

SEMESTER VI

Program: B.Tech
Semester: Six
Course: Underground Metal Mining
Course Code: 8PCCMiE308

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Course Learning Objective:

CLO 1: The students will have good knowledge about the various advanced methods of metal mining and special mining techniques to overcome the field issues.

CLO 2: The students will have basic concept on metal mining methods, mine design, development and operations of metal mines. They will also know about novel methods of metal mining and its applications.

CLO 3: To understand the various advanced and recent methods of metal mining.

CLO 4: Enables the students to select suitable methods of working underground metal mines and decide the necessary parameters of mine construction.

Course Outcome:

On the completion of the Course, the students will be able to:

CO 1: Develop the understanding of metal mining industry.

CO 2: Sketch the development of a working underground metal mines.

CO 3: Acquire knowledge and hands-on competence in applying the concepts in the design of metal mine.

CO 4: Recommend the various support system for underground metal mine working.

Course Content:

Topics	Hours
Unit I:	
Introduction: Present status of Indian metal mining industry; Scope and limitations of underground mining.	4
Unit II:	
Development: Choice of level interval and back/block length; Shape, size, position, excavation and equipping of shaft station/plat, grizzly, ore/waste bin, main ore pass system, underground crushing and loading stations, underground chambers, sump and other subsidiary excavations; Arrangements for dumping into main ore pass; Cross-cuts and drifts their shape, size and position; Review of excavation process groundbreaking, mucking, ventilation and support; Track extension and car switching; Use of modern drilling and loading equipment in drifting; Raises and winzes their shape, size and position; Excavation process ground breaking, mucking, ventilation and support ; Modern methods of raising-Alimakand Jora- lift raising, long hole method including vertical crater retreat method of raising; Raise boring systems and their details; Modern methods of winzing; Secondary breaking at grizzleyconventional and mechanized methods.	12
Unit III:	
Stoping : Selection of stopingmethods; Classification of stoping methods; Stoppingof narrow ore bodies by underhand, overhand, breast, long hole and raise mining methods; Resuing; Mining of parallel veins; Room & pillar, sublevel, large diameter blast hole/DTH, cascade, shrinkage and vertical crater retreat methods, their applicability, stope layouts ,stope preparation, ground breaking, mucking, ventilation and supporting; Haulage and dumping; Supported methods–horizontal over hand and under hand cut-and-fill methods, square-set method and its variations, details of, ground breaking, supporting, mucking, ventilation, haulage and dumping.	8
Unit IV:	
Mine supports: Timber support: Post, drift-set of various types, square-set, crib-set, cog, stull and chock/chock mat supports; fore poling/piling; load bearing capacity of timber supports; bulkheads. Steel support: Steel set-rigid and yielding types; tubbing, wire mesh, steel lining,; improvised steel props, friction props, hydraulic props; link bars and chocks, powered supports; Cement support: Poured monolithic and reinforced concrete lining; monolithic pump packing, concrete blocks, concrete slabs, guniting and shotcreting. Rock support: Pillars of ore and waste, packwalls, masonry walls and arches building materials and construction.	8

Suggested Reading:

1. *Elements of Mining Technology Vol I, II, D.J. Deshmukh, Central techno publication, Nagpur*
2. *Surface Mining, G.B. Misra, Oxford University Press, Calcutta*
3. *Introductory Mining Engineering, H.L. Hartman, A Wiley Interscience Publication, Singapore*

Program: B.Tech
Semester: Six
Course: Advanced Underground Mining
Course Code: 8PCCMiE309

L	T	P	C
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Course Learning Objective:

CLO 1: To introduce the recent trends of level of mechanization for coal face.

CLO 2: To understand the various advanced methods of coal mining.

CLO 3: To study the various special methods of winning coal.

CLO 4: To study the development of panels and extraction of coal in Bord and Pillar method.

CLO 5: The students will have knowledge on development and depillaring of coal in Bord and Pillar and advancing and retreating in Longwall methods. They will also know about novel methods of winning of coal.

Course Outcome:

On the completion of the Course, the students will be able to:

CO 1: Define & explain the underground mining of thick seam & hydraulic mining.

CO 2: Analyze the design of thin seam mining method in underground & coal gasification techniques.

CO 3: Describe the working methods & present status of underground metal mining.

CO 4: Design & solve the deep mining method & special mining methods.

Course Content:

Topics	Hours
Unit 1: Underground Coal Mining of thick seams: Concept of a thick seam; Problems of mining thick seams; Past experience of working thick seams by Bord & Pillar method in multi-sections; Longwall based multi-slice methods:- Inclined slicing, horizontal slicing and cross-slicing in ascending and descending sequence; Under winning methods:-sub-level caving, integral caving, blasting gallery method, descending shield method.	8
Unit II: Hydraulic Mining of Coal: Conditions suitable for hydraulic Mining of Coal, Hydraulic Mining Operation, Hydraulic breaking of coal, hydraulic transport and hydro hoisting; Layout of workings for hydraulic mining of moderately thick seams.	8
Unit III: Mining of thin seams: Problems in Mining thin seams; Equipment and methods for thin seam extraction. Underground Coal Gasification: Conditions suitable for Underground Coal Gasification; Basic principle and technology of underground coal gasification, Advantage and disadvantage of UCG: Scope of application of UCG in Indian conditions, Highwall Mining: Introduction, Applicability and Method.	8
Unit IV: Deep mining: Problems of deep mining and the remedial measures; Design and layout of stopes in rock burst prone mines. Special methods:Hydraulic, thermal, hydro chemical and biochemical methods; Underwater/sea-bed mining- current status; recent developments in underground metal mining.	6

Suggested Reading:

1. *Elements of Mining Technology Vol I, II, D.J. Deshmukh, Central Techno Publication, Nagpur*
2. *Surface Mining, G.B. Misra, Oxford University Press, Calcutta*
3. *Introductory Mining Engineering, H.L. Hartman, A Wiley – Inter science Publication, Singapore.*

Program: B.Tech
Semester: Six
Course: Mine Ventilation
Course Code: 8PCCMiE310

L	T	P	C
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Course Objective:

CLO 1: Enables the students to understand the airflow in sufficient quantity and quality to dilute contaminants to safe concentrations in all parts of the facility where personnel are required to work or travel.

CLO 2: Enables the students to understand the ventilation requirements.

CLO 3: Students will be able in selecting appropriate mine fans and design suitable ventilation structures.

CLO 4: The students will have deep knowledge about the mine accidents, disaster, disease and mine safety with risk assessment, mitigation and management.

CLO 5: To learn ventilation methods and strata monitoring instruments.

Course Outcome:

On the completion of the Course, the students will be able to:

CO 1: Classify mine gases & summaries various ventilation instruments.

CO 2: Illustrate the technical knowledge on origin, occurrence, effects, and detection of various mine gases, air conditioning of surface and underground mining.

CO 3: Explain & differentiate between natural ventilation & mechanical ventilation.

CO 4: Design ventilation plan & layout considering various parameters.

Course Content:

Topics	Hours
Unit I: Composition of mine atmosphere: Mine gases □ production, properties and effects; Sampling and analysis of mine air; Methane content; Methane drainage; Flame safety lamp and its uses; Methanometer; Methane layering; Radon gas and its daughter products; Monitoring of gases.	8
Unit II: Heat and humidity: Sources of heat in mines; Effects of heat and humidity; Psychrometry, Kata thermometer; Air-conditioning. Air flow through mine openings: Laws of flow, resistance of airways, equivalent orifice, losses in airways, distribution of air, economic design of airways; Flow control devices; Permissible air velocities in different types of workings/openings; Standards of ventilation.	8
Unit III: Natural ventilation: Causes, effect of seasonal variations, calculation of NVP from air densities, thermodynamic principles and other methods. Mechanical ventilation: Types of mine fans; Theory, characteristics and suitability of fans; Selection, testing and output control; Fans in series and parallel; Forcing and exhaust configurations; Reversal of flow; Fan drifts, diffusers, evasee; Booster and auxiliary ventilation; Venturi blowers; Ventilation of deep mines □ underground and open pit.	10
Unit IV: Ventilation planning: Planning of ventilation systems and economic considerations; Ventilation layouts for mining of coal and ore deposits; Ventilation of workings/stopes using heavy blasting; Calculation of air quantity required for ventilating a mine; Calculation of total mine head; Network analysis principles and computer applications; Automation and remote control of ventilation installations; Ventilation surveys.	6

Suggested Reading:

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

Program: B.Tech

Semester: Six

Course: Mine Ventilation Lab

Course Code: 8PCCMiE310P

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List of Experiments:

1. Study and use of MSA-D6 Methanometer.
2. Flame safety lamp–construction and gas testing.
3. Detection of carbon monoxide using detector tube.
4. Estimation of air cooling power using Kata thermometer.
5. Demonstration of vane Anemometer and determination of quantity by Anemometer.
6. Demonstration of velometer and measurement of air velocity by velometer.

Program: B.Tech
Semester: Six
Course: Mine Planning
Course Code: 8PCCMiE311

L	T	P	C
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Course Learning Objective:

CLO 1: To introduce the various techniques for mine planning, geotechnical investigation and equipment management.

CLO 2: To appreciate the modern trends in opencast mines, safety and environment.

CLO 3: The students will have knowledge about the available mineral resources, exploration techniques and its strategy. They will know about the methods of preparation of feasibility reports and its evaluation techniques.

Course Objective:

On the completion of the Course, the students will be able to:

CO 1: Apply knowledge of mine planning for understanding, formulating and solving mine planning & scheduling problems.

CO 2: Describe stripping ratio and opencast working & geometry.

CO 3: Acquire knowledge and hands-on competence in applying the concepts in the development of mine planning.

CO4: Analyze feasibility & detailed report of opencast mining.

Course Content:

Topics	Hours
Unit I:	
Basic Concepts: Objectives of mine planning. Characteristics of planning process. Planning stages – long, intermediate and short range planning. Technical, economical and environmental information required for mine planning. Preparation of Feasibility and Project Report.	8
Unit II:	
Stripping ratio Concept of stripping ratio; Types of stripping ratios and their significance; Choice between surface and underground mining. Geometrical considerations Basic bench geometry; Ore access; Pit slope geometry; Addition of haul road on pit plan; Pit layouts.	8
Unit III:	
Underground Coal Mine Planning: Mine planning components and planning steps; Optimization of mine size (mine production capacity) based on techno-economic considerations; Mine system and sub-systems; Equipment and face scheduling against targeted production: Closure of underground mines.	8
Unit IV:	
Feasibility Report and Detailed Project Report: Contents, preparation and economic evaluation.	6

Suggested Reading:

1. *Elements of Mining Technology Vol I, II, D.J. Deshmukh, Central techno publication, Nagpur*
2. *Surface Mining, G.B. Misra, Oxford University Press, Calcutta*
3. *Introductory Mining Engineering, H.L. Hartman, A Wiley- Interscience Publication, Singapore.*
4. *Principles of Mine Planning, Jay ant Bhattacharjee*

Program: B.Tech
Semester: Six
Course: Ground Control
Course Code: 8PCCMiE312

L	T	P	C
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Course Objective:

CLO 1: The students will have knowledge on rock mechanics instrumentation, approach to pit slope stability, theories of subsidence and failure of rocks.

CLO 2: The students will have knowledge on time dependent properties of rock, subsidence, ground vibration monitoring, stowing characteristics and permeability.

CLO 3: They will also know about design of underground opening and methods of stowing.

CLO 4: Student will know about subsidence control, governing norms and regulations.

CLO 5: The students will know the fundamental mechanics of rock slope failure, types of failure and its influencing parameters.

CLO 6: The students will have the concept about the rock mass classification, mechanism of rock reinforcement, existing and special methods of rock reinforcement.

Course Outcome:

On the completion of the Course, the students will be able to:

CO 1: Sketch of strata control for understanding, formulating and solving strata control problem in any underground mine.

CO 2: Analyze and solve strata movement problems.

CO 3: Acquire knowledge and hands-on competence in applying the concepts in the development of strata control.

CO 4: Describe subsidence & develop in depth knowledge of monitoring prediction & control.

Course Content:

Topics	Hours
Unit 1: Engineering classification of rocks and rock masses: Classification systems in rock engineering; Classification of intact rocks; Classification of rock masses- Terzaghi's rock load, RQD, Rock Structure Rating, Bieniawski's RMR, Barton's Q-System Rock mass classification and Recent developments; correlations between different classification systems; Applications of Rock mass Classification in rock engineering.	10
Unit II: Design of mine pillars: Mine pillars and their classification; pillar mechanics; Design of mine pillars and shaft pillar: stresses acting on pillars; stress distribution in pillars; mechanics of pillar failure; interaction of pillar, floor and roof; design of rooms and pillars; design of barrier and yield pillars. Design of support for underground excavation.	10
Unit III: Rock support: principles of supports; Types and classification of support; support design methodology; support design criteria; rock- support interaction analysis; support requirement under different conditions – influencing parameters, selection and estimation. Design of rock reinforcement for underground excavation: Development of reinforcement by rock bolting; rock bolt types; theories of rock bolting; design of rock reinforcement system.	8
Unit IV: Subsidence: Causes and impacts of subsidence; Mechanics of surface subsidence, discontinuous and continuous subsidence; Monitoring, prediction, control and management of subsidence. Rock burst and coal bump: Phenomenology of rock bursts and coal bump; causes prediction, monitoring.	8

Suggested Reading:

1. *Elements of Mining Technology Vol, I, D.J. Deshmukh, Central techno publication, Nagpur*
2. *Modern Coal Mining Technology, S.K. Das, Mintech publication Bhubaneswar*
3. *The Elements of Mechanics of Mining Ground, B.S. Verma, Tuhin & Co. Lucknow*

Program: B.Tech

Semester: Six

Course: Ground Control Lab

Course Code: 8PCCMiE312P

L	T	P	C
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List of Experiments:

1. Load-yield characteristics of friction prop and hydraulic prop/leg.
2. Drillability of rock.
3. Anchorage strength of rock bolt.
4. Dynamic modulus of elasticity.
5. Use of high speed video camera.
6. Use of rock mass monitoring system in assessing blasting performance.
7. Load cell, extensometer, vibrating wire stress meter and convergence meter.

Program: B.Tech
Semester: Six
Course: Mine Planning & Design Exercise
Course Code: 8PCCMiE313P

L	T	P	C
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Course Learning Objective:

CLO 1: The students will have knowledge on planning of opencast mining, underground mining and equipment utilization.

CLO 2: To understand the planning of opencast mining, underground mining and equipment Utilization.

Course Outcome:

On the completion of the Course, the students will be able to:

CO1: Design layout of opencast mine to know the calculation of output.

CO 2: Plan layout of opencast mine to know organizations charts for mine management.

CO 3: Analyze & draw layout of with a target output.

CO 4: Design layout of opencast mining with equipment scheduling.

List of Experiments:

1. Know the calculation of output for open cast mine

Calculation of No. of shovels, dumpers, drills require for given output. Calculation of bucket capacity of the shovel, drill capacity, capacity of the dumper for the above problem.

2. Know the organizations charts for mine management.

Draw the Organizations charts for one Mechanized underground Coal Mine.

3. Draw a layout for a surface mine with an output 10,000 tonne/day in a flat deposit.

Draw a Layout for Mechanized opencast mine assume require condition data-Design of blasting sequence in surface mine.

4. Design of Open cast Coal Mines.

5. Design of underground Coal &Metalliferous mines including entries, ventilation, support, transport system etc.