

SEMESTER-III

NUMERICAL ANALYSIS AND PROGRAMMING (MA 3103)

Numerical computation and error, solution of algebraic and transcendental equations- Bisection method, Regula-Falsi method and Newton-Raphson method and their order of convergence. Iterative methods for system of non-linear equations. Linear system of equations: Gauss elimination method, Crout's method, Jacobi's method, Gauss-Seidel method. Computer programming of above methods.

Finite differences, difference operators and symbolic relations, difference of a polynomial, Interpolation, error in interpolation, Newton's forward and backward formulae, Lagrange's interpolation formula, Newton general interpolation formula, Numerical differentiation, error in numerical differentiation. Numerical integration: Newton's cote's formula, Trapezoidal rule, Simpson 1/3 rule, Simpson 3/8 rule and their error estimation. Computer programming of above methods.

Ordinary differential equations: Taylor's series method, Euler's method, Euler's modified method, Runge-Kutta method, Boundary value problem-linear and non-linear equations. Computer programming of above methods.

MATERIAL SCIENCE (A) (ML 3101)

1. Atomic Bonding:- Classification of Engineering Materials, Ionic, Covalent, Metallic and Vander Walls Bonding. Effect of types of Bonding on properties of materials.
2. Structure of Solids:- Crystalline Solids, Crystal System, Unit Cells, Space Lattice, Miller Notations, Structure in Metallic Elements, Ionic and Molecular Crystals, Imperfection in Crystals.
3. Introduction to Iron Carbon Diagram and Principles of Heat Treatment. Annealing, Normalizing, Hardening, Tempering, T-T-T Diagram etc. recovery, recrystallisation and grain growth. White Cast Iron, Grey, Spheroidal Graphite, Malleable Cast Iron, their properties and applications.
4. Brief Introduction to Polymer, Ceramics, Composite Materials and Their Application as Engineering Materials.

MATHEMATICS – III (MA 3104)

LAPLACE TRANSFORMATION :- Definition of Laplace transform and linearity and shifting property, Laplace transform of elementary functions, Inverse Laplace transform, Laplace transform of derivative and integration, convolution theorem, Solution of differential equation by Laplace transform, Unit Step function, Unit impulse function.

VECTOR CALCULUS :- Differentiation of vector function, gradient, divergence, curl and their geometrical or physical interpretation, Line, Surface and Volume integrals, Statement of Green's Theorem , divergence theorem and Stoke's theorem and their applications. Curvilinear co-ordinates.

FOURIER SERIES :- Fourier series, Dirichlet's conditions, Half Range series.

FOURIER TRANSFORM :- Definition of Fourier Transform, linearity, shifting, frequency theorem, Fourier transform of derivatives and Dirac-delta function, Inverse Fourier transform, Fourier Sine and Cosine transform, Solution of simple differential equation by Fourier transform method.

Z- TRANSFORMATION :- Definition, Z-transformation of standard sequences, linearity property, Shifting theorem, inverse of Z-transformations, Scaling property of Z-transformation, differentiation of Z-transformation, convolution of sequences, solution of difference equations by Z-transformation.

MECHANICS OF SOLIDS – I (ME 3103)

Introduction and fundamental concepts: Introduction purpose and scope of the subject. Generalized procedure, Basic assumption, Types of forces (External and Internal forces), method of sections, constitutive laws, Elastic material, principle of superposition, St. Venant's Principle, Tensile test, Generalized Hook's law for isotropic and linear elastic material.

Simple stress and strain : Uniaxial tension or compression of a bar (prismatic and non prismatic) Cases of simple shear, shear strain components in terms of shear stress. Biaxial and tri-axial tension or compression. Thermal stress and strain. Statically determinate system of bars in tension (or compression), thin walled pressure vessels. Cylindrical and spherical shells.

Shearing force and Bending moment : Use of singularity functions in drawing B.M.D. and S.F.D.

Stress due to bending : Pure bending of beams. Normal stress and shear stress distribution in a beam subjected to both B.M. and S.F.

Deflection due to bending, Double integration method, Moment area method.

Torsion : Torsion of solid and hollow circular shaft. Torsion of hollow thin walled shaft. Closed coiled spring Flanged coupling.

Two-dimensional stress analysis : Plane stress, stress components on a general plane at a point. Mohr's circle of stress.

Cases of combined loading : Bending with tension (or compression). Eccentrically loaded member; Core of section, Torsion and shear. Torsion and bending. Cases of Transmission shafts subjected to bending tension or axial thrust.

Elastic strain energy and its application. Elastic strain energy of a rod under various kinds of loading. Elastic strain energy for various states of stress. Simple application. Castigliano's theorem.

ENGINEERING GEOLOGY – I (GE 3101)

Introduction : Introduction of Geology in Mining Engineering

Physical Geology : Weathering & Erosion, Drainage Pattern, Denudational agents, Geological work of River, Wind & Glacier

Earthquake, causes and mechanism ; Seismic Zones of India

Interior of the Earth

Structural Geology : Dip & Strike, Contour, Stratification, Lamination, Bedding, Linear & Planar Structures, Fold, Fault, Unconformity & Joints - their classification and recognition in the field.

Crystallography : Concept of Symmetry in crystals ; Normal Classes of each Crystal System

Mineralogy : Introduction, Physical, Chemical,& Optical properties and Mode of Occurrence of minerals, Structural classification of Silicates, Mineral Groups : Olivine, Pyroxene, Amphibole, Feldspar, Silica & Mica

Petrology :

Igneous – Magma and its classification, Forms, Texture, Structure and Classification of Igneous rocks, Differentiation of basaltic magma, Petrographic studies of Pegmatite, Granite, Granodiorite, Diorite, Syenite, Gabbro, Dolerite, Basalt, Anorthosite, Dunite, Peridotite, Rhyolite, Trachyte

Sedimentary – Texture, Structure and Classification of Sedimentary rocks, Petrographic studies of Shale, Sandstone, Arkose, Limestone, Conglomerate & Breccia

Metamorphic – Definition, agents and types of metamorphism, Concept of Zone, Grade and Facies, Petrographic Studies of Marble, Quartzite, Slate, Phyllite, Schist, Gneiss & Charnockite

Hydrogeology – Introduction, Hydrological Cycle, Vertical distribution of Ground Water, Aquifers. Darcy's law, Hydrological Properties of Rocks, Ground Water Provinces of India

FLUID MECHANICS (ME 3106)

INTRODUCTION:

Concept of continuum, difference between fluid mechanics and solid mechanics, brief history of classical hydraulics, hydrodynamics and fluid mechanics.

Characteristic properties of fluids, ideal and real fluids, Newtonian and non-Newtonian fluids viscosity, surface tension, capillarity, compressibility, fluid statics and buoyancy.

FLUID KINEMATICS:

Streamlines, path lines, streak lines, velocity potential functions and stream functions, laminar and turbulent flows, steady and unsteady flow, rotational and irrotational motion, circulation, vorticity, velocity and acceleration.

FLUID DYNAMICS:

Conservation of mass, principle of momentum and energy, moment of momentum, equation of motion, Euler's equation, and introduction to Navier-Stokes equation, energy equation, hydraulic and energy gradients.

LAMINAR FLOW:

Flow through pipes, frictional and other losses.

TURBULENT FLOW:

Fully developed flows, boundary layer theory, rough and smooth pipe flows.

DIMENSIONAL ANALYSIS:

Similitude of fluid flows, hydraulic modeling, non-dimensional parameters(Reynolds's, Froude's, Euler, Weber and Mach numbers)

FLOW MEASUREMENTS:

Piezometer, manometers, pressure gauges, pitot tube, orifices, notches and weirs, orifice meter, venturimeter.

FORCES ON IMMERSED BODIES:

Drag and lift, aerofoil section.

SEMESTER-IV

MATHEMATICS – IV (MA 4105)

SPECIAL FUNCTIONS :- Series solution of differential equations, Bessel and Legendre's equations and their series solution, elementary properties of Bessel's function and Legendre's polynomial.

COMPLEX VARIABLE:- Analytic function, Cauchy- Riemann equation. Complex Integration, Cauchy's theorem and Cauchy Integral formula. Taylor and Laurent's expansion. Poles and Residue, Residue theorem. Conformal transformation, Bilinear and Schwartz's transformations.

PARATIAL DIFFERENTIAL EQUATION :- Formulation of partial differential equation, Linear and non-linear partial differential equations of the first order, Lagrange's method and Charpit's method. Higher order Partial Linear differential equations with constant coefficients. Method of separation of variables. Equation of vibrating strings, heat flow, Laplace's two dimensional equation and simple problems.

PROBABILITY AND STATISTICS (MA 4106)

Probability: classical and axiomatic definitions, addition law, conditional probability, multiplication law, total probability, Baye's theorem and independence of events.

Random variables: Discrete and continuous random variables, probability mass, probability density and commutative distribution functions. Mathematical expectation, variance, moment and moment generating function, Chebyshev 's inequality.

Regression Analysis: Linear regression, principle of least square, non-linear regression, correlation, coefficient of correlation, Rank correlation.

Distributions: Binomial, Hypergeometric, Geometric, Poisson and Normal distributions.

Sampling Distribution: Population samples, sampling distribution, estimate for population mean and variance, point of estimation, confidence interval for mean and variance of normal population, Testing of hypothesis, the critical and acceptance region, two type of errors, Chi-square, t-student and F distributions.

Analysis of Variance: completely randomize design and randomized block design, Quality control, control charts(X-chart, R-chart, P-chart and C-chart).

SURVEYING – I (CE 3101)

1. Introduction :- Importance & Principle of surveying, classification of survey, conventional signs.
2. Measurements of distance: - Instruments used, chain, tape, optical square, offset rods, chaining on sloping ground, errors in chaining, corrections to tape measurements.
3. Measurements of Angles & Direction :- Instrument used, prismatic compass, reference meridians, Bearings, magnetic declination, local attraction.
4. Measurement of elevations :- Leveling instruments, temporary adjustment, methods of leveling, curvature & refraction correction, reciprocal leveling, profiles.
5. Contouring :- Characteristics , methods, uses, Drawing of contour maps. Representations of relief.
6. Plane table survey :- Instruments used, Methods of plane table surveying, traversing by plane table, two points & three points problem.
7. Theodolite & Theodolite traversing :- Types of theodolites, Temporary adjustments, errors in theodolite & removal, measurement of Angles, traversing with theodolite, plotting of traverse, omitted measurements.
8. Tacheometry :- Definition, Principle of stadia, Determination of instrument constant , use of stadia measurement.
9. Simple curve :- Definition , types of curves, elements of curves, setting out curves.

ELECTRICAL ENGINEERING FOR MINES (EE 4108)

Transmission and distribution layouts of electrical energy w. r. to surface and under ground installations, Load factor, diversity factor and tariffs , distribution of electrical power in mines (mechanized , semi- mechanized and conventional surface and under ground mines. Introduction to pit –top and pit- bottom sub-stations : layouts and schemes.

Metering equipments – Energy meter, Maximum demand meter, Power factor meter and Tri-vector meter.

Different types of cables, including mine cable, junction box , mining switch of cars/ locomotives .

Principles of flame proof enclosures, FLP mine equipments and the associated safety devices , principles of intrinsic safety and intrinsically safe apparatus .

Protective relays in mine power system , earthing, power factor improvement concepts: synchronous condenser, capacitor bank etc.

Indian electricity rules with reference to mines, safety principles , Principles and characteristics of synchronous , synchronous induction and induction motors and their uses in mines for different drives. principles of thyristors and their applications in mine drives .

Starting and speed control of synchronous , synchronous induction and induction motors.

Gate- end box ,drill panel and signaling and lighting (u. g.& surface) system, alarm annunciators .

Electrical concepts related to drills, shovels , dumpers, conveyors and coal face machines.

Introduction to Electronics and Communication in mining , on- line monitoring and display tools.

INTRODUCTION TO MINING TECHNOLOGY (MN 4101)

Definition and scope of mining, definition of mining terms.

Boring: Principle of boring and purpose of boreholes; methods of boring; borehole deflection and deviation.

Explosive and Blasting: Definition, classification, composition and property of different types of explosives; detonator, detonating cord, nonel detonators. Storage and transportation of explosives; accident due to explosives and safety provisions.

Blasting Methods: Underground and surface mining blasting practices; priming, charging, stemming and shot firing.

Opening of mineral deposits: Types of mine openings, selection, location, shape and size of different types of openings. Drivage methods for adits and inclines and cycle of operation, support of adit and their mouths.

Conventional and special methods of shaft sinking, shaft lining (temporary and permanent), surface arrangements, ventilation, pumping and illumination arrangement

during shaft sinking, widening and deepening of shafts, drivages and lining of insets, simultaneous sinking and lining, shaft fittings.

ENGINEERING GEOLOGY – II (GE 4103)

Stratigraphy – Principles of Stratigraphy ; Geological Time Scale ; Stratigraphic Correlation, Physiographic Divisions of India, Achaean, Vindhyan, Gondwana & Tertiary formations of India

Economic Geology :

Ore, Gangue, Tenors of Ores, Grade, Assay value, Cut Off grade ; Processes of formation of Mineral deposits - Magmatic Concentration, Hydrothermal Processes, Placer Deposits & Supergene Sulfide Enrichment deposits.

Distribution, mode of occurrence, genesis and uses of following deposits :

Iron, Copper, Aluminum, Manganese, Lead & Zinc, Radio active Minerals

Mica, Asbestos, Kyanite, Limestone and Gypsum

Mineral Exploration :

Geological, Geophysical and Geochemical Prospecting - principles and methodology.
Principles of Ore beneficiation.

Coal Geology – Introduction, Coal Petrography, Origin, Classification, Structural features of Coal seams, Distribution of Coal in India, Study of Jharia, Bokaro, Raniganj & Neyveli Coal Fields of India.

Oil & Natural Gas – Introduction, Origin, Classification, Accumulation, Migration, Cap rocks, Traps, Distribution and Surface indication of oil & gas, Study of important Indian Oil fields such as Digboi, Cambay & Bombay High.

SEMESTER-V

UNDERGROUND COAL MINING METHODS (MN 5102)

Introduction to Mine Planning: Size of mining property, reserves and production capacity.

Opening of Deposits: Developments of mine for in-seam mining and horizon mining (including shaft pillar and their comparison, advantages and disadvantages), division into levels and districts.

Bord and Pillar method of working:

Development: General principle of Bord & Pillar Development, their choice, suitability, advantages and disadvantages, layout of Bord & Pillar panel, size of panel, statutory provisions, manual and mechanized system of development; conditions suitable for application of mechanized loader and continuous miners; factors affecting the selection of equipment.

Pillar Extraction: preparatory arrangement for depillaring operation, statutory provision for depillaring, principle and designing of pillar extraction, size of a district, factors affecting choice of pillar extraction, depillaring with caving, stowing, mechanised depillaring operation, organization and safety. Layout for required outputs, types of machines, personnel and working of thick seams in two or more sections in brief.

Longwall Mining: Longwall methods of working, their choice, suitability, advantages and disadvantages. Layout of the workings for the required output, length and orientation of longwall faces, Shape & size of development roadways and gate roads and their maintenance. Mechanised longwall face organisation.

Mechanized extraction of longwall panel with shearer and plough; support systems of longwall face and gate roads.

SURFACE MINING METHODS (MN 5103)

Basic Concept of Surface Mining: Status of surface mining in India. Selection between surface mining and underground mining. Preliminary evaluation of surface mining prospects; stripping ratio -- concepts and significance, mine life.

Opening up of deposits with Box Cut: Factors affecting selection of site of box-cut, Production benches -- formation parameters and factors affecting their selection.

Preparation for Excavation: Working principle of ripper and Scraper-- their cycle of operation, application and limitation. Drilling and blasting: drilling principles, types of blast hole drills, performance parameter of drills, estimation of number of drill for a given mine production, blast design, determination of charge weight, factors affecting blast design, calculation of charge required per hole, secondary blasting, fragmentation principle. Problems associated with drilling and blasting.

Excavation and Transportation: Cyclic methods-- shovel-dumper, pay-loader, dragline. Continuous methods -- bucket wheel excavator, bucket chain excavator, continuous miner, conveyors. Principle and operation of these machines, their advantages and limitations, capacity calculations, maintenance.

Design and organization: Basic design principle of large opencast mines and their organizational structure. Mechanised quarries over underground developed zones.

MINE SURVEYING (MN 5104)

Surveying Instruments: Mining theodolite, miner's dial, loose and fast needle traversing with miner's dial, EDM & Total Station -- their applications. Introduction to Gyro-theodolite & GPS.

Correlation Survey: Correlation of underground and surface surveys and different methods of correlation-- connection through adit, incline and shafts, method of connection through single or double vertical shafts. Corrections by means of magnetic needle.

In-pit Survey: Setting out a point of known rectangular co-ordinate. Control of directions and gradients for inclined shafts, slopes, levels and tunnels. Maintaining alignments,

simple curve laying underground, laying out and fixing of mine boundaries claims, subsidence surveys on surface and underground. Volume calculations.

Stope Surveying: Stope surveying with Hanging Compass and Alignometer, tape triangulation, radiation and other methods.

Mine Plans and Sections: Legal requirements as to mine plans and sections in India, preparation and preservation of plans and sections, representation of geological and other surface and underground features on mine plans and sections.

Astronomy: Astronomical terms and definitions, Introduction to field astronomy, determination of true meridian, latitude, longitude and time including hour angle.

MINING MACHINERY-I (MN 5105)

Prime Mover for Mining Machinery: I.C. engine, hydraulic power, pneumatic power, elements of mechanical power transmission -- gear, belt, chain, coupling, clutch and brake.

Rope haulage: Construction of the wire ropes, rope haulages -- gravity, direct, balanced direct, main & tail, endless, reversible endless. Suitability of these haulages and their limitations. Dimension of ropes, drum and pulleys, care and maintenance of ropes, changing of haulage ropes, rope splicing, safety appliances in haulage road, signaling, Statutory requirements of haulages.

Track Laying: Rails, joints, crossings, plates, turn tables, and curves, track extension

Aerial Ropeways: Types, construction, application and operation

Mine Locomotives: Types, constructional features of compressed air, diesel, battery and electric trolley-wire locomotives, comparison of various locomotive haulages, comparison of rope and locomotive haulages.

Conveyors: Principle types and their operations, installation, shifting, maintenance and applicability, shuttle cars, stage loaders, bridge conveyors, capacity.

Drills for Coal and Stone: Various types, their construction and maintenance, Jumbo drills.

MINE VENTILATION (MN 5106)

Atmospheric air- Its composition, mine air --its composition and variation, origin, occurrence, physical, chemical and physiological properties of mine gases, various types of damp. Sampling and analysis of mine air. Methane content and pressure, methane drainage and methane layering. Monitoring of gases.

Heat and humidity: Sources of heat in mines, effect of heat and humidity, psychometry, kata thermometer, methods of improving of cooling power of mine air. Air conditioning – basic vapour cycle, representative layout

Air flow through mine openings: Laws of air flow, resistance of airways, equivalent orifice, distribution of air, flow control devices.

Natural Ventilation: Calculation of NVP from air density, thermodynamic treatment etc., artificial aids to natural ventilation.

Mechanical Ventilation: principal types of mine fan and their suitability, merits, limitation, efficiency and characteristics. Selection of mine fan, fan testing, output control in fans, series and parallel operation of mine fans. Ventilation of advancing heading- auxiliary fan, duct, matching of fan to the duct system. Reversal of air current. Fan drift, evasee, diffuser, booster fans.

Ventilation Planning: Standard of ventilation including permissible air velocities. Ascensional, descensional, homotropical, anti-tropical ventilation. Central and boundary ventilation – layouts and comparison. Quantity and pressure requirement. Ventilation layout for coal mining and metal mining. Calculation of air quantity and total mine head required for ventilating a mine. Introduction to Network analysis: Hardy-Cross method, Ventilation survey.

SEMESTER-VI

UNDERGROUND METAL MINING METHODS (MN 6107)

Development: Mine development for working veins, lodes and tabular deposits, shape, size and position of the development working in relation to the ore body, layout of the drifts, cross-cut, raises and winze in ore body, different types of raising methods and their merits and demerits.

Classification of stoping methods, factors influencing the choice of stoping method.

Stoping Methods:

- Room & Pillar
- Sublevel Open Stoping
- Shrinkage Method
- Cut & Fill method of Stoping
- Sublevel Caving
- Block Caving
- Special methods of working of thin deposits

Applicability of methods, stope layout, stope development, ground breaking, mucking, ventilation, support, haulage and dumping. Productivity and cost of mining of ores.

Principles of in-situ leaching, scope and limitation of in-situ leaching.

MINING MACHINERY-II (MN 6108)

Mine Winders: Koepe and Drum winders and their applications, head gear, head gear pulley, shaft fittings -- Keps, rope guides, shaft sinking and bells, capping and recapping, cage and suspension gear. Winding Drum -types and construction, Safety devices in winders-over speed and over wind preventers, slow breaking, depth indicator, Methods of counter balancing rope. Duty cycle. Mechanical and electrical braking. Winding from different levels in shaft. Man riding system in underground mines.

Face Machinery: SDL & LHD-- their applications, capacity, operation, fitting, control and maintenance. Cutter loaders -- Shearers, Coal plough and Continuous Miners - their

constructional features, applications, capacity and maintenance. Layout of faces with Power loader working under varied condition. Shuttle cars

Pumps: Types, Construction, operation, characteristics and application. Calculation of size, efficiencies and capacities. Layout of drainage system.

Opencast Machinery: Blast Hole Drill, Ripper, Shovel, Dragline, Dumper, Bucket Wheel Excavators, Continuous Miners – their basic construction, applications and operation.

ROCK MECHANICS-I (MN 6109)

Concept of stress and strain in rock: Analysis of stress, strain and constitutive relations in isotropic and anisotropic rocks.

Physico-mechanical properties rocks: Determination of physical properties, strength, strength indices and static elastic constants, parameters influencing strength, abrasivity and its determination.

Physico-mechanical properties of soil: Physico-mechanical properties including consistency and gradation, classification of engineering soils, engineering properties of soils- compressibility, consolidation, compaction and strength.

Time dependent properties of the rock: Creep formation and strength behaviour, creep test and simple rheological models.

Behaviour of Rock Mass: Rock mass structure, in-situ elastic properties and strength determination.

Failure criteria for rock and rock mass: Theories of rock failure, Column, Mohr, Griffith and Empirical criteria.

Pre-mining state of stress: Sources, methods of determination including over coring and hydro-fracturing methods.

Ground water: Influence of water on rock and soil behaviour, permeability of rocks, measurement of permeability, ground water flow in rockmass, measurement of water pressure.

Dynamic property of the rock and rock mass: Propagation of elastic wave in rock media, determination of properties and elastic constants.

MINE ENVIRONMENTAL ENGINEERING –I (MN 6110)

Spontaneous Combustion: Various theories, factors, various indices for determination of susceptibility of coal to spontaneous heating, control measures.

Mine Fires: Survey of various causes of mine fires with statistical data of Indian mines, various methods adopted to combat fires and their advantages and disadvantages. Advances in fire fighting techniques and equipments, rescue operations in fire zones.

Mine Explosions: Causes of firedamp explosion with statistical data of Indian mines, preventive measures against firedamp explosion. Production, assessment and control of mine dust and associated hazards. Causes of coal dust explosion with statistical data of Indian mines, preventive measures against coal dust explosion.

Reopening of sealed-off areas: Factors to be considered, methods, precautions.

Mine Inundation: Causes of inundation with statistical data of Indian mines. Precaution to be taken while approaching old workings, preventive measures of inundation.

Noise and Vibrations: Causes and measurement of noise levels. Precautions, prevention and reduction of noise levels. Environmental aspects of blast induced vibration and noise.

Mine Illumination: Its effects on safety and efficiency, illumination standard, common types of flame safety lamps, their use and limitations, electric-hand and cap lamp, their maintenance and examination, lamp room design and organization. Illumination arrangement of opencast and underground working.

ELECTIVE I (ANY ONE OF THE FOLLOWINGS)

MINERAL PROCESS ENGINEERING (MN 6111)

Introduction: Scope, objectives and limitations of mineral processing, liberation and beneficiation characteristics of minerals and coal.

Comminution: Theory and practice of crushing and grinding; different types of crushing and grinding equipments - their applications and limitations.

Size Separation: Laboratory size analysis and interpretation; settling of solids in fluids; industrial screens; mechanical classifiers and hydro cyclones.

Gravity Concentration Methods: Jigging, Heavy media separation, flowing film concentrators - theory, applications and limitations.

Froth Flotation: Physico-chemical principles; reagents; machines; floatation of sulphides, oxides and coal.

Electrical and Magnetic Methods of Concentration: Principles, fields of applications and limitations.

Flow Sheets: Simplified flow sheets for coal, zinc, iron, and manganese ores.

GEOGRAPHICAL INFORMATION SYSTEM (MN 6112)

Introduction to automated geography, defining GIS and its components, Different coordinate system, working principle of GIS.

Geographic data, maps and automation, map as a model of geographic data, cartographic and GIS data structures.

Elementary spatial analysis, measurement, classification, statistical surfaces, spatial arrangements.

GIS data input, store and editing, development of computer methods for spatial data, Comparison of variables. Remote sensing data, image processing and use in GIS mapping.

Database associated with GIS, Applications of GIS in surface mining, Application of GIS in land development, post mining reclamation, forestation, mine environment management etc., Hands on exercise on image processing and GIS packages with special reference to mining. Cartographic modeling, GIS output. GIS design & management.

MARINE EXPLORATION AND MINING (MN 6113)

Scopes and prospects: Overview of terrestrial mining operation, marine environment, origin of poly-metallic nodules and other marine minerals.

Exploration and Characterization: Inland water, Outer continental shelf, Deep Ocean. Off shore exploration for oil & natural gas, drilling rigs. Exploration for poly-metallic nodules.

Extraction: Extraction methods, Storage and Transportation of marine extractions, Exploitation systems for dissolve sea bed and concealed mineral deposits, Sea beach mining, Dredges and Bucket chain excavators, Off-shore mining vessels—their constructional features and operations.

Economy and statutes: Techno-Economic and legal considerations in under sea mining with particular reference to India—Indian ocean and Arabian Sea.

Environmental impacts of ocean mining, measures for their control and mitigation.

ENGINEERING ECONOMICS (MN6114)

Introduction, demand and supply, statistical demand and supply analysis, managerial application of the elasticity of demand and supply.

Estimation of production and cost function; forecasting techniques and their use for decision making at different levels; linear programming and production analysis.

Price output determination: a review with special reference to condition of uncertainty, kinds of pricing problems.

Capital market and investment decisions: pay back method, average return on investment or accounting rate of return, net present value, and internal rate of return.

Outline of welfare economics, resource accounting and sustainability, income determination and fluctuations.

ADVANCED MINE VENTILATION (MN 6115)

Mine Thermodynamics: computation of thermodynamic properties of mine air; Basic modes of heat transfer in mine roadways. Evaporation and consequent changes in mine air properties; thermal properties of rocks; geothermal gradient; Fourier and Biot numbers; calculation of heat flow and temperature rise in mine airways.

Sources of heat and moisture in Bord and Pillar/ Longwall and other workings.

Network Analysis: Hardy-Cross method of iterative analysis; basic concept of application of linear theory.

Mine Gas Monitoring Systems - including sensors.

Mine air conditioning design. Surface spray tower design, ventilation in deep mines.

Radon sources in mines, permissible dose, measurement and control.

Ventilation leakage and recirculation: concept of controlled recirculation in advanced heading and mine district. Application of tracer gas in ventilation studies. Recent developments in mine ventilation.

SEMESTER-VII

MINE PLANNING AND DESIGN (MN 6116)

Principle of the planning, short range and long range planning, role of planning in mining ventures, ore reserve estimation, economic block model.

Mine Planning Input: Geological, mineralogical, structural, economical, environmental and technical inputs.

Determination of optimum output, life of a mine and size of mine field based on economic consideration, Taylor's mine life rule, ultimate pit configuration.

Optimum location of mine entries, theoretical considerations of opening and development of mine field.

Production planning and scheduling, mine equipment planning, estimation of their numbers, infrastructure planning.

Mine Closure-ongoing and final. Feasibility report and project report - contents and preparation.

ROCK MECHANICS-II (MN 7117)

Design and stability of structures in rock: Intact rock and rock mass classification systems, methods for design and stability analysis of underground excavations, design of single and multiple openings in massive, stratified and jointed rock mass, mine pillars and their classification, pillar stresses, pillar design, stability analysis of pillars, design of protective pillar.

Design of support and reinforcement for underground excavation: Types & classification of support and reinforcement systems, support and reinforcement requirement – influencing parameters, estimation and selection, support and reinforcement principle, method of design.

Subsidence: Causes and impacts of subsidence, mechanics of surface subsidence, discontinuous and continuous subsidence, monitoring, prediction, control and management of subsidence.

Caving of rockmass: Rock caving in underground mining, mechanics of rock caving, assessment of cavability, induced caving methods.

Rockburst: Phenomenology of rockbursts, prediction and control of rockbursts, coal bumps and gas outbursts.

Monitoring rockmass performance: purpose and nature, monitoring systems including seismic and microseismic methods.

Mechanics of Blasting: Mechanics of blasting, tensile cracking and blastability of rocks.

Slope stability in surface mines: Types of mine slope including waste dumps, common modes of slope failure, factors influencing slope stability, slope stability assessment techniques, stability analysis, measures to enhance slope stability, monitoring of slopes.

MINE ENVIRONMENTAL ENGINEERING – II (MN 7118)

Air Pollution: Sources of gaseous and particulate pollutants, their physical, chemical (with special emphasis to ozone and greenhouse gases) and physiological effects, monitoring and control.

Land Environment: Visual impacts; landscape analysis; land use; landscape planning; physical reclamation and subsidence management.

Water Regime: Availability; water quality; water pollution and water management.

Ecological Environment: Ecological environment and its management including biological reclamation.

Societal Environment: Societal environment and its management including resettlement and rehabilitation; socio-economic impacts; sustainable development; concept of carrying capacity based planning, mine closure.

Administration and Management: Environmental administration in India; Environmental modeling and prediction, Environmental laws and standards, environmental impact assessment and its methodologies, preparation of environmental management plan.

ELECTIVE II (ANY ONE OF THE FOLLOWINGS)

DESIGN OF OPEN PIT MINES (MN 7119)

Preliminary evaluation of deposits, different stages of exploration, drilling for grade and geo-technical information. Calculation of reserves, Collection of planning information.

Optimal size and output different stages of development, design of pit layout and method of advance.

Selection of open cast equipments and equipment scheduling, Design for unit operations, rock breaking, excavation, transportation, storage and dumping.

.Development of infrastructural facilities-communication power supplies, illumination, dewatering and other maintenance services, Site selection for mineral handling/beneficiation plant.

Control of opencast mining induced hazards- rock fall, fly rock, blast vibration, noise and mine dusts.

Planning for reclamation of mined out area.

ADVANCED COAL MINING METHODS (MN 7120)

Thick Seam Mining: Concept of thick seam, problems of the mining thick seams, past experience of working thick seams by Bord & Pillar method in multi sections. Modern multi- slicing method - incline slicing, horizontal slicing, cross slicing in ascending and descending order. Equipments for thick seam mining. Case Study.

Advanced Underground Winning Methods: Sublevel Caving, Integral Caving, Blasting Gallery Method, Descending Shield Method, Hydraulic Mining, Bhaska and Tipong Method. Case Study.

Steep Seam Mining: Mining technology of inclined and steep seams

Thin Seam Mining: Problems in thin seam mining, equipments and methods for thin seam extraction. Case Study.

Underground Coal Gasification and Coal Bed Methane: Basic concepts, applications and limitations of the methods with case studies.

ADVANCED METAL MINING METHODS (MN 7121)

Techno-economic analysis on choice of stoping method, high productive method, blast hole stoping, vertical retreat method of mining, block caving, raise stoping, stope design, production planning,

Underground bench blasting, special underground excavation, shaft pocket, ore bins, ore transfer, ramp, step mining method.

Consolidated and unconsolidated hydraulic & dry filling, paste filling stopes, preparation, transportation and filling operation.

Pillar Extraction Methods: Combined method of stoping.

Solution Mining: in-situ leaching, chemical, bio-chemical and thermal leaching, Introduction of the novel mining methods.

IN-SITU EXPLOITATION OF MINERALS (MN 7122)

Introduction: In-situ exploitation methods, types of in-situ exploitation methods, its scopes, limitations etc.

Underground Coal Gasification: Basic concept of underground coal gasification, methods of gasification, layout of gasification method, applications and limitations of U.C.G., Case Study.

Solution Mining: In-situ leaching, chemical, bio-chemical and thermal leaching, its basic concepts, its applications and limitations, Case Study.

Coal Bed Methane Production: Methane generation and storage in coal, geological control in Coal Bed Methane (CBM) exploration, methane adsorption & desorption in coal.

Coal as CBM Reservoir: In-place methane estimation, transport of methane in coal-bed. Hydraulic fracturing in coal beds, Compression and transport, liquefaction and utilization.

Nuclear Device Mining Systems: Scope of application for mining of deep seated low grade mineral deposits.

ELECTIVE III (ANY ONE OF THE FOLLOWINGS)

MINE DISASTER AND RESCUE (MN 7123)

Surface and underground mine fire -causes and prevention, causes and nature of spontaneous heating. Dealing with underground fire, study of atmosphere behind sealed off area. Factors, conditions, danger and safety measure for reopening. Methods of fire fighting, Fire fighting organization.

Precautions to be taken while approaching the old working area, causes and protective measure of inundation. Design and construction of water dams. Dewatering and recovery of water logged working, water danger plan.

Types and causes of explosions in mining. Preventive measures against mine explosions. Production, assessment and control of mine dust and associated hazard.

Rescue and recovery work in connection with mine fires, explosions and inundation. Different types of the rescue equipments. Use of an organization for rescue work, disaster management plans of mines.

MINE RECLAMATION AND CLOSURE (MN 7124)

Economical and technical aspects of reclamation of mined out land.

Reclamation Methods: Back filling, outside dumps and their stability.

Top soil handling, assessment of soil productivity potential, revegetation, factors for plant growth, parameters for soil quality and their importance.

Reclamation plan and land use plan, general requirements of protection of hydrologic balance.

Erosion of soil, types of erosion, estimation of top soil erosion.

Landscaping of disturbed land, estimation of reclamation cost and benefits, use of reclaimed land and structures.

Mine Closure Planning: Importance, methodology, statutes concerning mine closure.

Land reclamation as post mining operation, Statutes concerning reclamation of mined out area.

BULK MATERIAL HANDLING (MN 7125)

Properties of the bulk material vis-à-vis different bulk handling operations.

Classification of bulk material transportation system: Road transport system, Rail transport system, pipe line transport system, conveyor transport system.

Design, operation and maintenance: Belt conveyors. High angle conveyors, Cable belt conveyors, Booster belt conveyors -their selection and application in the mining industry.

Design and operation of slurry transport of minerals and mining wastes.

Operation and maintenance of Stacker, Reclaimer and Spreader.

Hydraulic and pneumatic conveying, stacking and blending, reclaiming of bulk materials.

Automation and online monitoring of bulk material handling system,

Storage systems: Silos, bins and bunkers. Rapid loading system, Merry-go-round system.

HEAVY EARTH MOVING MACHINES (MN 7126)

Classification of surface mining systems vis-à-vis machinery deployment.

Functional units of Dragline, Shovel, Dozer, Front-End-Loader, Scraper and their design aspects, power requirements for the above machinery, various capacity available.

Dumpers of various capacities, their functional units, operation and maintenance.

High capacity conveyors, high angle conveyors their functional units, various capacity available.

Functional units of Bucket Wheel Excavator and Bucket Chain Excavator, their design aspects, operation and maintenance.

Rippers, Continuous Miners, their design aspects, operation and maintenance.

Various types of opencast drilling machines, pneumatic and hydraulic rock breakers.

RELIABILITY OF MINING SYSTEMS (MN 7127)

Introduction to reliability concept.

Basic probability theory; application of reliability in mining systems.

Probability distributions in reliability evaluation – reliability functions. Poisson, Normal, Exponential, Log-normal and Weibull distributions.

Series and parallel systems; reliability allocation; Markov modeling.

Fault tree , HAZOP , Risk and criticality analyses, Availability estimation.

Application of FTA and FMECA in mining systems; maintenance and maintainability – definitions, concepts, and applications; maintainability prediction.

SEMESTER-VIII

MINE ECONOMICS AND RESOURCE MANAGEMENT (MN 8128)

Mineral Sampling: Definition, purpose and classes of samples, Chip, Grab, Groove, Bore hole, Dump , Alluvial & Bulk sampling. Development & stope sampling, Samples size reduction techniques . Errors in sampling-- its minimization.

Use of statistical techniques in mine sampling. Reliability of sampling results. Calculation of average assay, width and tonnage of mineral deposits. Introductory principles of Geostatistics.

Mineral resource, Mineral reserve estimations - various categories.

Mine Valuation: Depreciation. Amortization of capital.

Theory of mine valuation- its purpose, Factors affecting the value of a mine.

Hoskold, Morkill and other classical methods for mine valuation. Pay back method and

Discount cash flow (DCF) methods of project evaluation (NPV & IRR)

Financial Management: Mine accounts, mining costs, cost categorization, break even analysis, balance sheet, profit and loss accounts, mine budgeting.

Management Techniques: Elements of Management function, Project management, Organisational structures in mines.

Application of operation research techniques in mining--PERT, CPM and Linear Programming methods with special reference to mining industry.

MINE LEGISLATION AND SAFETY ENGINEERING (MN 8129)

Statutory laws regarding development and conservation of minerals; mines and mineral (regulation and development) act 1957; procedures for obtaining mineral concession, mineral concession rules 1960; mineral conservation and development rules 1958; coal mines (conservation and development) act 1974.

Mines act 1952; Mines rules 1955; Coal mines regulations 1957; metalliferous mines regulation 1961; coal mines rescue rules, crèche rules, electricity act and rules pertaining to mining.

Safety organization; role of management, supervisors and workers; pit safety committees; workmen's inspector; role of safety officers.

Classification of Accidents; Statistics, causes and prevention of accidents. Accidents rate in Indian mines. Accident enquiries and reports, health of workmen. Occupational disease in mining. International labor organization and its model code in the field of safety and accident prevention. Principles of management and organization. Industrial relations. Welfare organizations.

Development of safety consciousness; interest, publicity and propaganda for safety, audio-visual aids, safety drives campaigns.

ELECTIVE IV (ANY ONE OF THE FOLLOWINGS)

QUANTITATIVE DECISION MAKING (MN 8130)

Introduction: Objectives and scope of Quantitative methods; Classification or types of Quantitative methods; A brief history with particular reference to mining industry.

Linear Programming: Concepts, graphical solutions, simplex method, sensitivity analysis, transportation and assignment problems.

Network Analysis: CPM and PERT methods, their relative suitability vis-à-vis specific applications, time cost trading.

Dynamic Programming: Introduction, basic concept, Stage coach problem.

Stochastic Methods: Discrete and continuous probability distributions, Stochastic process and Markov chains.

Basic queuing models with constant arrival and service rates; inventory models.

Simulation of mining systems, Monte-Carlo method, System dynamics.

RELIABILITY AND QUALITY ENGINEERING (MN 8131)

Introduction to reliability concept.

System Structures: Status functions, series systems, parallel systems, and equivalent structures.

Reliability of System Structures: Series systems, parallel systems, equivalent structures.

Unit and system reliability- forward models, density and distribution functions, fault tree analysis, HAZOP analysis, risk and criticality analysis, maintainability analysis, calculation of maintainability parameters, availability calculations, maintenance management.

Introduction to product quality. Introduction to ISO 9000 series, concept of TQM and Business performance, HRD and quality management, organizing for TQM, CI.

GEOSTATISTICS (MN 8132)

Geostatistics: Introduction, concept.

Basics of Probability and Statistics: Mean, Median, Mode, Probability distribution (normal and log normal), Variance, Cumulative frequency and Cumulative probability.

Mineral Inventory: Prospecting, exploration, methods to quantify the size, shape & distribution of the ore reserve. Ore reserve calculation.

Extension method and application of classical statistics, regionalized variables, variogram and semi-variogram modeling, regularization, auxiliary functions.

Kriging: Introduction, concept of development, types of kriging, linear kriging methodology and their application in mining industry, common problems associated with the use of kriging.

Geostatistics for quality control, basis of non-parametric geostatistics and indicator kriging.

Introduction to SURPAC, STATISTICA Softwares

INDUSTRIAL MANAGEMENT (PE 8133)

Management functions.

Evolution of management theory and practice, organization.

Formation of companies, financial analysis and costing, engineering economy, work study.

Elements of Operation Research- PERT, CPM, LPP, Scheduling and Sequencing.

Deployment and management of human resources.

Product engineering.

Plant location and layout, production planning and inventory control.

Project management.

Assurance Sciences – reliability, quality and maintainability.

PERSONNEL MANAGEMENT AND INDUSTRIAL RELATIONS (PE 8134)

Personnel Management and Industrial Relations: Nature, scope, changing role of personnel manager, new people management.

Manpower Planning: Factors affecting manpower planning, organizational structure, job design and job analysis, process of manpower planning.

Recruitment and Selection: Process and methods, induction, placement, internal mobility.

Performance Appraisal: Scope and objective, methods of appraisal, development of an effective appraisal system.

Wages and Salary Administration: Wage legislation, factors affecting wage and salary issues, wage level, structure and wage determination, incentive and fringe benefits.

Trade Union and Collective Bargaining: Trade Union Act, Federations' roles and issues, process of collective bargaining.

Workers Participation in Management: Nature and Purpose, effective workers participation in management.

Grievance Handling: Nature, causes and procedures.

MARKETING MANAGEMENT (ME 8144)

Overview of Marketing: Importance and scope of marketing, marketing management and planning, environments of marketing strategy. Markets and segmentation, consumer buying behavior, and organizational buying behavior.

Research for Marketing Decisions: Problem formation, obtaining and organizing data, analyzing associative data, and selected activities in marketing research.

Product and Pricing Strategies: Product and services concepts, product development strategy, and pricing concepts and practices.

Placement and Promotion Strategy: Marketing channels, distribution of goods. Advertising, sales promotion and publicity, and personal selling and sales, management. Industrial marketing communication, and Industrial distribution strategy and control.

ELECTIVE V (ANY ONE OF THE FOLLOWINGS)

ROCK SLOPE ENGINEERING (MN 8133)

Introduction: economic implications, geological investigation, data interpretation for slope stability analysis.

Basic Mechanism of Slope Failure: Planar, wedge, rotational shear, toppling, buckling and rock fall.

Mechanism of failure of jointed rock mass. Determination of shear strength of discontinuities.

Influence of ground water on slopes and techniques of depressurization, remedial and corrective measures. Remedial measures for slope stabilization.

Monitoring and instrumentation techniques of rock slopes. Investigations of failed slopes.

Numerical analysis of slopes. Use of FLAC Software

ROCK FRAGMENTATION TECHNOLOGY (MN 8134)

General theory of rock cutting, selection of cutting tools for optimum penetration and wear characteristics.

Mechanics of rotary, percussive and rotary-percussive drilling; short and long hole drilling equipment; different types of bits; bit wear; drilling in difficult formations; drillability of rocks; drilling performance and costs.

Mechanism of rock breaking machines, Pneumatic and Hydraulic rock hammers.

Mechanics of rock fragmentation and fracture by explosive action; explosives; blasting accessories, blasting parameters, design of blasting rounds for opencast and underground mines; Blastability of rocks, blasting efficiency, mean fragment size.

Computational models of blasting; transient ground motion, misfires, blown out shots, incomplete detonation-their causes and remedial measures.

Controlled blasting techniques; perimeter blasting; safety precautions; ground vibrations and air over pressure from blasting.

Instrumentation in blasting: Borehole pressure transducer, V.O.D probe, vibration monitor, high speed video camera; impact of ground vibration and sound on the neighboring structures and communities, and mitigative measures.

TUNNELING AND DRIVAGES (MN 8135)

Introduction to tunneling: geological concept of tunneling, influence of geological aspects on design & construction of tunnels.

Tunneling Methods: Soft ground, drill & blast, roadway drivage machines, tunnel boring machines (TBM).

Stresses and displacements associated with excavating tunnels. Ground control or treatment in tunneling and drivages.

Design of Supports of Tunnels: Steel supports, rock enforcements, new Australian tunneling methods (NATM).

Design of Tunnels: Rock conditions, RMR, Q-system, RSR, rock mass behaviour, stress-strain behaviour, and stress analysis of tunnels.

Maintenance: Dewatering, ventilation and illumination of drivages and tunnels

Numerical techniques : Introductory use of FLAC, PLAXIS etc.

DRILLING TECHNOLOGY (MN 8136)

Principle of drilling, objectives, types of drilling, drilling tools--bits and drill string components, drilling parameter and their monitoring, drilling mud and others fluids.

Exploratory drilling: Drilling for oils and minerals, water well drilling, drilling for degasification of coal seams, drilling for foundation testing, directional drilling, formation-segregation-casing and cementing.

Drilling Problems and Solution: Lost, circulation, caving and sloughing, borehole restriction and wall cutting, blow out, fishing.

Planning & Economics: Planning for drilling and its cost optimization. Recent developments in drilling technology.

ROCK EXCAVATION ENGINEERING (MN 8137)

Scope and importance: Rock excavation engineering in mining and construction industries; physico-mechanical and geotechnical properties of rocks Vis-à-vis excavation method; selection of excavation method.

Drilling: Mechanics of rock drilling; design and operating parameters of surface and underground drilling; evaluation of drill performance; drillability of rocks; mechanism of bit wear; bit selection; problems of drilling; economics of drilling.

Blasting: mechanics of rock fragmentation by explosives; advances in explosives and their selection criteria for rock excavation; blast design for surface excavations and optimization; advanced blast initiation systems; blast performance evaluation; cast blasting; techno-economic and safety aspects of surface and underground blasting; advances in blast design for underground excavations; contour blasting; computer aided blast designs; review of tunnel blasting techniques in recent advances.

Rock Cutting: theories of rock tool interaction for surface excavation machinery- rippers, bucket wheel excavators, continuous surface miners; theories of rock tool interaction for underground excavation machinery- ploughs, shearers, road headers, continuous miners and tunnel boring machines; selection criteria for cutting tools; Advanced rock cutting techniques- high pressure water jet assisted cutting.

DIMENSIONAL STONE MINING (MN 8138)

Classification of dimensional stones, composition, chemical and geo-chemical properties, various standards for normalization of dimensional stones.

Mining of Dimensional Stones: Various techniques of dimensional stone mining – block mining and slab mining; manual mining; mechanized mining – line drilling, in-situ sawing by wire saw, chain saw, portable circular saw, flame cutting.

Cutting/ Sawing Tools: Tool carrier- circular steel blade, steel wire rope, chain jib saw, physical and mechanical properties, elastic properties, tension etc.; cutting tools- diamond segments, diamond pearls/ bits, tungsten bits etc.; process of manufacture, ingredients, brazing/ fitting, wearing pattern and control; cost of cutting.

Handling of Blocks and Slabs: Equipment used- derrick crane front loaders, fork lifts, mobile cranes, trucks and trailers.

Machines for Dimensional Stones Mining: Portable circular saw, wire saw, chain saw. Line drills – special design features of the machines, techniques of use and maintenance.

Monitoring, Production & Environmental Issues: Recovery, waste generation, productivity, inherent defects, measurement and corrective actions, cost evaluation. Management of solid waste, slurry waste, soil, land and water, protection and rehabilitation. Protective care from abrasive dust, personal safety and welfare.

Application Processing and Architecture in Dimensional Stone Mining: Application – flooring, roofing, cladding, stairs, paving, facets; processing and polishing- various techniques for sawing blocks, shaping of edges, polishing and calibration; fixing and installation – techniques of fixing of dimensional stones in various applications like flooring, cladding, faced, stairs, roofing and paving; care and maintenance of dimensional stones.

ELECTIVE VI (ANY ONE OF THE FOLLOWINGS)

DESIGN OF MINE SUPPORTS (MN 8139)

Rock support and reinforcement-terminology, support and reinforcement principles and design; pressure arch theory; classification of mine supports; computation of support requirement under different conditions.

External Ground Support

Timber support: Prop/post, drift-set of various types, square-set, crib-set, cog, stull and chock/ chock mat supports; fore poling/ spilling; 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; safari support.

Cement Support: Poured monolithic and reinforced concrete lining; monolithic packing in longwall advancing gate roads, 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; sand gathering plant; theoretical aspects of slurry transportation; preparation, transport and placement of hydraulic backfill with and without cement; rock and concrete fills; surface arrangement for storage and mixing; pneumatic and mechanical method of backfilling.

Internal Ground Support

Pre-enforcement materials and techniques; rock bolts and dowels- different types and uses; mechanics of bolting.

Anchor Rock-bolts: Slot and wedge type, expansion shell type, grouted point anchor type.

Full column anchors: Wooden and fiberglass dowels, mechanical full column anchors, split sets/ friction rock stabilizers, swellex, full column grouted rock-bolts.

Installation and testing of rock bolts.

Cable bolting- its installation and applications.

Ground Stabilization: Ground dewatering, ground cementation, ground freezing and ground de-stressing. Open pit ground control.

MINE SYSTEM ENGINEERING (MN 8140)

Introduction to system engineering, system concept analysis, models in system analysis.

System approach to mine design, sub-system, engineering design phases of planning.

Economic considerations in planning of opencast and underground mining, optimal size, capacity and development parameters.

Tactical and strategic planning, project planning, project appraisal, preparation of project feasibility report.

Introduction to Statistical decision theory and its applications in the mineral industries, Technological forecasting.

Introduction to operations research techniques, network analysis, application of PERT and CPM to mining projects.

Introduction to linear planning, transportation problems, queuing models their application in mining industries problem.

Inventory systems and models, optimization. Planning of optimal location of mine entries, use of analytical methods and sieve analysis.

NUMERICAL TECHNIQUES IN GEOMECHANICS (MN 8141)

Introduction: Principle of continuum mechanics, need for numerical modeling in design of excavation in mines, domain and boundary conditions, discretisation of domain and boundary, principal methods of numerical simulation for excavation in mining (FEM, FDM, & BEM).

Finite Element Method: Basic principle, assembling elements to form a structural stiffness matrix, imposing boundary conditions, solving structural equations using plane truss, elements on assumed displacements, constant strain triangle, iso-parametric formulation.

Finite Difference Method: Basic principle, Explicit finite difference method, finite difference equation, mechanical damping, mechanical time-step determination, solution stability.

Boundary Element Method: Basic principle, introductory ideas of its application in mining excavations.

Introduction to numerical modeling packages: ANSYS, PLAXIS, FLAC etc.

REMOTE SENSING AND GEO-INFORMATICS (MN 8142)

Basic concepts of remote sensing, airborne and space borne sensors, present status of remote sensing satellites, data acquisition techniques from different sources.

Digital image processing, restoration, image enhancement, segmentation feature extraction, clustering edge detection, introduction to digital terrain modeling.

Geographic Information System, introduction to microwave remote sensing and Global Positioning System, application of GPS in remote sensing.

Applications of remote sensing in mineral resource identification and estimation, mine environment and ecology, post mining land reclamation, mine disaster management and reuse of mined out areas.

Use of relevant softwares for remote sensing and GIS with particular reference to mining. Hands on exercises on image processing and GIS packages.

MINE VENTILATION PLANNING (MN 8143)

Classification of plans for the ventilation of districts, necessary requirements of plans for ventilation of districts, selection of plans for ventilation of districts, selection of plans for ventilation of districts based on gas factor, degree of stability of air streams, air leakage, thermal factor. Application of ventilation plans with isolated dilution and removal of methane along sources into mine atmosphere.

Design of Ventilation for Preparatory Working: Calculating methane content of preparatory workings, computation of air requirements for ventilation, determination of permissible gas concentration. Selection of ventilation type, selection of blower, and improving reliability of ventilation.

Determination of Main Parameters of Robbing Surface in Different Systems of Development: Effect of length & rate of advance on degassing of productive seams, methane emission changes with face advance, effect of sequence of operation on methane content, maximum permissible production on gas factor.

Quantity of air requirements to ventilate faces, districts & mines, method of calculating air leakage.

Determination of Mine Water Gauge: Head losses caused by local resistances, selection of course with maximum water gauge, calculation of mine water gauge, cross sections of workings in gassy mines.

Selection of Basic Parameters of Mine Ventilation: Selection of systems and plans of mine ventilation, selection of mine ventilation method.

SMALL SCALE MINING (MN 8144)

Introduction to small scale mining: concepts and definitions, scenario and Indian policy on small scale mining.

Problems of small scale mining: Geo-mining, conservational and financial implications, environmental impacts and mitigation measures, legislation related to small scale mining.

Aqueous Extraction of Placer Deposits: Scope and applicability, alluvial mining.

Beach Sand Mining: Ground sluicing, Hydraulicking, Dredging, Machinery for placer mining.

Small Scale Mining Methods: Manual, semi-mechanized and mechanized mining methods, conventional and novel techniques occurrence of granite and minor minerals geological aspects of small scale mining, processing and finishing.