

BASICS OF ENGINEERING

Mining – definition and economic importance; Mine – definition, different types and classification; Mine life cycle; Mineral deposit – different types and their classification; Mineral resources of India; Modes of entry to a mine – shaft, incline, decline, adit and box-cut. Overview of surface mining: Types of surface mines, unit operations, basic bench geometry, applicability & limitations and advantages & disadvantages. Overview of underground mining: Different coal mining methods and their applicability & limitations; Different metal mining methods and their applicability & limitations; Basic concepts of transportation, ventilation, illumination and support in underground mines.

DRILLING AND BLASTING

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

MINE SURVEYING

Surveying: Definition, objective, classification and principles of surveying.

Linear Measurement: Instruments for measuring distances; Ranging and taping survey lines; Chain surveying – principle, field work, off-sets, booking and plotting, obstacles in taping.

Angular Measurement: Bearing of lines; Rectangular coordinate system; Essentials of the micro-optic theodolite; Measurement of horizontal and vertical angles; Temporary and permanent adjustments; Theodolite traversing; Computation of co-ordinates; Adjustment of traverse; Temporary and permanent adjustments.

Levelling: Definition & terminology; Levelling instruments types - tilting, auto set and digital levels; Levelling staves; Different types of levelling - differential, profile, cross-sectional and reciprocal levelling; Booking and reduction methods; Underground levelling; Temporary and permanent adjustments of levels.

Total Station: Principle of electronic measurement of distance and angles; construction and working with Total Station; Errors; Application and recent developments in Total Station.

Plane Table Surveying: Methods

Contours: Concepts; Characteristics of contour; Contour Interval; Methods of contouring and uses of contours. Computation of areas and volumes

MINERALOGY, PETROLOGY AND STRATIGRAPHY

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.

MECHANICAL ENGINEERING CONCEPTS:

Introduction to Strength of Materials; Stress-strain diagram; Elastic constants and their relations, Thermal stresses and strains, Stresses in oblique planes - Principal stresses and principal planes. Theory of simple bending; Deflection of beams - integration method and moment area

method. Analysis of stresses in pressure vessels - thin and thick cylinders. Torsion of solid and hollow circular Shafts. Introduction to theory of Machines; Basic concepts: degrees of freedom, kinematic constraints, linkages, mechanisms. Different types of gears, gear trains, reduction ratio and torque assessment, application of gearboxes. Basic principles and constructions of governors, flywheels, brakes, clutches and dynamometers.

MINE DEVELOPMENT

Opening-up of Deposits: Choice of mode of entry – adit, shaft, decline and combined mode, their applicability, number and disposition.

Vertical and Inclined Shafts: Location, shape, size, and organisation of shaft sinking, construction of shaft collar, shaft fittings.

Shaft Sinking Operations: Ground breaking and muck disposal – tools and equipment, lining; ventilation, lighting and dewatering; sinking in difficult and water-bearing ground.

Insets: Design, excavation and lining.

Mechanised Sinking: Simultaneous sinking and lining; slip - form method of lining; high speed sinking.

Shaft Boring: Methods and equipment.

Special Attributes: Widening and deepening of inclined and vertical shafts; staple shafts, raised shafts.

Main Haulage Drifts and Tunnels: Purpose, shape, size and location; excavation – ground breaking, muck disposal, ventilation and supporting.

High Speed Drifting/Tunnelling: Application of mechanised methods; roadheaders and tunnel boring machines.

Recent Developments in shaft sinking and drifting/tunnelling.

Layouts of pit-top and pit-bottom, Coal Handling Plant, Bunkers and Railway Sidings.

MINE SURVEYING

Mine Plans and Sections: Statutory requirements of Mine Plans and Sections, accuracies, scale.

Control Surveys: Triangulation – classification; Reconnaissance; Procedures for angles and base-line measurement; Comparison with precise EDM traversing.

Gyro-North Determination: Principle of Gyro-theodolite/Gyromat; Determination of Gyro-north. Correlation: Methods of correlation – direct traversing in inclined shaft, correlation in vertical shaft – single and two shafts, Gyro-Laser combination; Shaft depth measurement. Development Surveys: Control of direction and gradient in drifts, tunnels, raises, winzes. Slope Surveying: Purpose; Methods of survey in moderately and steeply inclined ore bodies, flat and vertical ore bodies/seams.

Slope Monitoring in Opencast Mines: Geodetic and Remote Sensing Methods, Slope Stability Radars.

Subsidence Monitoring: Subsidence Monitoring of subsidence due to underground mining activities.

GPS: Principle of GPS; Instrument; Errors and working with GPS; Application of GPS in mine surveying; Developments in satellite based Navigation system. Application of Automation & IT in surveying: Data acquisitions; Preparation of plans and sections; Calculation of earth works. Introduction to Surveying softwares. Application of GIS and Remote Sensing in Surveying MINE. Precise Levelling and distribution of closing error; Study and sketch of Digital Level; Detailed surveying and contouring with Total Station; Working with SURPAC and preparation of Mine Plan; Earthwork calculation using SURPAC and plotting; Plotting of sections using LISCAD; Study and practice of Gyro-theodolite/Gyromat; Study of GPS and data collection; GPS data downloading and post-processing; Study of Nadir Plummet and LASER for Correlation survey; Subsidence monitoring using 1" – Micro-optic Theodolite & Precise Level

GEOLOGY FOR MINING ENGINEERS

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

ROCK MECHANICS

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.

Engineering classification of rocks and rock masses: Classification systems in rock engineering; Classification of intact rocks; Classification of rockmasses-Terzaghi's rock load, RQD, Rock Structure Rating, Bieniawski's RMR, Barton's Q-System, Laubscher's-MRMR, Hoek's-GSI, Palmstrom's RMI, CMRI-ISM Rock mass classification and Recent developments; correlations between different classification systems; Applications of Rockmass Classification in rock engineering

SURFACE MINING:

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.

UNDERGROUND COAL MINING

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.

UNDERGROUND METAL MINING

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; cable bolting – its installation and applications.

Innovations in support and reinforcement systems for hard rock mines

MINE ELECTRICAL ENGINEERING

Concept of earth fault current limitation in underground (UG) mine power systems, Type of electrical power supply systems for UG coal mines, solidly-earthed, restricted-neutral and insulated-neutral systems of power supply-their comparison.

Earth fault protection techniques for various types of mine power supply systems, sensitive and fail-safe earth fault relays.

Mining type circuit breaker-air circuit breaker, vacuum and SF₆ breaker, Tran switch unit, Gate-end box, drill panel, Remote control and inter- lock circuits for mining type circuit breakers.

Electrical power planning for mechanized longwall coalfaces, General electrical distribution scheme, voltage drop problems and remedial measures, Inbye substation capacity selection Haulage signaling and longwall face signaling systems, Illumination planning for UG coal mines roadway lighting systems, intrinsically safe lighting systems for longwall faces. Shaft signaling system.

Earthing practice in mines: earth pits, earthing of mobile electrical equipment in mines, mining cable-types and construction, Selection of cable size.

Principle of flame-proof enclosure, intrinsically safe circuit, Methods of attaining intrinsic safety, Zener safety barriers and their applications. Indian electricity rules as applied to mines/CEA

Mine Winder – AC & DC Drives for winders, Static Ward-Leonard drive for D.C.

Winder, AC winder with liquid controller. Electrical braking of winders – Plugging & Dynamic braking. Winder depth and speed indicator. Automatic contrivances – overspeed, overwind, slack rope and rope slip detector system.

Design of power supply system in mines: load assessment, electrical layout diagram, selection of transformers and technique of power factor improvement

MINE VENTILATION

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; Methanometers; Methane layering; Radon gas and its daughter products; Monitoring of gases.

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.

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, evasees; Booster and auxiliary ventilation; Venturi blowers; Ventilation of deep mines – underground and open pit.

Ventilation planning: Planning of ventilation systems and economic considerations; Ventilation layouts for underground coal and metal mines; Calculation of air quantity required for ventilating a mine; Calculation of total mine head; Ventilation network analysis principles and computer applications; Ventilation surveys

SURFACE MINE PLANNING & DESIGN

Introduction

Stages/Phases of mine life; Preliminary evaluation of surface mining prospects; Mine planning and its importance; Mining revenues and costs - calculation of FW, PV, NPV, IRR, payback period, depreciation by different methods, cash flow and ACFC; 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; Classification of ore reserves.

Stripping ratio

Concept of stripping ratio; Types of stripping ratios and their significance; Choice between surface and underground mining.

Geometrical considerations Basic bench geometry;

Pit layouts. 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-off grade; Introduction to production scheduling.

Analysis and design of highwall slopes and waste dumps

Pit slope geometry; 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

Addition of haul road on pit plan; 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

MINING MACHINERY

Classification, application, constructional features of drilling machines used in underground coal and metal mining, coal cutters, shearer, plough, continuous miner, road header and dirt 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.

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.

MINE ENVIRONMENTAL ENGINEERING

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.

MINE LEGISLATION AND SAFETY

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.

COMPUTER AIDED MINE PLANNING

Introduction to strategic open pit planning and design; concepts of optimization in open pit design; Introduction to Mine Planning & Surveying software (SURPAC and others) – data acquisition, data representation and processing, database creation and management, computations of various parameters, digital terrain model (DTM), interpolation of data on triangular or rectangular grid points, reduction of data into presentable form, sectioning, compositing, solid modelling, autoplotting, 3D modelling, block modelling and determination of ultimate pit configuration (UPC).

OPEN PIT SLOPE ANALYSIS AND DESIGN

Introduction

Types and formation of slopes in surface mines, pit slope vis-à-vis mine economics, mechanism of common modes of slope failure, factors influencing stability of slopes, and planning of slope stability investigations.

Geotechnical Information

Geotechnical data required for highwall slope stability studies. Collection of Geological Data and their interpretation for stability studies of highwall slopes.

Shear Strength

Shear strength of intact rock, discontinuity surfaces, filled discontinuities and rock-mass - estimation and determination; Surface roughness, joint roughness coefficient - estimation and determination.

Water Flow

Concepts of water flow through a material and its permeability; water flow through rock-mass, water flow through soil type material and broken spoil material; Estimation and measurement of permeability and water pressure; Graphical solution of seepage problems (flow nets), seepage forces and seepage patterns under different conditions.

Analysis and Design of Pit Slopes and Waste Dumps

Slope stability assessment methods and techniques; Analysis and design criteria and methodology for highwall slopes and backfill and waste dumps; Probabilistic approaches of slope analysis and design.

ENVIRONMENTAL ASPECTS OF MINING

Introduction: Sustainable development, environmental carrying capacity - concepts & principles; Environmental impacts of mining and associated activities.

Ecology: Introduction to ecology, ecosystem structures and functions.

Air pollution: Atmospheric composition and meteorology; Sources of air pollution - point and non-point; Emission factors; Control measures - extraction, suppression and consolidation of dust.

Noise and vibration: Basic concepts, sources, monitoring and control measures.

Water pollution: Global hydrological cycle; Self-purification mechanism, sources of water pollution, important parameters-pH, turbidity, oil & grease, nitrates, DO, BOD, COD; Eutrophication, deoxygenation, acid mine drainage and heavy metal pollution- preventive and control measures.

Land environment: Land degradation due to mining; Physical and biological reclamation.

Environmental administration: Laws related to mining environment; EIA of mining projects.

Land Acquisition & Revenue: Concepts: Related laws and regulations.

Corporate Social Responsibility: Concepts and principles.

Mine closure: Concepts and principles.

MINE SYSTEM ENGINEERING

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 spanial 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.

Note: the above syllabus is indicative and not exhaustive