## COURSE STRUCTURE FOR B. TECH. (MINING ENGINEERING)

### B.TECH. (MINING ENGINEERING) PART – II SEMESTER – III

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<td>Mining Geology – I</td>
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<td>MN2102</td>
<td>Mine Surveying – I</td>
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**TOTAL OF THEORY**

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### PRACTICAL

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**TOTAL FOR SEMESTER – III**

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### B.TECH. (MINING ENGINEERING) PART – II SEMESTER-IV

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B.TECH. (MINING ENGINEERING) PART-III SEMESTER-VI

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*Open Electives*

- HU3208A : History of Science and Technology
- HU3208B : Industrial and Organisational Psychology
- HU3208C : Environment and Ecology
- HU3208D : Energy Management
- HU3208E : Industrial Sociology
- HU3208F : Human Values

NB: Six weeks of training will be undertaken after VI semester, which will be evaluated in VII semester
# Syllabus for B. Tech. (Mining Engineering)

## B.TECH. (MINING ENGINEERING) PART-IV SEMESTER-VII

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*Electives:

- MN4105 : Mine Safety Engineering
- MN4106 : Drilling and Blasting of Rocks
- MN4107 : Technology of Underground Excavation
- MN4108 : Numerical Methods in Geomechanics
B.TECH (MINING ENGINEERING) PART-IV SEMESTER-VIII

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| PRACTICAL    |                                  |                    |         |
| MN4401       | Underground Metalliferous Mining | 3                  | 2       |
| MN4402       | Project                          | 9                  | 6       |
| MN4403       | Comprehensive Viva-Voce          | -                  | 2       |
| TOTAL OF PRACTICAL |                            | 12                 | 10      |
| TOTAL FOR SEMESTER-VIII |                        | 25                 | 23      |
| TOTAL FOR PART-IV |                            | 46                 |         |

* Electives:

MN4204 : Operations Research in Mining
MN4205 : Mining Induced Subsidence Engineering
MN4206 : Fundamentals of Drilling Technology
MN4207 : Fundamentals of Rock Mechanics Instrumentation
B.TECH. (MINING ENGINEERING) PART – II SEMESTER – III

MN2101: MINING GEOLOGY – I (4 Credits)

Importance of Geology in Mining

Mineralogy


Crystallography

Scope, crystal systems. Polymorphism and isomorphism.

Economic Geology

Ores and gangue – genesis, classification, distribution in India and geological occurrences. Uses of important metallic and non-metallic minerals.

Atomic mineral resources of India – genesis and occurrence.

Structural Geology


Folds – genesis, classification, identification in field, impact on landscape, mineral deposits, mining and tunnelling.

Faults – mechanism of faulting, classification, impact of faulting on topography, significance of faults in mining engineering and tunnelling.

Joints – definition and characteristics, classification, occurrence of joints in igneous, sedimentary and metamorphic rocks. Engineering considerations and treatments.

Prospecting and Exploration


Reserve Estimation

Selection of methods, merits and demerits, applicability.
MN2102: MINE SURVEYING – I (3 Credits)

Distance Measurement

Chains, tapes, electronic distance measurement, total station.

Levelling

Levels, reduced level, corrections for curvature and refraction, reciprocal levelling, contouring, tacheometry.

Traversing

Triangulation and Trilateration

Theodolites, control point framework, baseline, satellite station, extension and double extension of base. Trilateration.

Plane Table Surveying

Methods, two and three point problems, errors.

Curve Ranging

Minor Instruments

Planimeter, sextant, abney level, optical square.

Computations

Area and volume calculations.

Theory of Errors

Definitions, indices of precision and weights, correction and adjustment of measurements.
MN2103: UNDERGROUND MINE ENVIRONMENT – I (3 Credits)

Introduction

Ventilation requirements in mines, natural ventilation and mechanical ventilation.

Mine Gases

Composition of atmospheric air. Mine gases - occurrences, properties, physiological effects, detection; sampling, analysis, monitoring. Methane layering, methane drainage. Radon and its daughter products - effects and control.

Heat and Humidity


Airflow in Mine Workings


Airborne Respirable Dust

Definition – generation, physiological effects, sampling, measurement and control measures.

Mine Illumination


Miners’ Diseases
MN2104: MINING MACHINERY – I (3 Credits)

Transmission of Power

Belt, rope, chain, gear, hydraulic and electro-hydraulic transmission.

Compressed Air

Comparison with other sources of power. Air compressors – types, construction, installation and maintenance. Compressed air transmission and distribution, compressed air drills, pneumatic picks, air motors and other compressed air equipment.

Wire Ropes

Types, construction and uses. Rope deterioration and maintenance. Capping and splicing of rope.

Haulage


Statutory Provisions
MN2105: MINE DEVELOPMENT (4 Credits)

Introduction to Surface and Underground Mining Terms

Definition of common mining terms. Overview of unit operations in surface and underground mines.

Explosives


Types of Support

Prop, bar, cog, friction and hydraulic prop, girder.

Mine Entries


Sinking


Primary and Secondary Development Drivages in Underground Mines

EC2108A : ELECTRONICS AND INSTRUMENTATION (3 Credits)

Semi-conductor diode characteristics, load line, half-wave and full-wave rectifiers, filters.

Power supply, regulators (723, 78XX, 79XX).

Amplifying devices (Vacuum tube, BJT, FET), their characteristics with LF equivalent circuit.

Single stage and multistage RC-coupled amplifiers (including types of coupling), calculations of voltage gain, impedances, frequency response, and feedback.

High input impedance circuit.

Oscillators (RC, LC, distributed X-tal.) criterion and one practical circuit.

Op-Amp and its applications, filters, VCO and PLL.

Timer and applications to systems.

Logic gates and basic logic circuits (SSI, MSI and basic system ICs).

Transducers, load cell, strain gauge, LVDT, optical shaft encoder, display devices, AID and D/A converters.

CRO and multimeters (A&D) (Intersil's A/D for instrumentation).

A typical instrumentation system.

Introduction to microprocessors and their basic peripherals.
B.TECH. (MINING ENGINEERING) PART – II SEMESTER – IV

MN2201: MINING GEOLOGY – II (3 Credits)

Geological Time Scale

Petrology

Definition and scope, main classes of rocks forming minerals.

Igneous, sedimentary and metamorphic rocks – origin, characteristics, classification, uses and mining importance. Significance of texture and structure of rocks on geomechanical properties of rock mass.

Stratigraphy


Major geological formations of India – Dharwar, Cuddapah, Vindhyan, Gondwana, Tertiary & Quaternary systems and their economic significance.

Fuel Geology

Coal and lignite - origin, occurrences, petrography. Structural features of coal-seam. Grades of coal. Occurrences in India.

Petroleum and natural gas – formation of gas and oil basins, traps and reservoirs, occurrences in India. Coal bed methane.

Geohydrology

Sources of water in mines. Classification of rocks based on porosity and permeability. Water table and types of ground water. Geological controls on ground water movement in mines.

Environmental Geology

MN2202: ROCK MECHANICS (4 Credits)

Status of Rock Mechanics
Role and status of rock mechanics in mining and civil engineering.

Stress and Strains

Stress-strain relationships. Effect of temperature and pressure on stress and strain relationships. Equilibrium and compatibility equations.

Rockmass Classification Systems
Q-system, RMR, Modified RMR and their applications.

Physico-Mechanical Properties of Rocks
Specific gravity, hardness, porosity, moisture content, permeability, thermal conductivity. Compressive, tensile and shear strengths. Modulus of elasticity. Poisson’s ratio and triaxial strength.

Swell index, slake durability, point load index, Protodyakonov index.

Determination of in-situ strength.

Determination of In-situ Stresses
Methods of measurement – hydrofracturing and stress-relief.

Rheological Models and Time Dependent Properties of Rocks

Theories of Rock Failure
Griffith, Mohr-Coulomb, Hoek and Brown. Types of rock fractures.

Post-failure Behaviour.
MN2203: MINING MACHINERY – II (3 Credits)

Surface and Underground Layout


Winding


Trackless Haulage

Types of conveyors and their sequence control. High angle conveyor. Free steered vehicles - shuttle cars, LHD, SDL and low profile dump trucks (LPDT).

Aerial Ropeways

Types, construction and installation. Loading, unloading and angle stations,

Man-riding Systems

Statutory Provisions
AM2208A: NUMERICAL METHODS (3 Credits)


EE2208A : ELECTICAL ENGINEERING – I (3 Credits)

Electrical Circuits


Electrical Machines


Distribution of Electrical Power

Tariff calculation. House and factory wiring.

Introduction to Electrical Measurements

Indicating instruments, voltmeter, ammeter, wattmeter and energy meter.
B.TECH. (MINING ENGINEERING) PART – III SEMESTER – V

MN3101: GROUND CONTROL (3 Credits)

Design of Mine Opening

Stress distribution around narrow and wide openings. Extent of failure around mine openings. Determination of size of opening and extent of failure.

Design of Pillars

Determination of shape and size of pillars in coal and hard rock mines, barrier pillars.

Rock Supports


Caving


Subsidence

Theories of subsidence. Factors affecting subsidence. Sub-critical, critical and super-critical widths of extraction. Subsidence prediction and control. Design of shaft pillar.

Slopes


Rock Bursts

Rock bursts and bumps – mechanism, prediction and control.

Load and Deformation Monitoring

Visual monitoring, instrumental monitoring – load cells, convergence recorders.
MN3102: UNDERGROUND MINE ENVIRONMENT – II (3 Credits)

Main Mechanical Ventilation

Centrifugal and axial flow fans – construction, pressure development, characteristic curves, series and parallel operations, installation and testing. Forcing and exhaust ventilation. Fan drift, evasee, diffuser. Reversal of airflow.

Auxiliary and Booster Ventilation


Ventilation Planning


Ventilation Survey

Purpose, instrumentation, procedure and data tabulation for air quantity and pressure survey. Determination of fan and mine characteristic. Ventilation Plans.
MN3103: MINE SURVEYING – II (3 Credits)

Mine Plans and Sections
Mining plans and sections. Statutory requirements, conventional signs, limits of accuracy.

Underground Traversing
Traversing through roadways and drifts.

Surface and Underground Correlation
Orientation of underground net through adits, inclines and shafts. Depth of shaft. Magnetic and gyroscopic orientation.

Stope Surveying

Photogrammetry
Terrestrial and aerial photogrammetry. Flight planning. Applications in mine surveying.

Global Positioning System
Theory and applications in mine surveying.

Subsidence Surveying
Construction and layout of subsidence monitoring stations. Subsidence measurements.

Borehole Surveying

Laser
Types, characteristics and mining applications of Laser.
MN3104: UNDERGROUND COAL MINING – I (4 Credits)

Coal and coal measure rocks. Classification of mining methods. Division of mine area into panels on district and level patterns.

Factors influencing the choice of mining method.

**Bord and Pillar Method**

Size of headings, pillars and panels.

Development of panels by drivage of group of headings to strike, dip and rise with V, diagonal and straight fronts. Cycle of operations, work-organisation and scheduling for drivage of heading groups by conventional and continuous methods.

Depillaring of panels with V, straight and diagonal fronts. Conventional and mechanized depillaring schemes with emphasis on coal, water, air routes and supports.

Simultaneous development and depillaring, partial extraction, room and pillar methods.

**Longwall Method**

Classification of longwalls, advancing and retreating methods, working in districts and levels (central and boundary ventilation) size of panel, development of panel with single and multiple heading gate roads, various orientations of longwall face, single and double unit longwalls.

Extraction of longwall panels with conventional and fully mechanized methods, length of face, daily advance, cycle of operations, organisation, scheduling and layouts with special reference to coal, water and air routes. Bleeder ventilation scheme.

Gate, goaf and face area support in conventional and fully mechanised longwalls.

**Room and Pillar Method**

**Shortwall Method**

**Stowing**

Applicability conditions, classification and description of various methods of goaf stowing. Surface and underground arrangements and precautions with stowing, full bore stowing and problems associated with stowing at surface and below ground.

**Comparison of Various Mining Methods**
MN3105: SURFACE MINING – I (3 Credits)

Classification and Basic Parameters

General information and classification of surface mining methods – associated terms, determination of major dimensions and main parameters. Annual production and life of mine.

Surface mining methods – Scope, applicability and limitations.

Opening of Deposits

Opening of deposits and formation of benches – trenching, non-trenching and underground methods and their combinations. Width & slope of entry trenches. Driving of opening and entry trenches.

Overburden Removal


Basic Layouts

Layout planning for horizontal, inclined and steep deposits. Factors influencing the choice of layouts. Design of benches.

Special Mining Situations

Quarrying of dimensional stones, hydraulicking, dredging of placers and deep-sea mining. Mining over old underground workings.

Ultimate Pit Design

Global and Indian Status of Surface Mining
EE3108A : ELECTICAL ENGINEERING – II (3 Credits)

Electric Drives

Advantages and disadvantages, factors affecting the selection, direct and indirect drives. DC, induction and synchronous motors – principle, starting, speed control and braking. Rating of machines and duty cycle, cooling curve. Speed-time relationships, time-revolution required to reach a particular speed or to stop. Load equalization. Selection of drives to meet specific requirement in mines and mineral treatment plants.

Electric Power Distribution

Types of distributors, AC & DC distribution, feeders, design.

Voltage Regulation of Lines

Short lines, medium lines, ABCD constant, over-head line insulator. Mechanical design of lines.

Underground Cable

Types, grading, heating, rating and laying in.


Instrumentation

Transducers, measurement of displacement, temperature, pressure, stress, strain and acceleration.
B.TECH. (MINING ENGINEERING) PART – III SEMESTER - VI

MN3201: MINERAL PROCESSING (4 Credits)

Introduction

Scope, objectives and limitations of mineral processing.

Liberation and Comminution

Concept and importance of liberation and its measurement. Theories of Comminution. Crushing and grinding equipment, their fields of application and limitations. Comminution circuits.

Sizing and Classification


Concentration Methods

Principles, equipment and circuits for various concentration processes such as gravity concentration, dense media separation, magnetic separation, high tension separation, flotation. Applications and limitations of each method.

Solid-Liquid Separation

Principles, techniques and application of dewatering units such as filters and thickeners.

Plant Practices

Location, layouts and selection of equipment for mineral processing plants. Processing flow sheets for coal and important ores. Associated environmental problems and their controls. Metallurgical accounting and control. Developments and research trends in mineral processing.
MN3202: ENVIRONMENTAL MANAGEMENT IN SURFACE MINES (4 Credits)

Environmental Issues

Air Pollution
Sources, characterization, ill effects, measurement, monitoring, standards, mitigating measures.

Water Pollution

Noise Pollution
Basics of acoustics. Sound power, intensity and pressure levels. Noise indices, effects, standards, instrumentation, monitoring and control.

Biological Land Reclamation

Socio-economic Rehabilitation

Environmental Impact Assessment
Methods of EIA and their applicability.

Environmental Management Plan
Structure and preparation of EMP.

Environmental Laws
MN3203: UNDERGROUND COAL MINING – II (3 Credits)

Global and Indian Status

Global and Indian status of different underground coal mining methods and scenario of coal production in India.

Mining Under Difficult Geological Situations


Hydraulic Mining

Concept, hydro-monitors, coal flumes and pipes, hydraulic elevators and pumps, coal sumps. Layout of working on district and level systems.

In-situ Gassification

Concept, chemistry, and applicability. Methods using underground excavations – vertical and directional drilling boreholes from surface. Linkages and innovations.
MN3204: SURFACE MINING – II (3 Credits)

An overview of unit operations in surface mining.

Drilling

Classification of drilling equipment, construction and design considerations, criteria for selection and performance of drilling equipment, drillability, mechanics of drilling.

Blasting

Selection of explosives, primary blast round design considerations and calculations, multi-row blasting, inclined hole blasting, initiation systems, secondary blasting, monitoring and assessment, blast nuisances (vibration, airblast, flyrock), blast casting.

Excavation and Loading


Transport


Storage


Lighting

Requirements, types and layouts.

Drainage

Sources of water, assessment of drainage requirements, sump design and drainage patterns.

Reclamation

Methods of reclamation of mined out areas, dumps and tailings pond.
MN3205: COMPUTER APPLICATIONS IN MINING (3 Credits)

Introduction to Software Packages Applicable to Mining

Development of Algorithms


Development of Programs

Simple computer programs based on the above algorithms.
B.TECH. (MINING ENGINEERING) PART – IV SEMESTER - VII

MN4101: MINE MANAGEMENT (3 Credits)


Management Process

Planning, organizing, directing, motivating, controlling, coordinating and communicating, staffing, manpower planning and recruitment. Performance appraisal, human resource development and planning.

Organizations

Principles of organization. Departmentation. Levels of management and organizational chart.

Management information systems, human resource development, workers participation in management, trade unionism, inventory control and materials management.
MN4102: MINE ECONOMICS (3 Credits)

Mineral Economics


Sampling and Estimation of Reserves


Economic Evaluation


Organisational and Financial Management

MN4103: MINING MACHINERY – III (3 Credits)

Mine Pumps
Types, construction and characteristics. Pipes. design, installation and maintenance of pumping systems. Series and parallel operations of pumps. Borehole and submersible pumps. Slurry pumps. Airlift pumps. Automatic pump control

Rock Drivage Machines

Underground Face Machinery

Machinery Maintenance
Planned, preventive and predictive maintenance. Routine and remote condition monitoring. Effect on availability and utilisation of equipment.

Automation and Remote Control of Mining
MN4104: MINE DISASTERS (3 Credits)

Spontaneous Combustion

Mechanism, causes, susceptibility indices, detection, preventive measures and control. Incubation period and its determination.

Mine Fires

Classification of fires, causes, detection, preventive measures. Dealing with underground and surface fires. Fire fighting – direct methods, sealing off and inertisation.

Explosions

Mechanism, causes, characteristics, preventive and control measures of firedamp and coal dust explosions. Investigation after explosion.

Reopening of Sealed-off Area

Monitoring of atmosphere behind sealed-off area. Precautions to be taken before reopening. Methods of reopening.

Inundation


Rescue and Recovery


Enquiry Report Preparation
Electives (any one)

MN4105: MINE SAFETY ENGINEERING (3 Credits)

Safety scenario in Indian mines.

Causes of accidents, accident report.

Accident analysis and control.

Cost of accident.

Systems engineering approach to safety, techniques used in safety analysis.

Safety management and organisation.

Human behavioural approach in safety.

Emergency organisation for disaster management.
MN 4106: DRILLING AND BLASTING OF ROCKS (3 Credits)

Drilling of Rocks in Underground and Surface Mines


Blasting in Underground Mines


Blasting in Surface Mines

Principles of blast round design for single and multi-row. Blast round design in surface mines. Bulk explosives Initiation systems and accessories.

Evaluation Methods, Nuisances and Mitigation

Evaluation of drilling and blasting methods for underground and surface mines by use of state-of-art techniques and gadgets. Blasting nuisances and their mitigation for underground and surface mines.
MN4107: TECHNOLOGY OF UNDERGROUND EXCAVATION (3 Credits)

Tunnelling

Drilling and blasting, mucking, transportation support, ventilation and illumination. Tunnel boring machines – factors influencing its performance, choice of TBMs, types of TBMs.

Design and Construction of Large Underground Excavations

Shape, dimensions, structural behaviour, methods and sequence of excavations.

Power stations.

Storage caverns.

Metro and large diameter trenches for communication.

Nuclear waste repositories and excavations for defence purposes.
MN4108: NUMERICAL METHODS IN GEOMECHANICS (3 Credits)

Finite Difference Method

Concept, formation of mesh, finite difference patterns, solutions. Application in mining problems.

Finite Element Method

Concept, discretization into elements, element types, element stiffness, assemblage and solution. Simulation based on FEM.

Boundary Element Method

Concept, discretization, solution for isotropic and infinite media.

Application to Mining Engineering Problems.
B.TECH. (MINING ENGINEERING) PART – IV SEMESTER – VIII

MN4201: UNDERGROUND METALLIFEROUS MINING (3 Credits)

Status of Metalliferous Mining Industry in India

Development

Opening of deposits – shafts (vertical and inclined), declines and adits. Cross-cuts. Division of orebody into levels and blocks. Level interval.

Driving of raises – conventional and raise boring machines methods.

Stopping Methods


Special Mining Situations


Orebody and Host rock

Salient features, dilutions, type of dilutions, methods of dilution assessment, computation of net smelter returns of mine, economic considerations for selection of stoping methods.

Pillar Recovery Methods
MN4202: MINE LEGISLATIONS (4 Credits)


Relevant provisions of Indian Electricity Rules, Indian Explosives Acts and Rules.
MN4203: MINE PLANNING (3 Credits)

Basic Concepts


Preparation of Feasibility and Project Report


Production Planning and Scheduling

Mine Closure Planning

Mine Plans
Electives (any one)

MN4204: OPERATIONS RESEARCH IN MINING (3 Credits)

Introduction to Operations Research

Linear Programming & Dynamic Programming

Transportation – problems in mining, supply of coal from various mines to various destinations, cost optimisations and optimisations tools.

Network Analysis

CPM and PERT Analysis.

Inventory Models

Definition, deterministic models, probabilistic models and their applications to mining.

Non-linear Programming

MN4205: MINING INDUCED SUBSIDENCE ENGINEERING (3 Credits)

Causes – Effect of depth, width of excavation, seam thickness and angle of draw.

Types of subsidence – non-effective width, sub-critical, super-critical width.

Theories of subsidence, sub-surface subsidence due to mining.

Rock kinematics, Extent of movement in the overlying beds.

Special Methods of Mining to control subsidence.

Prediction and nomograms of subsidence.
MN4206: FUNDAMENTALS OF DRILLING TECHNOLOGY (3 Credits)

Drilling Methods


Principles of Drilling

Drilling mechanics, factors affecting rock drilling, alignment and deviation.

Exploratory Drilling

Diamond drilling – types, rocks, barrels, bits and wire line system.

Production Drilling

Percussive drilling – mechanism, types and methods. Constructional features, specifications, merits and limitations of various types of percussive drills machines.
Rotary blast hole drilling – classification, characteristics, performance and applications of rotary cutting and rotary crushing drilling techniques.

Miscellaneous Drilling Techniques

Water-jet assisted drilling, fire jet drill, drilling for coal field degassification and horizontal and directional drilling.
MN4207: FUNDAMENTALS OF ROCK MECHANICS INSTRUMENTATION  
(3 Credits)

**Basic Concepts**

Sensitivity, range, reproducibility and accuracy, drift, absolute and relative measurements, error, environmental factors and planning for instrumentation.

**Operating Principles**

Mechanical, pneumatic, optical, vibrating wire, piezoelectric, electrical and thermal.

**Field Instruments**

Load cells, MPBX, tape extensor meters, convergence recorders.

**Laboratory Instruments**

Load, stress, deformation, strain measuring instruments.

**Applications in Mining**

Coal mining – bord and pillar development, depillaring and Longwall.

Metal mining applications