

JHARKHAND RAI UNIVERSITY



MINING ENGINEERING

B.Tech



SYLLABUS SEMESTER VI

Kamre | Ratu Road | Ranchi | Jharkhand

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B.TECH SEMESTER VI

B.TECH IN MINING ENGINEERING												
SEMESTER VI												
S. No	Subject code	Name of Subject	Period			Evaluation Scheme				Subject	Credit	Hours
			L	T	P	Assignment	TA	Total	ESC			
1	8.351	Underground Metal Mining	3	0	0	20	10	30	70	100	3	3
2	8.352	Advanced Underground Mining	3	0	0	20	10	30	70	100	3	3
3	8.353	Mine Ventilation	3	0	0	20	10	30	70	100	3	3
4	8.354	Surface Mine Planning	3	0	0	20	10	30	70	100	3	3
5	8.355	Applied Rock Mechanics & Numerical Modeling	3	0	0	20	10	30	70	100	3	3
6	8.356	Underground Mine planning	3	0	0	20	10	30	70	100	3	3
7	40B.351	**seminar in Executive communication I	2	0	0	20	10	30	20	50	0	2
PRACTICAL / SESSIONAL												
1	8P.355	Applied Rock Mechanics & Numerical Modeling Lab	0	0	2		20	20	30	50	1	2
2	8P.353	Mine Ventilation Lab	0	0	2		20	20	30	50	1	2
3	8P.357	Mine Design Exercises	0	0	2		20	20	30	50	1	2
									Total	750	21	24

- **** NOTE: Qualifying Non Credit Course & only Viva voce is conducted.**
- **MOOCS introduced through SWAYAM in all semester.**

Program: B.Tech
Semester: Six
Course: Underground Metal Mining
Course Code: 8.351

L	T	P	C
3	0	0	3

Course Objective:

- The students will have good knowledge about the various advanced methods of metal mining and special mining techniques to overcome the field issues.
- 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.
- To understand the various advanced and recent methods of metal mining.
- Enables the students to select suitable methods of working underground metal mines and decide the necessary parameters of mine construction.

Unit I

Introduction: Present status of Indian metal mining industry; Scope and limitations of underground mining.

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 ground breaking, 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- Alimak and 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 grizzly conventional and mechanized methods.

Unit III

Stoping : Selection of stoping methods; Classification of stoping methods; Stoping of 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.

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. Fill support: Materials of backfill and their procurement; theoretical aspects of slurry transportation; preparation, transport and placement of hydraulic backfill with and without cement.

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: 8.352

L	T	P	C
3	0	0	3

Course Objective:

- To introduce the recent trends of level of mechanization for coal face.
- To understand the various advanced methods of coal mining.
- To study the various special methods of winning coal.
- To study the development of panels and extraction of coal in Bord and Pillar method.
- 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.

Unit I

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.

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.

Unit II

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

Unit III

Underground Metal Mining Introduction: Current status of recent developments in underground metal mining methods in India and abroad. Caving methods: Top slicing, sub-level caving and block caving methods; Stope layouts, stope preparation and production operations; Design and construction of draw points; Mechanics of draw and draw control procedure; Recovery and dilution. Combined systems: Combined open-room, shrinkage, and cut-and-fill systems; combined systems with subsequent filling of rooms.

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.

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: Mine Ventilation
Course Code: 8.353

L	T	P	C
3	0	0	3

Course Objective:

- 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.
- Enables the students to understand the ventilation requirements.
- Students will be able in selecting appropriate mine fans and design suitable ventilation structures.
- The students will have deep knowledge about the mine accidents, disaster, disease and mine safety with risk assessment, mitigation and management.
- To learn ventilation methods and strata monitoring instruments.

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.

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.

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.

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.

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: 8P.353

L	T	P	C
0	0	2	1

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. Analysis of mine gases using Gas Chromatograph.
5. Measurement of air flow using velometer, vane anemometer and Pitot tube.
6. Plotting off a characteristic curves.
7. Determination of psychrometric properties of air.
8. Estimation of air cooling power using Kata thermometer.

Program: B.Tech
Semester: Six
Course: Surface Mine Planning
Course Code: 8.354

L	T	P	C
3	0	0	3

Course Objective:

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

Unit I

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. Ore reserve estimation Ore zone and bench/level compositing; Objectives and principles of ore reserve estimation; Estimation of grade at unknown point; Methods of ore reserve estimation-vertical cross section method, horizontal cross section method and 3-D geological block method.

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.

Unit III

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 millcut of grade; Introduction to production scheduling.

Unit IV

Analysis and design of high wall slopes and waste dumps 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 in surface mines. Selection of mining system vis-à-vis equipment system. Closure of surface mines. Feasibility Report-Contents and preparation.

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: Applied Rock Mechanics & Numerical Modeling

Course Code: 8.355

L	T	P	C
3	0	0	3

Course Objective:

- The students will have knowledge on rock mechanics instrumentation, approach to pit slope stability, theories of subsidence and failure of rocks.
- The students will have knowledge on time dependent properties of rock, subsidence, ground vibration monitoring, stowing characteristics and permeability.
- They will also know about design of underground opening and methods of stowing.
- Student will know about subsidence control, governing norms and regulations.
- The students will know the fundamental mechanics of rock slope failure, types of failure and its influencing parameters.
- The students will have the concept about the rock mass classification, mechanism of rock reinforcement, existing and special methods of rock reinforcement.

Unit I

Engineering classification of rocks and rock masses: Classification systems in rock engineering; Classification of intact rocks; Classification of rockmasss - Terzaghi's rock load, RQD, Rock Structure Rating, Bieniawski's RMR, Barton's Q-System, Hoek's-GSI, Palmstrom's R_{Mi}, CMRI-ISM Rock mass classification and Recent developments; correlations between different classification systems; Applications of Rock mass Classification in rock engineering. Design and stability of structures in rock: Methods for design and stability analysis of underground excavations; Energy released by making an underground excavation; Design of single and multiple openings in massive, stratified and jointed rock mass.

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: 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.

Unit III

Subsidence: Causes and impacts of subsidence; Mechanics of surface subsidence, discontinuous and continuous subsidence; Monitoring, prediction, control and management of subsidence. Caving of rock mass: Rock caving in mining; Mechanics of rock caving; Assessment of cavability; Caving prediction and control. Rock burst and coal bump: Phenomenology of rock bursts and coal bump; causes prediction, monitoring and control of rock bursts; gas outbursts. Monitoring rock mass performance: Purpose and nature; geotechnical instrumentation; Mechanics of fragmentation: Principles of coal and rock cutting and drilling mechanics; the performance of rock cutting by picks, disc and roller-cutters; cutting tool interaction; Mechanics of blasting; impact of rock mass properties, structure and discontinuities on rock fragmentation; Methods of assessing cuttability, Drillability, dig ability and rippability and blast ability of rocks.

Unit IV

Numerical modeling Introduction: Need for numerical modeling in design of excavations in mines; Domain and boundary conditions; Discretisation of domain and boundary; Methods of numerical simulation for

excavations in mining. Finite element method: Basic principle; Assembling elements to form a structural stiffness matrix; Imposing boundary conditions and solving structural equations using plane truss; Elements on assumed displacements, constant strain triangle, iso parametric formulation, advantages and their limitations.

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: Applied Rock Mechanics & Numerical Modeling Lab

Course Code: 8P.355

L	T	P	C
0	0	2	1

List of Experiments:

1. Load-yield characteristics of friction prop and hydraulic prop/leg.
2. Drillability of rock.
3. Anchor age strength of rock bolt.
4. Rock fracture toughness.
5. Dynamic modulus of elasticity.
6. Shear properties of discontinuity.
7. Blast induced ground vibration.
8. Use of high speed video camera.
9. Use of rock mass monitoring system in assessing blasting performance.
10. Load cell, extensometer, vibrating wire stress meter and convergence meter.

Program: B.Tech

Semester: Six

Course: Underground Mine Planning

Course Code: 8.356

L	T	P	C
3	0	0	3

Course Objective:

- The students will have insight about the advanced techniques for mine planning, geotechnical investigation and equipment management and also will understand the modern trends in opencast mines, safety and environment.
- 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.
- To study the prefeasibility and feasibility reports and its evaluation methods.

Unit I

Underground Metal Mine Planning General: Mine planning and its importance; technical and economical information for planning; cut-off grade and its estimation; ore reserve estimation, Stope planning: Cut-off grade decisions, evaluate stope boundaries, selection of a stoping methods, application of computer in stope design, economics of each stope

Unit II

Production planning: Stope reserve, development, manpower, ore/waste handling, equipment, essential services, production scheduling, time and work study for improvement of production

Unit III

Underground Coal Mine Planning: Mine planning components and planning steps; Optimal geometrical mine size; 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.

Unit IV

Feasibility Report and Detailed Project Report: Contents, preparation and economic evaluation.

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 Bhubaneshwar*

Program: B.Tech

Semester: Six

Course: Seminar in Executive Communication I

Course Code: 40B.351

L	T	P	C
2	0	0	0

Course Objective:

- To impart basic employability skills through intensive practice.
- The students get opportunities to apply their general awareness and classroom learning to practical situation to achieve the targeted career goals
- The students acquire Discussion Skills, Interview Skills, Job Search Strategies, Job Correspondence etc. , they need to undergo ,
- An average student acquires basic skills required for a cherished job. Can surf out different job opportunities, matching their career goals.
- A self reliant professional/entrepreneur.

Unit I

REPORT WRITING SKILLS (SCIENTIFIC & TECHNICAL)

- Introduction
- Important Features of Reports
- Types of Reports
- Structure/Layout
- Language & Style
- Project/Lab./Industry/Socio-Cultural Survey/Technical Report
- Proposals; Nature/Significance/Types/Structure & Importance

Unit II

PRESENTATION SKILLS

- Introduction
- Nature, Scope & Importance of Presentation
- Planning the Presentation
- Objective, Key Idea, Main Points, Supporting Materials-Steps
- Handling Stage Fright

Unit III

LISTENING SKILLS (COMPREHENSION)

- To Comprehend Spoken material in English, Indian/British & American
- Current Situation in India Regarding English
- American English Vs British English

Unit IV

ETHICS & VALUES

- Ethics of Life
- Emotional Quotients
- Emotional Intelligence
- Emotional Identification
- Emotional Understandings

Suggested Readings:

1. Monippally, Matthukutty. M. 2001. *Business Communication Strategies*. 11th Reprint. Tata McGraw-Hill. New Delhi
2. Swets, Paul. W. 1983. *The Art of Talking So That People Will Listen: Getting Through to Family, Friends and Business Associates*. Prentice Hall Press. New York
3. Lewis, Norman. 1991. *Word Power Made Easy*. Pocket Books
4. Sen , Leena .*Communication Skills ; Eastern Economy Edition*
5. Ghanekar , Dr. Anjali . *Essentials of Business Communication Skills ; Everest Publishing House*
6. David Green . *Contemporary English Grammar, Structure & Composition ; MacMillan*
7. *Dictionary; Oxford*
8. *Dictionary ; Longman*

Websites

- www.tatamcgrawhill.com/digital_solutions/monippally
- www.dictionary.cambridge.org
- www.wordsmith.org
- www.edufind.com
- www.english_the_easy_eay.com
- www.englishclub.com
- www.english_grammar_lessons.com
- www.wikipedia.org/wiki/english_grammar

Program: B.Tech

Semester: Six

Course: Mine Design Exercises

Course Code: 8P.357

L	T	P	C
0	0	2	1

Course Objective:

- The students will have knowledge on planning of opencast mining, underground mining and equipment utilization.
- To understand the planning of opencast mining, underground mining and equipment Utilization.
- They will also know about project implementation and monitoring methods.

List of Experiments:

1. Design of Open cast Coal Mines,
2. Design of Open cast Metalliferous Mines.
3. Design of underground Coal & Metalliferous mines including entries, ventilation, support, transport system etc.