

SYLLABUS FOR B.TECH. MINING ENGINEERING

BASKET IV

<i>Course Code</i>	<i>Course Title</i>	<i>Course Type</i>	<i>Credits</i>	<i>Prerequisite</i>
CCMN0101	<i>Mineralogy Petrology and Stratigraphy</i>	<i>Theory</i>	<i>3</i>	<i>Nil</i>
CCMN0102	<i>Geology for Mining Engineers</i>	<i>Theory</i>	<i>3</i>	<i>Nil</i>
CCMN0103	<i>Mine Environmental Engineering</i>	<i>Theory</i>	<i>3</i>	<i>Nil</i>
CCMN0104	<i>Surface Mining</i>	<i>Theory</i>	<i>3</i>	<i>Nil</i>
CCMN0105	<i>Underground Coal Mining</i>	<i>Theory</i>	<i>3</i>	<i>Nil</i>
CCMN0106	<i>Underground Metal Mining</i>	<i>Theory</i>	<i>3</i>	<i>Nil</i>
CCMN0107	<i>MINING MACHINERY – I</i>	<i>Theory</i>	<i>3</i>	<i>Nil</i>
CCMN0108	<i>MINING MACHINERY – II</i>	<i>Theory</i>	<i>3</i>	<i>Nil</i>
CCMN0109	<i>Mine Legislation and Safety I</i>	<i>Theory</i>	<i>3</i>	<i>Nil</i>
CCMN0110	<i>Mine Legislation and Safety II</i>	<i>Theory</i>	<i>3</i>	<i>Nil</i>
CCMN0111	<i>Mine System Engineering</i>	<i>Theory</i>	<i>3</i>	<i>Nil</i>
CCMN0112	<i>Drilling and Blasting</i>	<i>Theory</i>	<i>3</i>	<i>Nil</i>
CCMN0113	<i>Rock Mechanics</i>	<i>Theory</i>	<i>3</i>	<i>Nil</i>
CCMN0201	<i>Mineralogy Petrology Lab</i>	<i>Practical</i>	<i>2</i>	<i>Nil</i>
CCMN0202	<i>Geology for Mining Engineers Lab</i>	<i>Practical</i>	<i>2</i>	<i>Nil</i>
CCMN0203	<i>Rock Mechanics Lab</i>	<i>Practical</i>	<i>2</i>	<i>Nil</i>

CCMN0101 MINERALOGY PETROLOGY AND STRATIGRAPHY [3 0 0]

Mineralogy

Minerals: Physical and chemical properties; Crystal, crystal classes and systems; Classification of minerals and properties of common silicate minerals (Quartz, Feldspar, Pyroxene, Amphibole, Garnet, Olivine, Mica), sulphides (Pyrite, Chalcopyrite, Galena, Sphalerite) and oxides (Haematite, Magnetite, Chromite, Pyrolusite, Psilomelane).

Petrology

Igneous Rocks, Magma and lava, extrusive and intrusive forms, textures; Classification and description of some common igneous rocks (Granite, Dolerite, gabbro, Basalt, Rhyolite, Pegmatite). Sedimentary rocks: Sedimentation processes; Classification and description of some common sedimentary rocks (Conglomerate, Sandstone, Shale, Limestone). Metamorphic rocks: Processes of metamorphism, textures and structures of metamorphic rocks; Classification and description of some common metamorphic rocks (Slate, Phyllite, Schist, Gneiss, Quartzite, Marble).

Paleontology and Stratigraphy

Concepts of palaeontology; Fossils, their mode of preservation and significance as indices of age and climate; Concept of index fossils. Principles of stratigraphy; Broad stratigraphic subdivisions and associated rock types of important ore provinces, coal belts and oil fields of India.

CCMN0102 GEOLOGY FOR MINING ENGINEERS [3 0 0]

Structural Geology

Study of topographic maps; Attitude of planar and linear structures; Effects of topography on outcrops. Unconformities, folds, faults and joints - their nomenclature, classification and recognition. Forms of igneous intrusions - dyke, sill and batholith. Effects of folds and fractures on strata/orebodies and their importance in mining operations. Principles of stereographic projections of linear and planar features of rocks.

Economic Geology and Exploration Geology

Introduction and scope of economic geology; Ore and gangue; Processes of ore formation; Major Indian mineral deposits (Iron, Manganese, Copper, Lead, Zinc) distribution and mode of occurrence. Mineral Exploration – concepts and methods viz. surface and subsurface; Exploration strategy and design; Stages of exploration; Resources and reserves.

Coal and Petroleum Geology

Rank, characteristics and important constituents of coal; Classification and origin of coal; Chief characteristics of Indian coals; Geology of the principal coalfields of India. Concept

of organic constituents of petroleum origin, migration, accumulation, concept of traps and important petroliferous basins of India.

CCMN0103 MINE ENVIRONMENTAL ENGINEERING [3 0 0]

Mine fires: Causes and classification of mine fires; Spontaneous combustion mechanism, stages of spontaneous combustion, susceptibility indices, factors affecting spontaneous combustion; Detection and prevention of spontaneous heating and accidental fires; Dealing with mine fires □ direct and indirect methods, fire stoppings;

Re-opening of sealed-off areas; Fires in quarries, Coal stacks and waste dumps.

Mine explosions: Firedamp and coal dust explosions causes and prevention, explosive limits; Stone-dust and water barriers; Explosion in quarries over developed pillars; Investigation after an explosion.

Inundation: Causes and prevention; Precautions and techniques of approaching old workings; Dewatering of waterlogged working, safety boring apparatus, pattern of holes; Design and construction of water dams.

Rescue and recovery: Rescue equipment and their uses, classification of rescue apparatus; Resuscitation; Rescue stations and rescue rooms; Organisation of rescue work; Emergency preparedness and response system.

Airborne respirable dust: Generation, dispersion, measurement and control; Physiological effects of dust, dust-related diseases.

Illumination: Cap lamps; Layout and organisation of lamp rooms; Standards of illumination; Photometry and illumination survey.

CCMN0104 SURFACE MINING [3 0 0] Introduction

Surface mining - basic concepts, applicability, advantages and disadvantages; Role of surface mining in total mineral production; Deposits amenable to surface mining vis-à-vis excavation characteristics; Surface mining unit operations; Surface mining systems vis-à-vis equipment systems – classification, applicability, advantages and disadvantages.

Opening up of deposits

Box cut – objective, types, parameters, methods; Factors affecting selection of box cut site; Production benches – formation, parameters and factors affecting their selection.

Preparation for excavation

Ripper: Types, classification, applicability and limitations; Method and cycle of operation; Estimation of output; Concept of rippability. Estimation of number of drills required for a given mine production.

Discontinuous/cyclic methods of excavation and transport

Shovel-dumper operation: Applicability and limitations of electric shovel, hydraulic excavators and dumpers; Cycle time and productivity calculation for shovel and dumper; Estimation for equipment (shovel, dumper and other heavy earth moving machines) required for a given mine production; Method of work for sub-surface bedded and massive deposits and for hilly massive deposits by shovel – dumper combination. Dragline operation: Applicability and limitations, different modes of operation; Side cast diagram and calculation of reach; Cycle time and productivity calculation; Calculation of required bucket capacity for a given handling requirement; Maximum usefulness factor and its significance in selection of dragline for a given situation; Method of work by simple side casting. Scrapers: Applicability and limitations, various types; Method and cycle of operation; Pusher dozer and push-pull operation. Dozers: Applicability and limitations; Types and classification; Types of blade and corresponding merits and demerits; Method and cycle of operation. Front-end-loaders: Applicability and limitations; Method and cycle of operation; Minimum tipping- load – concept, estimation and significance; Calculation of maximum working load and selection of bucket capacity of a front-end-loader for a given job condition.

Continuous methods of excavation and transport

Bucket wheel excavators: Applicability and limitations; Types and principle of operation; Operational methods – lateral block / half block method, full block methods and their corresponding merits and demerits; Calculation of productivity. Continuous surface miners: Types, classification, applicability and limitations; Principles of operation; Operational methods – classification; Wide / full bench method, block mining method and stepped cut method; Empty travel back method, turn back method and continuous mining method; Conveyor / truck loading method, side casting method and windrowing method, Respective merits & demerits and applicability & limitations of these methods.

Conveyors: Shiftable and high angle conveyors; Mode of operation, applicability and limitations; Merits and demerits of conveyor as a system of transportation.

Semi-continuous methods of excavation and transport

Continuous excavation and partly/fully cyclic transport system: Different methods and applicability & limitations. Cyclic excavation and partly/fully continuous transport system: Different in-pit crushing and conveying methods and their respective applicability & limitations.

Mining of developed coal seams and dimensional stones

Mining of developed coal seams: Problems associated; Methods of working. Dimensional stones: Types, occurrences and uses; Methods vis-à-vis equipment for extraction of primary blocks in granite and marble quarries.

Slopes in surface mines

Types of mine slope – highwall and waste dumps; Common modes of slope failure; Factors influencing stability of slopes; Slope stability assessment techniques; Waste dumps - types and formation methods; Slope protection, stabilization and monitoring.

CCMN0105 UNDERGROUND COAL MINING [3 0 0]

Introduction: History of coal mining; coal resource and their geographical distributions; Coalification and factors affecting coalification process, modes of accumulation of coal, evidences in support of in-situ and drift theories; Geological time scale vis-à-vis formation of coal, occurrence and distribution of coal in various stratigraphic horizons; Coal seam structure and abnormalities, geological and other features of Indian coalfields.

Bord and Pillar Mining: Choice of methods of mining coal seams; factors affecting choice of mining methods. General principles of Bord and Pillar (B&P) development, different schemes of development and associated merits/demerits; Design of B&P workings, statutory provisions related to B&P workings, Semi-mechanised and mechanized schemes of B&P development; Mechanised face loading. Conditions suitable for mechanical loaders and continuous miners.

Pillar Extraction: Preparatory arrangement for depillaring operation, statutory provisions on depillaring; principles of designing pillar extraction, factors affecting choice of pillar extraction; partial and full extraction; depillaring with caving and stowing; mechanization in depillaring operation. Local and main fall, indications of roof weighting, measures to bring down roof at regular interval; air blast and measures to minimize its effects; precautions during depillaring operation against fire and inundation; multi-section and contiguous workings. Extraction of pillars in seams prone to bumps.

Longwall Mining: Factors affecting longwall mining, longwall face layouts, advancing and retreating faces, single versus double unit longwall faces, orientation of longwall faces; single versus multiple heading gate roads, factors affecting length and width of longwall panel. Extraction of Longwall panel, working with shearer and plough, support system of longwall face and gate roads, monolithic packing in longwall advancing gate roads; case studies of longwall faces in India.

Roof Supports: Timber props and cogs; friction/hydraulic props and chocks; other steel supports; types of roof bolts; function, applicability and advantage of roof bolting and cable bolting; powered supports; systematic support rules; supporting scheme of development gallery, B&P and L/W faces, depillaring district; withdrawal of support.

Conditions requiring stowing in mines; types of stowing; suitable materials for hydraulic stowing; stowing plant and stowing range; hydraulic gradient and hydraulic profile.

CCMN0106 UNDERGROUND METAL MINING [3 0 0]

Introduction:

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

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; Underground crushing, loading and hoisting. 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, longhole method including vertical crater retreat method of raising; Raise boring □ systems and their details; Modern methods of winzing; Secondary breaking at grizzly □ conventional and mechanised methods. Waste handling systems in underground workings **Stoping:**

Selection of stoping methods; Classification of stoping methods; Stoping of narrow ore bodies by underhand, overhand, breast, longhole 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 overhand and underhand cut-and-fill methods, square-set method and its variations, details of stope layouts, ground breaking, supporting, mucking, ventilation, haulage and dumping.

Mine supports:

Timber support: Post, drift-set of various types, square-set, crib-set, cog, stull and chock/chockmat supports; forepoling/piling; load bearing capacity of timber supports; bulkheads. Steel support: Steel set □ rigid and yielding types; tubbing, wire mesh, steel lining, screw jacks and ratchet jacks; 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, pack walls, 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; Paste fills; rock and concrete fills; surface arrangement for storage and mixing; pneumatic and mechanical methods of backfilling.) Reinforcement systems: Materials and techniques; rock bolts and dowels – different types and uses; mechanics of bolting; point anchored rockbolts - Slot

and wedge type, expansion shell type, grouted point anchor type; full column anchors - Wooden and fibreglass dowels, mechanical full column anchors, split sets/friction rock stabilizers, swellex, full column grouted rockbolts; installation and testing of rock bolts; cablen bolting □ its installation and applications. Innovations in support and reinforcement systems for hard rock mines.

MINING MACHINERY – I [3 0 0]

Classification, application, constructional features of drilling machines used in underground coal and metal mining, coal cutters, shearer, plough, continuous miner, road header and dint header, loading and transport equipment, man riding systems, free steered vehicles, shuttle car, ram car. Classification and constructional difference of different types of winders, mechanics of winding, power calculation, rope selection, inspection and maintenance. Safety features and automatic contrivances. Classification, construction, and selection of mine pumps and compressors

MINING MACHINERY – II [3 0 0]

Design, construction and operation of blast hole drills, rippers, shovels, hydraulic excavators, scraper, dragline, dumpers, wheel loaders, dozers, graders, surface miners, BWE, spreader, stacker & reclaimer. High capacity belt conveyors – constructional detail and selection procedures. Aerial rope ways – classification, layout and constructional features. Classification, application and constructional features of crushers, breakers and feeders.

CCMN0109 MINE LEGISLATION AND SAFETY- I [3 0 0] Mine Legislation

The Mines Act, 1952; The Coal Mines Regulations, 1957 The Metalliferous Mines Regulations, 1961

Mine Safety

Occupational hazards of mining; Accidents and their classification; Frequency and severity rates of accidents; Basic causes of accident occurrence; Place wise and Cause wise analysis; Measures for improving safety in mines; Cost of accidents.

Introduction to risk based safety and health management system; Methods of Risk assessment.

**CCMN0110 MINE LEGISLATION AND SAFETY –II [3 0 0] Mine
Legislation**

The Mine Rules, 1955; The Mines Rescue Rules, 1985; Provisions of Electricity Rules, 1961 relevant to Mining. Salient provisions of the Mines and Minerals (Development & Regulation) Act, 1957, Mineral Concession Rules, 1960, and Mineral conservation and Development Rules.

Mine Safety

Investigations into mine accidents and accident reports; Mine Emergency Management System

CCMN0111 MINE SYSTEM ENGINEERING [3 0 0]

Introduction to systems engineering:

Concept of system, sub system and system environment; Classification of systems; Systems analysis; Creative aspects of planning and design; Factors influencing creativity, techniques and alternative ideas/solutions.

Linear Programming:

Linear Programming models; Assumption of linear programming, Graphical and Simple method of solving Linear Programming Problems; Basic and Basic feasible solution, optimal solution, interpretation of SIMPLEX table. Primal and Dual Problem. Application of Linear Programming for solution of mining related problems of production planning, scheduling and blending.

Transportation and Assignment Problem:

Transportation models, Variations on Classical Transportation models, Solution. Algorithm for Transportation problem. Assignment model, Variations on Classical Assignment model; solution algorithm for Assignment problems. Application to mining problems.

Project Management with PERT & CPM:

Assumption of PERT and CPM; Methods of drawing network; Redundancy and identification of redundant jobs; Critical path calculation, Criticality index; Statistics related to PERT; Probability of completing a project by a due date, Lowest cost schedule: Case studies.

Network Models:

Introduction and concept; shortest route and minimal spannial tree problems, application to mining problems.

Simulation:

Introduction and concept; Scope and limitation; System type versus simulation technique; Generating input data; Monte Carlo simulation; Simulation of equipment maintenance and inventory systems in mines.

Inventory management:

Introduction, components and nature of inventory problems,; Classical E.O.Q model; EOQ model with quantity discount; Static and dynamic inventory problems.

CCMN0112 DRILLING AND BLASTING [3 0 0] Exploration Drilling

Boring for exploration; Various types of exploratory drills and their applicability Auger, Cable tool, Odex, Core Drills; Core recovery: single and double tube core barrels, wire line core barrel; Storage of cores; Interpretation of borehole data.

Explosives and Initiating Systems

Types of explosives, their composition and properties, classification; Selection of explosives; Manufacture, transport, storage and handling of explosives; Testing of explosives; Types of initiating systems, Electrical Detonators, Detonating Fuse, Detonating Relays, NONEL, Electronic Detonators, Blasting accessories, exploders.

Drilling & Blasting in Surface Mines

Drilling: Blasthole drills types, classification, applicability and limitations; Mechanics of drilling, performance parameters, drilling cost, compressed air requirement for hole cleaning; Selection of drilling systems, drilling errors, organization of drilling.

Blasting: Mechanics of rock fragmentation; Livingstone theory of crater formation; Factors affecting blasting, Blast design estimation of burden and spacing, estimation of charge requirement; Initiation patterns; Secondary blasting pop and plaster shooting; Problems associated with blasting, Ground vibration and air over pressure, Blast instrumentation

Drilling & Blasting in Underground Mines

Coal mines: Drilling systems and their applicability, blasting off solid, different blasting cuts, ring hole blasting, calculation of specific charge, specific drilling and detonator factor, initiation patterns. Metal mines: Drilling systems and their applicability, blast design for horizontal drivages, different blasting cuts, long hole blasting, vertical crater retreat blasting

CCMN0113 ROCK MECHANICS [3 0 0]

Rock mechanics:

Definition, history, inherent complexities, source of information and field of application of rock mechanics. Concept of stress and strain in rock Analysis of stress, strain and constitutive relations in isotropic and anisotropic rocks.

Physico-mechanical properties of rock:

Determination of physical properties, strengths, strength indices and static elastic constants; Parameters influencing strength; Abrasivity of rock and its determination.

Dynamic properties of rock and rockmass

Propagation of elastic wave in rock media; Determination of dynamic strength and elastic constants of rock.

Time dependent properties of rock:

Creep deformation and strength behaviour; Creep test and rheological models. Strength and Deformability of Rock Mass: In situ shear tests; Evaluation of shear strength; In situ bearing strength test; In situ deformability tests-Plate Loading Test, Plate Jacking Test and Borehole Jack Tests

Failure criteria for rock and rockmass

Theories of rock failure; Coulomb, Mohr and Griffith criteria; Empirical criteria.

Pre-mining state of stress:

Sources, methods of determination including over coring, hydro-fracturing methods and other methods.

Physico-mechanical properties of soil

Origin of soils; Basic relationships; Index properties including consistency and gradation; Clay mineralogy; Classification of engineering soils; Engineering properties of soils compressibility, consolidation, compaction and strength **Ground water:**

Free and confined groundwater; Exploration and engineering importance of groundwater; Influence of water on rock and soil behaviour; Permeability of rocks; Measurement of permeability; Ground water flow in rockmass; Groundwater pressure in rockmass and its measurement

CCMN0201 MINERALOGY AND PETROLOGY LAB [0 0 2]

Mineralogy

Study of physical properties of:

- (A) Rock forming minerals: Talc, Gypsum, Calcite, Fluorite, Feldspar (Orthoclase, Microcline, Plagioclase), Muscovite, Biotite, Quartz, Beryl, Tourmaline, Corundum, Kyanite, Serpentine, Garnet and Sillimanite
- (B). (B) Ore minerals: Haematite, Magnetite, Chalcopyrite, Malachite, Azurite, Chromite, Bauxite, Pyrolusite, Psilomelane, Sphalerite, Galena

Petrology

Study of common rocks with reference to their structures, mineral composition and uses.

(A) Igneous Rocks: Granite, Syenite, Gabbro, Basalt, Dolerite, Lamprophyre, Aplite, Pegmatite.

(B) Metamorphic Rocks: Slate, Schists, Gneisses, Quartzite, Marble, Amphibolite, Charnockite.

(C) Sedimentary Rocks: Conglomerate, Sandstone, Shale, Carbonaceous Shale, Coal, Limestone

CCMN0202 GEOLOGY FOR MINING ENGINEERS PRACTICAL [0 0 2]

Study of topographic maps; Completion of outcrops : 1 – and 3 – point problems; Map illustrating ‘V’ rules; Calculation of attitude, thickness and depth of orebodies; Fracture patterns in rose diagram; Maps illustrating fold, fault and unconformity; Stereographic projection.

CCMN0203 ROCK MECHANICS [3 0 0]

Rock mechanics:

Definition, history, inherent complexities, source of information and field of application of rock mechanics. Concept of stress and strain in rock Analysis of stress, strain and constitutive relations in isotropic and anisotropic rocks.

Physico-mechanical properties of rock:

Determination of physical properties, strengths, strength indices and static elastic constants; Parameters influencing strength; Abrasivity of rock and its determination.

Dynamic properties of rock and rockmass

Propagation of elastic wave in rock media; Determination of dynamic strength and elastic constants of rock.

Time dependent properties of rock:

Creep deformation and strength behaviour; Creep test and rheological models. Strength and Deformability of Rock Mass: In situ shear tests; Evaluation of shear strength; In situ bearing strength test; In situ deformability tests-Plate Loading Test, Plate Jacking Test and Borehole Jack Tests

Failure criteria for rock and rockmass

Theories of rock failure; Coulomb, Mohr and Griffith criteria; Empirical criteria.

Pre-mining state of stress:

Sources, methods of determination including over coring, hydro-fracturing methods and other methods.

Physico-mechanical properties of soil

Origin of soils; Basic relationships; Index properties including consistency and gradation; Clay mineralogy; Classification of engineering soils; Engineering properties of soils compressibility, consolidation, compaction and strength **Ground water:**

Free and confined groundwater; Exploration and engineering importance of groundwater; Influence of water on rock and soil behaviour; Permeability of rocks; Measurement of permeability; Ground water flow in rockmass; Groundwater pressure in rockmass and its measurement