Systems, Prentice Hall, USA, 1995.
7. Shyam Divan and Armin Rosencranz, Environmental Law and Policy in India, Oxford University Press, New Delhi. (2001)
8. Gregor I. Mcgregor. Environmental Law and Enforcement, Lewis Publishers, London, 1994.

MODERN SURVEYING TECHNIQUES

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

OBJECTIVE :

- 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

UNIT I

FUNDAMENTALS OF TOTAL STATION AND ELECTROMAGNETIC WAVES 9

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 9

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 9

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 9

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 9

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.

TOTAL : 45 PERIODS

OUTCOMES: At the end of the course the student will be able to understand

- various techniques available for surveying and mapping along with working principles, functioning and applications of total station and GPS instruments
- Propagation of EMR through atmosphere and corrections for its effects.
- Concepts of ALTM and working principle• Available types of ATLM sensors and components of ALTM system. Process of data acquisition, data processing and possible applications. The fundamentals of terrestrial scanners and their applications.

TEXTBOOKS:

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

REFERENCES :

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

w. e. f. 2018-2019

DESIGNING OF MINING MACHINES

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

Objectives:

- To understand the mechanisum of modern equipments used in the mines
- To design and analysis new mining machinery
- To understand the probabilistic approach for designing the mining machinery

Unit I: 9

Modern, underground mechanised mining equipment promises improved safety and productivity in both established mechanised coal operations and in hard-rock operations ,Effective management, based on sound understanding of mechanised mining systems

Unit II : 9

Selection of material and design of Winder drum, Winder braking system; Recovery of flooded mines; Dewaterin g of old working; Water blast: dangers and precautions.

Unit III : 9

Design and analysis of head gear structure; dimetions specifications
design for space constrains, determination of number of teeth, design mechanical strngth, a moore relistic strength, design for four surface resistance.

Unit IV : 9

Conveyor components, pulleys design and analysis; Design of excavator boom, bucket and bucket teeth; Selection of materials and design of wire ropes;
Design and analysis of material storage vessel and structure;

Unit V : 9

Design and analysis of gear box related to mining applications; Bearing design and selection; Design of mine ventilation fan; winch and hooks; dewatering pump; Brakes.

Course Out come:

The students will be able to understand the mechanisum , design of mining equipments used in the mines.

Text books:

1. Machine Design, V. L. Maleev and J. B. Hartman.
2. Mechanical Engineering Design, J. E. Shigley, Mischkee & R. Charles

References:

1. Design of Machine Elements, M. F. Spotts& T. E. Shamp.
2. Machine Design, Robert L. Norton.
3. Design Data Hand Book, PSG College of Technology

w. e. f. 2018-2019

ADVANCED EXPLORATION TECHNIQUES

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

AIM: To learn the mineral resources, exploration strategy, preparation and evaluation of reports.

OBJECTIVES:

- This course gives fundamental knowledge to the student on exploration of economic minerals and ores. It describes various techniques and methods used in exploration of minerals.
- To know the mineral resources and prospecting techniques
- To study the chemical properties of earth and application of chemistry in geology, to understand rock chemistry and evolution of various rock types through geochemical differentiation. Also to understand various surface guides for exploration of economical ores and minerals.
- To study the physical properties of earth and application of physics in geology, to understand subsurface features and structures for better understanding of subsurface geology. It describes various geophysical techniques and their field setup, data processing and interpretation.
- To study the prefeasibility and feasibility reports and its evaluation methods
- To understand exploration techniques and strategy and to establish mineral resources

UNIT - I

EXPLORATION **9**

INTRODUCTION TO MINERAL AND MINING INDUSTRY

Introduction to mineral exploration, mineral resources in India and worldwide, National Mineral Policy, Economic Mineral Deposits, Sampling, Geological Prospecting - field survey and mapping techniques - field equipments- methods of mapping- pits and trenches, Mineral Prospecting**,** Exploration by Diamond Drilling, Exploration Geology, Regional Planning and Organization, Topographic Survey, Geological Mapping, Stratigraphy Correlation, Exploration Geochemistry, Field Procedure, Analytical Methods, Mineral Exploration -Triangulation, Establishment of Local Base from National Grid Base- - Exploration Strategy, Groups and their role, Strategy and structure of the exploration group, government policies Exploration investment decision, exploration targets.

UNIT - II

GEO-PHYSICAL PROSPECTING **9**

Electrical Methods Scope of exploration geophysics – physical properties of the earth – Electrical methods – SP, IP, EM and Resistivity - methods of electrode arrangement – field methods resistivity, self potential methods- interpretation -application in mineral prospecting – groundwater targeting, electrical logging methods in oil exploration, **Geophysical Well Logging** — Fundamentals of radioactivity, principle of radioactivity, methods – types of counters – field methods and interpretation – Well logging - Self potential – resistivity –

radioactivity logging methods – caliper and other miscellaneous logging methods – field procedure and interpretation of data, Radioactivity Methods and Geophysical Well Logging; **Magnetic and Gravity Methods** — types of magnetometer-field survey – anomaly - interpretation and prospecting. Magnetic methods – principle - field procedure – magnetometers – interpretation of magnetic data – size and shape of bodies – correction of magnetic data - applications - airborne geophysical surveys, **Gravity Methods** Principle – field methods – gravimeters – corrections – interpretation of gravity data – determination of shape and depth of ore bodies — corrections & applications – GRACE mission - gravity methods- gravimeter-identification of size and shape of bodies-correction of the data-application in mineral exploration, **Seismic Methods —**Seismic waves – travel velocity in various geological formations – principles – field operation – refraction and reflection survey – correction of seismic data – methods of interpretation – determination of altitude and depth of formations – various types of shooting. interpretation of seismic data- application-identification of geological structures-oil fields location.

UNIT - III

GEO-CHEMICAL PROSPECTING **9**

Geochemistry of Minerals, Rocks And Waters — Mineral stability, compositional changes in minerals. River water, Seawater, Seafloor hydrothermal systems; Groundwater and Lakes. Characteristics of Magma, Melting of rocks, Water in Magmas, eutectic and melting. Distribution of trace components between rocks and melts. **Principles of Geochemistry** — Introduction, Geochemistry of the Earth; Formation of the solar system and geochemical history of the earth, geochemical cycle- Distribution of elements in rocks and soils. **Geochemical Prospecting —** anomaly- background values- mobility of ions-associated elements-path finder elements-surface indicators - geobotanical methods. **Exploration Geochemistry —** Introduction – Primary dispersion pattern, Secondary dispersion pattern – background values. Geochemical anomaly – geochemical sampling. Principles and techniques used in the design and implementation of an exploration geochemical survey. Anthrosphere aquatic environment – Marine, fluvial, lacustral, aerosols. Perturbations caused by human activity. **Isiotope Geochemsirty** Radioactive Decay, Determining Isotope Decay time, Potassium-Argon Systematic, Uranium, Thorium - Lead Systematics. Types of Isotope-Fractionation, isotope Exchange between minerals and water, Carbon, Oxygen and Sulphur isotopes, First-order decay and growth equations.

UNIT -IV

GEO-STATISTICAL METHODS **9**

Practice of semi-variogram modelling; practice of kriging - steps and procedure. Ordinary Kriging: definition, point/block estimation procedures, techniques of semi-variogram model fitting; Geo-statistical evaluation scheme; Effect of Nugget variance on kriged weights. Brief capsule on Non-linear and Non-parametric Geo-statistics: Lognormal, Disjunctive and Multi-Gaussian, Indicator and Probability Kriging. Concepts of Geo-statistics; Semi-variogram : definition, derivation and characteristics and properties. Derivation and solving kriging system of equations for point and block. Geostatistical conditional simulation – Theory and approach, techniques and applications with special reference to Simulated Annealing Simulation. Relation with Co-variogram characteristics; Calculation of Experimental Semi-variograms in One, Two and Three- Dimensions calculation procedures. Computation of semi-variograms; mathematical models of semi-variogram associated difficulties (Models with Sill and without Sill, Nested Models and Trend Models.) viz. anisotropy, non-stationarities, regularisation, presence of nugget effect and presence of trend.; Techniques of semi-variogram model fit.

UNIT - V

ORE-BODY MODELLING, ORE RESERVE ESTIMATION and preparation o f project reports

9

Mineral Reserve Estimation — Reserves and Resource, classification of mineral deposits – Geological / Techno economic Considerations in Reserve Classification - Reserve Estimation Methods – Surface and Underground Deposits, **Orebody Modelling —**Integrating Surface/ Underground mapping Drilling Sampling to evolve a 3D Model - Fold/Fault Interpretation from Maps and Bore hole Data - GIS Applications in mining and Mineral Projects, **Preparation and Evaluation of Project Reports —** Evaluation of exploration and development projects, study of typical pre-feasibility and feasibility reports.

TOTAL: 45 PERIODS

OUTCOME:

- Better understanding on geochemistry of rocks and minerals and interpretation of geochemical path finders for economical minerals and ores.
- Better understanding on geophysical anomalies, interpretation of subsurface features and modelling of geological structures.
- The student will be having thorough knowledge on various geophysical and geochemical prospecting techniques.
- The students will be able to choose the proper techniques of exploration and estimation of the reserves.
- The students will be able to choose the proper techniques of exploration and estimation of the ore reserves.
- The students will have knowledge about the, exploration techniques and its strategy.
- They will have knowledge of different mineral processing techniques.
- They will know about the methods of preparation of feasibility reports and its evaluation techniques.
- This course gives additional knowledge to the student on prospecting of economic minerals and ores.

REFERENCES

Exploration and prospecting

1. Butterworth-Heinemann, Aspects of Ore Treatment and Mineral Recovery, , 8th Edition, 2015.
2. Chaussier, J.B., and Mores, J Mineral Prospecting manual, North Oxford Academic press,1987.
3. Haldar, S. K., Mineral Exploration Principles and Applications, Elsevier,First Edition, 2013.
4. Kuzvart, M. and Bohmer, M., Prospecting and Exploration of Mineral Deposits, Elsevier Science Publishers, 1993.
5. Lahee, Field geology, CBS pub, New Delhi, 1987.
6. Moon C J., Whateley M K.G. & Evans A M., Introduction to Mineral Exploration, Blackwell Publishing, Second Edition, 2012

Geo-physics

7. Arnaud Gerkens, J. C. d'. Foundation of exploration geophysics. Amsterdam ; New York : Elsevier ; New York, NY, U.S.A, 1989.

8. Bhattacharjee, S., Frontiers in Exploration Geophysics Oxford and IBH Publishing Company, 1992. 109
9. Burger, H.R., Exploration Geophysics of the Shallow Subsurface, Prentice Hall, 1992.
10. Butler, B.C.M and Bell, J.D, interpretation of geological maps, Longman Scientific & technical Publ.,1st ED., New Delhi, 1988.
11. Dobrin, Geophysical prospecting, McGraw hill, New Delhi ,1981.
12. Dobrin, M.B An introduction to geophysical prospecting, McGraw Hill, New Delhi,1984
13. Rama Rao, B.S and Murthy I.B.R Gravity and magnetic methods of prospecting. Arnold Heinmann Pub. New Delhi, 1978.
14. Ramachandra Rao, M.B. Outline of geophysical prospecting. Wesley press, Mysore, 1975

Geo-Chemistry

15. Arthur Brownlow, Geochemistry (Second edition), Pearson Education, INC., Australia, 1996.
16. Faure, G., Principles and applications of Geochemistry, Pearson Education, INC, Australia, 1998.
17. John V. Walther, Essentials of Geochemistry, Jones and Bartlett Publishers, 2005, Boston.
18. Mason, B., Introduction to geochemistry, John Wiley, USA, 1982.

MATERIAL HANDLING

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

AIM: To study the various handling systems deployed in mineral industry.
OBJECTIVES: To introduce the basic principles in material handling and its equipment

- To study the conveyor system and its advancement•

UNIT I
BULK HANDLING SYSTEMS **9**

Basic principles in material handling exclusive to mining industry and its benefits. Classification of material handling equipments. Current state of art of bulk handling materials in mining in the world and Indian scenario; Selection of suitable types of systems for application. Stacking, blending, reclaiming and wagon loading, machinery and systems used at the stack yards; stock piles, silos, bunkers – their design, reclamation from them, various types of weigh bridges. Segregation - size wise and grade wise, Railway sidings.

UNIT II
SHORT CONVEYORS AND HAULAGE SYSTEMS **9**

Roller conveyor, overhead conveyor, screw conveyor, auger conveyor, apron feeder, bucket elevators, scraper haulage, conveyors in steep gradient, Armoured face conveyor, Off-highway Trucks, haul roads, In-pit crushers and modular conveyors, electric trolley assisted haulage, shuttle cars, skip hoist, winders, LHD's, pneumatic conveying, hydraulic transport.

UNIT III BELT CONVEYOR SYSTEM **9**

Design, capacity, calculations with respect to the size, speed, troughing, power requirement, tension requirement, belt selection, factor of safety; developments in the design, of various components of belt conveyor systems such as; structures, rollers, gear boxes and motors, drums and pulleys, belting, ancillary components and safety gadgets.

UNIT IV
NEW TYPES OF BELT CONVEYOR SYSTEMS **9**

Curved conveyors, cable belts, pipe conveyors, rock belts – mine-run-rock conveyor, steel belt conveyors, steel slot conveyor, chain belt conveyors, etc., and other new developments, stackers and reclaimers, Different types of High Angle Conveyors (HAC); New inventions in HAC , Mobile or fixed installations; Woven wire belts, En Masse conveyor, Vibrating conveyor, gravity bucket conveyor. Pneumatic and hydraulic transport systems. Safety and control devices.

UNIT V

MATERIAL HANDLING IN MINES, PLANTS AND WORKSHOPS 9

Mobile cranes, derrick cranes, pillar cranes, tower cranes, radial cranes, bridge cranes, fork lifters, over head gantry material handling in workshops. Mineral handling in dimensional stone quarries, Mineral handling plants(coal, etc.,) Locomotives, rail tracks, rail cars, railways wagons; Aerial ropeways, gravity ropeways; Containers and shipping; Rope haulage - different types.

TOTAL: 45 PERIODS

OUTCOME: The students will get exposure towards the material handling methods and systems and its principle to convey the minerals or materials from mines, plants and workshops.

TEXT BOOKS:

1. Allegri (Sr.), T.H., Material Handling – Principles and Practices, CBS Publishers and Distributors, Delhi, 1987.
2. Hustrulid, W., and Kuchta, M. Open Pit Mine Planning & Design, Vol. 1, Fundamentals, Balkema, Rotterdam, 1998.
3. Peng, S.S., and Chiang, H.S., Longwall Mining, John Wiley and Sons, New York, 1984.
4. Hartman, H.L., (Ed.), SME Mining Engg. Handbook Vol.I and II, Society for Mining, Metallurgy, and Exploration, Inc., Colorado, 1992. 105

REFERENCES:

1. Kennedy, B.A., Surface Mining – 2nd Edition, SME, New York, 1990.
2. Deshmukh, D.J., Elements of Mining Technology, Vol.I, II and III, EMDEE Publishers, Nagpur, 1979.
3. Vorobjev, B.M., and Deshmukh, R.T. Advanced coal Mining, Vol.I and II, Mrs Kusum Deshmukh, P.O. Indian School of Mines, 1966.
4. Woodruff, S.D., Methods of Mining, Working, Coal and Metal Mines, Vol.II and III, Pergamon Press, 1968.
5. Sinclair, J., Winding and Transport in Mines, Sir Isaac Pitman and Sons, Ltd., London, 1959.

GEO-STATISTICS

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

Aim: To study various Geo-statistics techniques and their applications to mineral industry
Objectives:

UNIT - I
STATISTICS **9**

Theoretical models of Statistical distributions, viz. Normal (Gaussian), Lognormal, Binomial, Negative Binomial, Exponential and Poisson and their applications in resource evaluation; Characteristics and properties of Normal (Gausian) and Lognormal Probability Distributions, Graphical and Numerical Techniques of Model Fitting, Estimation of Distribution Parameters and their applications in Ore Evaluation. Geostatistical Concepts and Theories: Regionalized Variable Theory, Geostatistical Schools of Thought, viz. American, South African and French; Stationarity assumptions – Strict Stationarity, Second Order Stationarity and Intrinsic Hypothesis.

Overview of Deterministic and Probabilistic models of Estimation; Exploratory data analysis. Classical what, when and why of geo-statistics. Extension, estimation and dispersion variance; calculation by discretisation and auxiliary functions.

UNIT - II
GEOSTATISTICS **9**

Practice of semi-variogram modelling; practice of kriging - steps and procedure. Ordinary Kriging: definition, point/block estimation procedures, techniques of semi-variogram model fitting; Geo-statistical evaluation scheme; Effect of Nugget variance on kriged weights.

Brief capsule on Non-linear and Non-parametric Geo-statistics: Lognormal, Disjunctive and Multi-Gaussian, Indicator and Probability Kriging.

Concepts of Geo-statistics; Semi-variogram : definition, derivation and characteristics and properties. Derivation and solving kriging system of equations for point and block. Geostatistical conditional simulation – Theory and approach, techniques and applications with special reference to Simulated Annealing Simulation. Relation with Co-variogram characteristics; Calculation of Experimental Semi-variograms in One, Two and Three-Dimensions calculation procedures. Computation of semi-variograms; mathematical models of semi-variogram associated difficulties (Models with Sill and without Sill, Nested Models and Trend Models.) viz. anisotropy, non-stationarities, regularisation, presence of nugget effect and presence of trend.; Techniques of semi-variogram model fit.

UNIT - III
SAMPLING METHODS- 9

Theory and Concepts. Classical Statistical methods: Uni-variate and Bi-variate; Exploratory data analysis. Probability distributions: (i) Continuous distributions, viz. Normal (Gaussian), and Lognormal distributions and their fit to a sample distribution; (ii) discrete distributions, viz. Binomial, Negative binomial and Poisson distributions.

UNIT - IV

ADVANCED GEOSTATISTICS 9

Practical difficulties associated with semi-variography, viz. anisotropy, non-stationarity, regularisation, misclassified tonnage; grade control plan. presence of nugget effect and presence of trend. Extension, Estimation and Dispersion variances: definitions, methods of calculations and applications; Screen Effect.

UNIT - V

GEO-STATISTICAL APPLICATIONS: 9

Optimisation of exploration drilling, calculation of mineral inventory, establishment of grade-tonnage relations, calculation and planning cut-off grade; misclassified tonnages; geo-statistical grade control plan.

Practical applications of Geo-statistics in geotechnical investigation, hydrocarbon exploration and reservoir modelling with case studies. Geo-statistical case studies of selected mineral deposits.

Outcome:

Text Books:

1. Sarma, D.D. Geostatictics with Applications in Earth Sciences, Springer Publications, 2009.
2. Journel, A.G. and Huijbregts, Ch. J., Mining Geostatictics, Academic Press, 1981.
3. Andereson, F. Geostatictics by Example Approach using R.

w. e. f. 2018-2019

FINITE ELEMENT ANALYSIS

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

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To appreciate the use of FEM to a range of Engineering Problems.

UNIT I
INTRODUCTION **9**

Background - General description of the method - Analysis Procedure. Node numbering – Mesh generation - Linear constitutive equations - Plane stress, Plane strain and axisymmetric cases of elasticity - Energy principles - Variational methods – Raleigh-Ritz method – Galerkin Method.

UNIT II
ONE DIMENSIONAL PROBLEMS **9**

Finite element modelling – Coordinates and shape functions – Linear and quadratic elements - Applications to axial loadings of rods – Extension to plane trusses – Bending of beams Element, Finite element formulation of stiffness matrix and load vectors – Assembly for global equations – Boundary conditions.

UNIT III
TWO DIMENSIONAL PROBLEMS **9**

Convergence requirements - Constant Strain Triangular (CST) Element – Rectangular Element -Finite element modelling - Element equations, Load vectors and boundary conditions – Assembly - shape functions from Lagrange and serendipity family— Application to heat transfer.

UNIT IV
ISOPARAMETRIC FORMULATION **9**

Introduction – Coordinate Transformation –Basic theorem of Isoparametric concept – Uniqueness of mapping – Isoparametric, Subparametric and Superparametric elements – Assembling Stiffness matrix – Numerical Examples.

UNIT V
APPLICATIONS **9**

Application of displacement finite elements to the analysis of simple problems (one and two dimensional cases) in the area of structural mechanics. Computer Programs: Development of computer programs for an axial and beam bending elements – Programming and use of computer packages for design of underground excavations, mining structures, slope and dump stability, design of supports, etc..

Theory: Total: 45 Periods

OUTCOMES: Upon completion of this course, the students can able to understand different• mathematical Techniques used in FEM analysis and use of them in Structural and thermal problem.

TEXT BOOK:

1. J.N.Reddy, "An Introduction to the Finite Element Method", 3rd Edition, Tata McGrawHill, 2005.

REFERENCES

1. Krishnamoorthy, C.S, Finite Element Analysis Theory & Programming, McGraw-Hill, 1995.
2. Desai C.S and Abel,, J.F., Introduction to Finite Element Method, Affiliated East West Press Pvt. Ltd., New Delhi, 2000
3. Chandrupatla T.R., and Belegundu A.D., "Introduction to Finite Elements in Engineering", Pearson Education, 2011, 4th Edition.
4. Bhavikkatti, S.S. Introduction to Finite Element Analysis –Newage International (P) Limited Publishers, New Delhi, 2011.
5. Seshu, P., Textbook of Finite Element Analysis. New Delhi: Prentice-Hall of India, 2006.
6. Bathe. K.J., "Finite Element Procedure", Prentice Hall of India, New Delhi, 2006.
7. Logan, D.L., "A First course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002
8. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002.
9. Rao, S.S., "The Finite Element Method in Engineering", 3rd Edition, Butter worth Heinemann, 2004
10. Chandrupatla, R & Belagundu, A.D. "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice Hall College Div., 1990.
11. Cook R.D., "Concepts and Applications of Finite Element Analysis", John Wiley and Sons Inc., New York, 1989.
12. Zienkiewicz, O.C., Taylor, R.L. and Zhu, J.Z. "The Finite Element Method : Its Basics and Fundamentals", Seventh Edition, Volumes 1 &2, Elesevier Publications, 2013.

EE3005 *w. e. f. 2018-2019*

RELIABILITY ENGINEERING

Instruction	: 3 Periods / Week
Duration of Univ. Examination	: 3 Hours
SEE	: 70 Marks
CIE	: 30 Marks

UNIT I

Discrete and Continuous Random Variables - Binomial, Poisson, Normal, Lognormal, Exponential and Weibull distributions - Causes of failure - Failure rate and Failure density - Reliability and MTTF.

UNIT II

Maintainability and Availability - MTBF and MTTR - Reliability block diagram - Series and parallel systems -Redundancy - Standby system with and without imperfect switching device - r out of n configuration.

UNIT III

Morkov models - Reliability models of single unit, Two unit, Load shared and Standby systems - Reliability and availability models of the above systems with repair. Frequency of failures - State transition matrices and solutions - Accelerated life testing.

UNIT IV

Chi-square distribution - Confidence limits for Exponential and Normal distributions - Applications of Weibull distribution and ML estimates - Goodness of fit test - Preventive maintenance - Reliability and MTTF - Imperfect maintenance - Age replacement policy.

UNIT V

Power system reliability – Outage definitions - Morkov model of a generating plant with identical units and un-identical units - Capacity outage probability table – Cumulative frequency -LOLP and LOLE.

Suggested Reading:

1. Charles E. Ebeling, An Introduction to Reliability and Maintainability Engineering, McGraw Hill International Edition, 1997.
2. Endrenyi, Reliability Modelling in Electrical Power Systems - John Wiley & Sons, 1980.
3. Roy Billington and Ronald N.Allan, Reliability Evaluation of Engineering Systems Plenum Press, NewYork,1992.
4. Roy Billington and Ronald N.Allan, Reliability Evaluation of Power Systems, Plenum Press, NewYork, 1996.

ME2206 **COMPUTATIONAL FLUID DYNAMICS**

Instructions	: 3 periods/week
Duration of university Examination	: 3 hours
SEE	: 70 Marks
CIE	: 30 Marks

Objectives:

1. To convert the conservation equations of fluid flow in differential form into algebraic equations and apply numerical methods to obtain solutions.
2. To learn the finite difference method.
3. To learn finite volume method and solution methodology for fluid flow problems.

UNIT-I

Review of basic equations of fluid dynamics: Continuity, Momentum and Energy equations, Navier Stokes equations, Reynolds and Favre averaged N – S equations. Differential equations for steady and unsteady state heat conduction. Differential equations for diffusion. Introduction to turbulence, Turbulence models-mixing length model, K- turbulence Model.

UNIT-II

Classification of PDEs – Elliptic, parabolic and hyperbolic equations. Initial and boundary value problems. Concepts of Finite difference methods – forward, backward and central difference. Errors, Consistency, Stability analysis by von Neumann. Convergence criteria.

UNIT-III

Grid Generation- Types of grid O,H,C. Coordinate transformation, algebraic methods. Unstructured grid generation.

UNIT-IV

Finite difference solutions-Parabolic PDEs – Euler, Crank Nicholson, Implicit methods, Elliptic PDEs – Jacobi, Gauss Seidel, ADI, methods. FD- solution for Viscous incompressible flow using Stream function – Vorticity method & MAC method.

UNIT- V

Introduction to Finite volume method. Finite volume formulations for diffusion equation, convection diffusion equation. Solution algorithm for pressure velocity coupling in steady flows. Use of Staggered grids SIMPLE Algorithm.

Suggested Reading:

1. Pradip Niyogi, Chakrabartty SK, Laha M.K., Introduction to Computational Fluid Dynamics‟‟, Pearson Education, 2005.
2. Muralidhar K, Sundararajan T, „Computational Fluid flow and Heat transfer‟‟, Narosa Publishing House, 2003.
3. Chung, T J, „Computational Fluid Dynamics‟‟, Cambridge University Press, 2002.
4. John D Anderson, „Computational Fluid Dynamics‟‟, Mc Graw Hill, Inc., 1995.
5. Patankar, S.V, „Numerical Heat transfer and Fluid flow‟‟, Hemisphere Publishing Company, New York, 1980

CE 1316

GEO-ENVIRONMENTAL ENGINEERING

Pre-requisite **:Soil Mechanics / Env. Engg of BE / B.Tech-Civil Engg.**

Instructions **: (L/T/S/P) 3 theory periods per week (3/0/0/0)**
Duration of University Examination **: 3 Hours**
University Examination **: 70 Marks**
Sessionals through continuous evaluation (Two midterm assessments) **: 30 Marks**

Course Objectives

- To understand the necessity and scope of safe waste disposal systems
- To gain comprehensive understanding about the planning and design of waste disposal systems
- To learn the analysis and design of applications of Geosynthetics in Geo-environmental applications.

Course Outcomes

- Competence in identifying the requirements of a safe waste disposal system
- Ability to analyse and design the Geo-environmental application of geosynthetics
- Competence in construction practices and evaluation of post construction improvement

UNIT – I

Wastes: source, production and classification of wastes, soil pollution processes, waste characterization.

UNIT – II

Waste disposal facilities such as landfills and impoundments, slurry walls, landfill planning and design.

Barrier systems – basic concepts, design and construction, stability, compatibility and performance contaminant transformation and transport in subsurface.

UNIT – III

Monitoring surface contamination, stabilization, and modification of wastes.

Reuse of waste materials, contaminated site remediation. Case studies in waste handling.

UNIT – IV

Soil erosion and conservations – causes of soil erosions, factors contributing to erosion – climatic factors, topographical factors, vegetation factors. Erosion control – cropping systems, gullies, check dams, contouring, wind striping, ridging, bank protection.

UNIT – V

Application of Geosynthetics : Introduction – Classification & Functions of Geosythetics – Over view of Geotextiles, Geogrids, Geonets, Geomembranes and Geocomposites.

Geosynthetics in Geo-environmental Engineering : Capping & Lining – Design requirements – Case studies.

Suggested Reading:

1. Daniel, D. E. Geotechnical practice for waste disposal, Chapman and Hall, London 1993
2. Rowe, R. K., Quigley, R. M. and Booker, Clay barrier systems for waste disposal facilities, J.R., E & FN Spon, London, 1995
3. Reddi, L. N., and Inyang, H. F. Geoenvironmental Engineering – principles and applications, Marcel Dekker, 2000
4. Bagchi, A. Design, construction and monitoring of landfills, John Wiley & Sons, New York 1994
5. Sharma, H. D. and Lewis, S. P., Waste containment systems, Waste stabilization and landfills: Design and evaluation John Wiley & Sons, New York 1994
6. Koener, R.M. (2012), "*Designing with Geosynthetics, Vol.1 & 2,* Xlibriss Corporation LLC.

CE 1218

MODELS OF AIR AND WATER QUALITY

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

Course Objectives:

- Description of the concepts of water and air pollution
- Exposure to the principles of modeling and their application to water bodies
- An overview regarding reservoir sedimentation

Course Outcomes:

- Capable of analyzing stream water and air quality issues along with the modeling techniques and standards
- Capable to estimate the reservoir sedimentation problems and apply various methods to control them

UNIT – I

Introduction: Water pollutants and their sources Stream sampling – hydrological factors affecting the stream self – purification. Steady state conservative system, steady state with non-conservative pollutants.

UNIT – II

Stream pollution modeling concepts: Measurement of BOD – Streeter Phelp's equation – Effect of temperature on BOD, Kinetic reaction rate – Stream re-aeration. Analysis of DO Sag curve by Streeter – Phelps equation method, statistical method.

UNIT – III

Water Quality of Lakes and Reservoirs: Mass balance model, Phosphorus model, Thermal stratification, Eutrophication of lakes.

Reservoir sedimentation: Determination of sediment yield, measurement of suspended load, Bed load estimation by empirical methods, control of sedimentation

UNIT – IV

Air Pollution: Sources and effects, scales of concentration, classification and properties of air pollutants effects of air pollution and air pollution standards, dispersion of air pollutants. Meteorological aspects of air pollution and atmospheric stability

UNIT -V

Plume behavior, modeling of air pollution: Gaussian plume model – determination of maximum ground level concentration due to elevated source pollutants. Limitations of Gaussian model, effective stack height concept and estimation of plume rise**.**

Suggested Reading:

1. Keily Gerard (1998), 'Environmental Engineering' McGraw-Hill International Publishers, London.
2. Fischer, H.B., E. John List, Robert C.Y. Koh, Jorg Imberger, and Norman H. Brooks(1979), 'Mixing in Inland and Coastal Waters' Academic Press Inc., New York.
3. Nelson Leonard Nemerow (1974), 'Scientific Stream Pollution Analysis' McGraw-Hill Publishers.
4. Wurbs, R. A. and James, W.P.(2002), 'Water Resources Engineering', Prentice-Hall of India, New Delhi.
5. Graf, W.H. (1971), 'Hydraulics of Sediment Transport', McGraw-Hill Book company, New York
6. Yalin, M.S. (1997), 'Mechanics of Sediment Transport', Pergaman Press, Oxford.

CE 1203

GROUNDWATER ENGINEERING

Instruction	**: 3 periods per week**
Duration of University Exam	**: 3 hours**
CIE	**: 30 marks**
SEE	**: 70 marks**
Credits	**: 3**

Course Objectives:

- A pathway to understand the basic physical principles of groundwater flow, differential equations, boundary condition and groundwater quality.
- Knowledge of various aspects of recharge of groundwater.
- Exposure to use the numerical solutions to solve problems with complex realistic situations.

Course Outcomes:

- Knowledge of groundwater hydrology and hydraulics of the movement of water in aquifers to manage groundwater resources.
- Use of knowledge and skill for the enhancement of human welfare.
- Ability to deal with more realistic situations to solve problems pertaining to groundwater quality.
- Conduct simulation studies for future state of groundwater systems, optimal protection and rehabilitation strategies

UNIT-I

Introduction: Ground water in hydrologic cycle, Distribution of subsurface water, ground water potential, occurrence of groundwater in hydro geologic formations, components of groundwater studies, Darcy's law and its validity.

Governing equations of groundwater flow in aquifers: 3-D Ground water flow equations in Cartesian and polar coordinates, equations for steady radial flow into a well in case of confined and unconfined aquifers, equations for effect of uniform recharge in a fully penetrating unconfined aquifer, well flow near aquifer boundaries.

UNIT-II

Equations for unsteady radial flow into a well in case of confined aquifer, determination of Storage coefficient and Transmissibility(S and T) by Theis's graphical method, Cooper-Jacob's and Chow's method. Image well theory, partial penetration of wells, multiple well system.

UNIT-III

Artificial recharge of aquifers: Introduction, current trends in artificial recharge, spreading methods, injection wells, technical feasibility and economic viability.

Geophysical methods in groundwater Exploration: surface geophysical methods: electrical resistivity method, seismic method, magnetic method, determination of aquifer thickness.

UNIT-IV

Quality of groundwater and seawater intrusion in coastal aquifers: Dissolved constituents in groundwater and their effects, fluctuations in groundwater, mechanism of salt water intrusion, Ghyben-Herzberg relation, slope and shape of the interface, prevention and control of seawater intrusion, case studies involving sea water intrusion.

UNIT-V

Models in ground water analysis: Major applications of ground water models, sand models, viscous fluid models, membrane models, thermal models, electric-Analog models, numerical modeling of ground water systems.

Suggested Reading:

1. Ven-Te-Chow, (1964) 'Hand book of Applied Hydrology', McGraw-Hill Book Company, New York.
2. Todd, D.K. (1980) 'Groundwater Hydrology', John Wiley and Sons, New York.
3. Karanth, K. R. (1987) 'Groundwater Assessment, development and Management', Tata Mc Graw – Hill publishing company New Delhi.
4. Raghunath H.M,(1982), 'Ground water' Wiley Eastern Ltd, New Delhi.
5. Wang Herbert. F. and Anderson Mary. P.(1995), 'Introduction to groundwater modeling; FDM and FEM', Academic Press, New York.
6. Rastogi, A.K. (2007) 'Numerical Groundwater Hydrology', Penram International publishing (India) Pvt Ltd.

GROUND IMPROVEMENT TECHNIQUES

Pre-requisite : Soil Mechanics of BE / B.Tech-Civil Engg.
Instructions : (L/T/S/P) 3 theory periods per week (3/0/0/0)
Duration of University Examination : 3 Hours
University Examination : 70 Marks
Sessionals through continuous evaluation
(Two midterm assessments) : 30 Marks

Course Objectives

- To understand the objectives, necessity and scope of ground improvement techniques
- To learn different methods of insitu densification of cohesive, cohesionless soils
- To learn the classification, functions and applications of Geosynthetics in ground improvement
- To learn the process of identification of necessity for ground improvement, finding alternative methods and recommendation of the ideal technique through case studies

Course Outcomes

1) Ability to understand the necessity of ground improvement and potential of a ground for improvement
2) To gain comprehensive understanding about the improvement of in-situ cohesive soils as well as Cohesion less soils
3) Competence to analyse an in-situ ground, identification of ground improvement techniques feasible, selection of the ideal method, its planning , design, implementation and evaluation of improvement level

UNIT – I

General : Formation of rock, soils and soil profiles, soil distribution in India and other countries - marine, black cotton soils (expansive)., lateritic, alluvial, desert soils peat etc., factors affecting the alteration of ground after formation – natural and man-made – reclaimed soils – methods of geotechnical processes.

UNIT – II

Compaction methods: moisture density relations – compactive efforts – field methods – surface compaction, deep compactions- vigor compaction methods, vibro-probes, stone columns, sand compaction, stone column piles, selection of methods – quality control – specifications for compaction process for solving field problems.

UNIT – III

Drainage methods: seepage, ground water seepage control – filter requirements methods of dewatering – well point methods of discharge computations – design of steps for dewatering – design of well screens – selection of pumps and accessories – deep bored wells.

Precompression methods: compressibility and consolidation properties of soils estimation of rate of consolidation settlements – accelerating methods – monitoring compressions – design of vertical drains – consolidation by electro osmosis and vacuum compression methods.

UNIT – IV

Grouting and injection methods: principles, design methods, selection of methods and requirements. Aspects of grouts, types of grouts and chemical applications, seepage control, solidification and stabilization – equipment and accessories used – quality control – specifications for achieving satisfactory results.

UNIT – V

Stabilization methods: mechanical, cement, lime, chemical methods of stabilization of soils – use of admixtures – polymers – geosynthesis – reinforcements thermal slurry trenches, void filling – prewetting – improving rock stability methods – exercise quality control to achieve desired results.

Suggested Reading:

1. J.E. Bowles – Foundation Design & Analysis.McGraw-Hill Edition 1995.
2. Ground improvement techniques by P. Purushottam Raj, Laxmi Pub., 1999.
3. F. S. Fang Handbook of Foundation Engg. CBS Pub., 1985.

MINE SYSTEMS ENGINEERING

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

To study the application system engineering concept in mining industry.

OBJECTIVES: To know basic of system engineering concept and analysis
To study the various techniques of operations research, simulation and network analysis

UNIT I
INTRODUCTION **9**
Introduction to systems engineering, systems concept and analysis, models in systems analysis, tools and methodology of system analysis.

UNIT II
OPERATIONS RESEARCH **9**
Introduction to operations research, introduction to linear programming, application to mineral industry.

UNIT III
SIMULATION TECHNIQUES **9**
Introduction to Monto-carlo sampling and deterministic simulation of different mining subsystems and total system, simulation application for equipment selection and production scheduling.

UNIT IV
NETWORK ANALYSIS **9**
Network analysis, monitoring and control of developmental activities in mining project by CPM and PERT.

UNIT V
MISCELLANEOUS **9**
Inventory of mineral resources, basic models and optimisation, introduction to statistical decision theory and its application in mineral industry.

TOTAL : 45 PERIODS

OUTCOME: The students will learn the concept of system engineering and applicability in mining field.

REFERENCES

1. Syal, I.C., and Gupta, B.P., Computer Programming and Engineering Analysis, A.B., Wheeler and Company, Madras 1986.
2. Anon., Management by Network Analysis, The Institution of Engineers (India), 1976.
3. Rao, S.S., Finite Element Methods in Engineering, Pergamon Press, 1982.
4. Cummings, A.B., and Given I.V. SME Mining Engg., Handbook Vol I and II, SME-41 ME, Inc, New York, 1973.

ENGINEERING RESEARCH METHODOLOGY

No. of Credits	**: 3 Credits**
Instruction	**: 3 Periods per week**
Duration of University Examination	**: 3 Hours**
Semester End Evaluation	**: 70 Marks**
Continuous Internal Evaluation	**: 30 Marks**

Course Objectives:

- Learn the research types, methodology and formulation.
- Know the sources of literature, survey, review and quality journals.
- Understand the research design for collection of research data.
- Understand the research data analysis, writing of research report and grant proposal.

Course Outcomes:

- Differentiate the research types and methodology.
- Able to do literature survey using quality journals.
- Able to collect research data.
- Process research data to write research report for grant proposal.

UNIT - I

Research methodology: Objectives and motivation of research - Types of research - Research approaches - Significance of research - Research methods verses methodology - Research and scientific method - Importance of research methodology - Research process - Criteria of good research - Problems encountered by researchers in India - Benefits to the society in general. Defining the research problem: Definition of research problem - Problem formulation - Necessity of defining the problem - Technique involved in defining a problem.

UNIT – II

Literature survey: Importance of literature survey - Sources of information - Assessment of quality of journals and articles - Information through internet.

Literature review: Need of review - Guidelines for review - Record of research review.

UNIT – III

Research design: Meaning of research design - Need of research design - Feature of a good design - Important concepts related to research design - Different research designs - Basic principles of

experimental design - Developing a research plan - Design of experimental set-up - Use of standards and codes.

UNIT – IV

Data collection: Collection of primary data - Secondary data - Data organization - Methods of data grouping - Diagrammatic representation of data - Graphic representation of data - Sample design - Need for sampling - Some important sampling definitions - Estimation of population - Role of statistics for data analysis - Parametric vs. non parametric methods - Descriptive statistics - Measures of central tendency and dispersion - Hypothesis testing - Use of statistical softwares.

Data Analysis: Deterministic and random data - Uncertainty analysis - Tests for significance - Chi-square - Student's t-test - Regression modeling - Direct and interaction effects – ANOVA - F-test - Time series analysis - Autocorrelation and autoregressive modeling.

UNIT - V

Research report writing: Format of the research report – Synopsis – Dissertation - Thesis - Its differentiation – References – Bibliography – Webliography - Technical paper writing - Journal report writing - Making presentation - Use of visual aids.

Research proposal preparation: Writing a research proposal and research report - Writing research grant proposal.

Suggested Reading:

1. C.R Kothari, "Research Methodology, Methods & Technique", New Age International Publishers, New Delhi, 2004.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, Chennai, 2011.
3. Ratan Khananabis and Suvasis Saha, "Research Methodology", Universities Press, Hyderabad, 2015.
4. Y.P. Agarwal, "Statistical Methods: Concepts, Application and Computation", Sterling Publishing Pvt. Ltd., New Delhi, 2004.
5. Vijay Upagade and Aravind Shende, "Research Methodology", S. Chand & Company Ltd., New Delhi, 2009.
6. G. Nageswara Rao, "Research Methodology and Quantitative methods", BS Publications, Hyderabad, 2012.

MINING ENGINEERNIG LAB

Instructions	**: 3 Lab periods per week**
Duration of University Examination	**: 2 Hours**
Sessionals	**: 50 Marks**
No. of Credits	**: 2**

Objectives:

- Expose the students to different types of soils that present as overburden on mines
- Understand the determination of coefficient of permeability that govern the seepage in mines
- Make the students to relate theoretical concepts in doing lab tests.

Outcomes:

- Competence in performing the laboratory experiments on soil specimen, analyse the results, interpret and validate the same
- Greater insight in to the soil behavior and hence enhanced understanding of soil mechanics
- Ability to model a field application in the laboratory to take up research

1. Identification tests

(a) Sieve analysis- Wet and dry hydrometer analysis-LL,PL,
PI- Activity- Relative density- field application tests.

2. Permeability Tests:
   (a) Falling and constant head tests – Their implications –correlation w.r.t. grain size, viscosity- void ratio and temperature
   (b) Determination of ‘k’ for layered soils- Horizontal and Vertical

3. Shear strength of soils.
   (a) Direct Shear Test
   (b) Unconfined Compression Test
   (c) Vane shear test
   (d) Tri-axial test

4. Ground Improvement techniques:
   (a) Soil stabilization methods-cement,Ca,k,etc.
   (b) Grouting tests-equipments.
   (c) Geo textiles- Geo fabrics & synthetics-metallic-determination of their basic properties-soil reinforcement tests (friction).

4. Rock Specimen preparation:
   (a) Core Drilling procedure
   (b) Core Cutting and grinding
   (c) Core Polishing and Lapping

5. Tests on Rock
   (a) Specific Gravity, Porosity and Water Absorption tests
   (b) Uni-axial Compression test
   (c) Tensile test
   (d) Determination of Modulus of Elasticity
   (e) Explanation of True Triaxial Compression Test for Rocks

6. Engineering Characterization of Rock :
   (a) Computation of CRR and RQD
   (b) Rock Mass Rating (RMR)
   (c) Engineering Classification of Rock Mass

WATER RESOURCES LABORATORY EXPERIMENTS

1. Experiment on Determination of infiltration parameters of Soil in site
2. Determination of Drawdown due to yield from single well from model Aquifer system
3. Computation of yield from well from model Aquifer system
4. Determination on effect of drawdown due to interference of well in aquifer system
5. Demonstration of Basic Hydrology system
6. Computation of runoff and derivation of Unit Hydrograph for storm in catch basin

Suggested Reading :

1. IS: 2720 – Relevant Parts.
2. Lambe, T.W., "*Soil Testing for Engineers*", Wiley Eastern Ltd., New Delhi, 1969.
3. Jaeger, J.C. and Cook, N.G.W., *Fundamentals of Rock Mechanics*", Chapman and Hall, 1976
4. Goodman, R.E. *Introduction to Rock Mechanics*, John Wiley and Sons, 1989
5. Ven Te Chow (1964), 'Hand book of Applied Hydrology' McGraw-Hill Book Company, New York.
6. Todd, D.K. (1980) 'Groundwater Hydrology', John Wiley and Sons, New York.

LABORATORY COURSES

COMPUTER APPLICATIONS IN MINING LABORATORY

AIM: To develop algorithms and programs on various mining related problems in basic programming languages.

OBJECTIVE: To study the computer programming for mining problems, mine ventilation network analysis, modelling of surface and underground workings using various software.

1. Computer programming for mining problems like design of pillars / blast design / subsidence prediction.
2. Mine ventilation network analysis.
3. Database systems and analysis
4. Digitisation and scanning of mine plans
5. Ore body modelling.
6. Pit optimization.
7. Truck dispatch system optimization.
8. Production Scheduling for grade control
9. Digital Terrain modelling and Wire-frame modelling
10. Mine modelling
11. Slope stability analysis
12. Modelling of airflow through underground workings using finite element method.
13. Solving problems on excavation in rock and support
14. Patch test and stress around simple openings and comparing the numerical solution with closed form solution.
15. Modelling of typical open stope in metal mine and stability analysis of walls and pillars
16. Modelling of mechanical behaviour of pillars under different geo-mining conditions
17. Modelling of caving behaviour in strata
18. Modelling of slope
19. Modelling of supports in mines
20. Modelling of a hydroelectric cavern and gas oil storage cavern

TOTAL: 60 PERIODS

OUTCOME: The students will have knowledge on design and planning of surface and underground mining methods using mining software

SEMINAR-I

Instruction **: 3 periods per week**
CIE **: 50 marks**
Credits **: 2**

Course Objectives:

- Prepare the student for a systematic and independent study
- Selection of topics in the state of art topics in his/her specialization

Course Outcomes:

- Literature collection and broad understanding of the concepts of domain area
- Effective preparation and presentation skills.

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

SEMINAR-II

Instruction : 3 periods per week
CIE : 50 marks
Credits : 2

Course Objectives:

- Problem definition
- Literature survey, familiarity with research journals
- Broad knowledge of the available techniques to solve the problem
- Technical writing skills
- Presentation skills

Course Outcomes:

- Selection of focused area for dissertation work.
- Understanding the methodology and enhancing presentation skills

The objective of the seminar is to prepare the student for a systematic and independent study of the state of art topics in his/her specialization. Seminar topics may be chosen by the students with the advice of the faculty members. Students are exposed to the following aspects:

Each student is required to submit a technical write-up, presentation of their study (about 20 minutes) followed by a discussion.

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

w. e. f. 2018-2019

PROJECT SEMINAR

Instruction	**: 4 periods per week**
CIE	**: 100 marks**
Credits	**: 8**

Course Objectives:

- Define the statement of research problem.
- Update the literature in chosen area of research and establish scope of work.
- Develop the study methodology.
- Carryout basic theoretical study/experiment.

Course Outcomes:

- Detailed literature review and collection of relevant material
- Narrowing the suitable dissertation topic
- Framing the objectives

Each student will be attached to a faculty member who will monitor the progress of the dissertation. The student is required to submit a technical write-up, presentation of their study (about 20 minutes) followed by a discussion.

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

DISSERTATION

Instruction	**: 6 periods per week**
SEE	**: 200 Marks**
Credits	**: 16**

Course Objectives:

- Expand on the defined research problem in dissertation.
- Conduct laboratory/analytical studies.
- Analyse data, develop models, offer solutions and give conclusions.

Course Outcomes:

- Comprehensive understanding and formulation of dissertation topic.
- Implementation and modeling for the selected problem.

Each student will be attached to a faculty member who will monitor the progress of the student. The student is required to submit a technical write-up, presentation of their study (about 20 minutes) followed by a discussion.

The dissertation shall be internally scrutinized by a Viva-Voce committee consisting of the Head of the Department, Chairman Board of Studies, Supervisor and Examiner.

The Dissertation will be scrutinized by an external examiner as per the institute guide lines applicable.

ADDITIONAL SUBJECTS PROPOSED FOR ELECTIVES

ADVANCED COAL MINING AND MECHANIZATION

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

To understand the advanced methods of working and mechanization for winning Coal.

OBJECTIVES: To introduce the recent trends of level of mechanisation for coal face
To understand the various advanced methods of coal mining

UNIT I
COAL FACE MECHANISATION **8**
Recent Trends, mechanised bord and pillar mining, case studies.

UNIT II
MINING OF THICK SEAMS **8**
Problems, past experiences in India, current methods, mining of thick, contiguous, and steep seams

UNIT III
HYDRAULIC MINING **9**
Applicability, operating parameters, equipment, layouts, Indian experience. Computer applications such as remote control and environmental monitoring in hydraulic mining.

UNIT IV
LONGWALL MINING **10**
Powered supports, development of powered supports, their types and designs, selection for different conditions, last drivages for longwall panelling, remotely operated powered support and longwall faces, Indian experiments, salvaging in longwall.

UNIT V
UNDERGROUND COAL GASSIFICATION **10**
Scope, application, methods of gasification, design of gasification plants, coal bed methane. Environmental monitoring techniques and computer applications in coal gasification techniques.

OUTCOME: The students will have good exposure about the various advanced methods of coal• mining with the knowledge about advanced coal face mechanization.

REFERENCES:

1. Das S.K., Modern Coal Mining Technology, Lovely Prakashan, Dhanbad, 1994

2. Singh, T.N., and Dhar, B.B. Thick Seam Mining, Problems and Issues, Oxford & IBH Publishers, 1992
3. Mathur, S.P., Mining Planning for Coal, M G Consultants, Bilaspur, 1993
4. Peng S.S. and Chiang, H.S., Longwall Mining, John Willey and Sons, New York, 1992
5. T.N. Singh, Underground Winning of Coal, Oxford IBH Publishers, 1999
6. R.D. Singh, Principles and Practices of Modern Coal Mining, New Age International, 1997

LONGWALL MINING

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

AIM: To study the various operations and working methods of longwall mining.
OBJECTIVES: To pioneer the history of longwall mining and its development stages
To understand the extraction, support and transport on a longwall face
To learn ventilation methods and strata monitoring instruments

UNIT I
PLANNING **10**
History of longwall mining and its development, techno-economic consideration of the modified longwall retreat panels, longwall advance panels with caving method and stowing method, design of gate roadways and their size disposition, layout of panels, production and manpower planning, sublevel caving systems for thick seams, caving system in thin seams, multi-slice longwall mining, application of longwall mining for steep seams, longwall caving in metal mines.

UNIT II
SUPPORTS **10**
Types of supports used in longwall mining in the past and present, design of powered supports for different situations, longwall face end problems, supports in longwall gate roadways during drivage and extraction, pressure distribution around a moving longwall face, caving of thick seams and thin seams. Main roof fall, local fall and induced roof wall, floor heaving, precautions during main fall and surface subsidence.

UNIT III
EXTRACTION AND TRANSPORT ON A LONGWALL FACE **10**
Methods of mining coal on longwall faces, machines – shearers, ploughs etc., methods of cutting and face advancement, stables and sumping, gate road pillar extension. Mode of transporting coal or ore in longwall face and machinery used. Shortwall Mining – a modified longwall mining. Remotely operated longwall faces. Shifting of longwall equipment.

UNIT IV
DEVELOPMENT AND WORKING OF LONGWALL FACES **8**
Methods of driving gate roadways, choice of selection of machinery, road headers and dinters, special problems associated with working of longwall faces - faults, roof caving, face spalling, overburden movement, subsidence control, hydraulic stowing, dealing with spontaneous heating while working thick seams in coal.

UNIT V

ENVIRONMENT AND ANCILLARY **7**

Methods of ventilating longwall faces and gate roadways. Methane control, dust control and noise control, monitoring at longwall faces. Assessment of cost of ventilation. Electric and 103 hydraulic circuits. Surface and ground water effects. Strata monitoring with instruments.

TOTAL: 45 PERIODS

OUTCOME: The students will have better understanding about mine planning, methods of working, development of longwall face, support systems, methods of ventilating longwall faces and transport system on a longwall face.

TEXT BOOKS:

1. Peng , S.S., Longwall Mining, 2rd Edition, John Willey and Sons, New York, 2006
2. Peng , S.S., Coal Mine Ground Control, 3rd Edition, John Willey and Sons, New York, 2008.
3. Singh, R.D., Principles and Practices of Modern Coal Mining, New Age International, 1997.
4. Singh, T.N., Underground Winning of Coal, Oxford IBH Publishers, 1999.

REFERENCES:

1. Mathur, S.P., Mining Planning for Coal, M.G. Consultants, Bilaspur, 1999
2. Singh T.N., Dhar, B.B. Thick Seam Mining, problems and Issues, Oxford & IBH Publishers, 1992.
3. Das S.K., Modern Coal Mining Technology, Lovely Prakashan, Dhanbad, 1994.
4. Longwall Mining in Company Seminar – Proceedings – The Singareni Collieries Co. Ltd., 1990.

ADVANCED METAL MINING AND MECHANIZATION

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

To understand the advanced methods of working and mechanization for metal mining.

OBJECTIVES: To introduce the recent advancement of metal mine development
To understand the various advanced methods of metal mining

UNIT I
ADVANCED MINE DEVELOPMENT **9**
Recent advances in raising, winzing, development of drives, tunnels, cross- cuts, drifts, stope preparations, opening up of mineral deposit, enlargement of drives and raises, recent trends in shaft sinking. Techno economic aspects.

UNIT II
ADVANCED METAL MINING AND STOPING PRACTICES **9**
Recent advances in stoping practices, VCR mining, deep mining, stoping practices in rock burst prone mines, back-filling, recent developments in metal mining in India.

UNIT III
MECHANISATION, SUPPORT SYSTEMS IN METAL MINES **9**
Mechanisation in metal mines – LHD declines, hydraulic transport, trackless mining, modern support system used in metal mines, recent developments in winding and transport

UNIT IV
SPECIAL MINING TECHNIQUES **9**
Marine mining methods – sea water, marine beaches, continental shelves, sea-bed sediments and polymetallic nodules, solution mining, ore leaching, in situ leaching techniques.

UNIT V
SPECIAL PROBLEMS OF ORE MINING **9**
Special problems of deep mines – rock pressure, heat, humidity, rock burst, noise and dust pollution, deep winding and transport, etc.

TOTAL: 45 PERIODS

OUTCOME: The students will have good knowledge about the various advanced methods of metal• mining and special mining techniques to overcome the field issues.

REFERENCES:

1. Cummings, A.B. and Given, I.V., SME Mining Engg. Vol.I and II,Society of Mining Engineers of American Institute of Mining, Metallurgical Petroleum Engineers, Inc., New York, 1994.
2. Hartman, H.L., Mine Ventilation and Air Conditioning, Wiley Inter Science Publication, New York, 1986
3. Peng, S.S, Ground Control, Wiley Interscience, New York, 1985
4. Underground Mining Methods Handbook, AMIE Publication, 1992
5. Karmakar, H., Mine Working, Vol. I and II, Lovely Prakashan, Dhanbad, 1995
6. Underground Mining Methods and Technology, Elsevier Science Publishers, 1990