

MINING ENGINEERING
(DEGREE STANDARD)

SUBJECT CODE: 347

UNIT – I: GEOLOGY, MINE DEVELOPMENT, DRILLING AND BLASTING

Geology: Earth structure & Composition, weathering, ground water, Geological time scale, types of rocks and their modes of occurrence, mineral resources, their distribution in different types of rocks of different ages, classification and properties of minerals, Geological structures like folds, faults, etc., their classification and their significance in the mineral exploration & mapping, ore reserve estimation including their shape. Different Ore forming processes, origin & modes of occurrence, classification of mineral deposits, fossil fuels like coal, petroleum etc Mineral distribution in India. Various exploration and prospecting methods including geophysical prospecting, their fields of application & limitations. Introduction to aerial and photography, remote sensing & GIS for mapping and exploration.

Role of Mining Industry in National Economy, Role of Mining Engineers in Mining Industry, Challenges faced by Mining Industry, Indian and World Mineral Resources, Types of Drilling; exploratory & production drilling; core recovery, core logging & interpretation of bore hole data, machines for opencast and underground mines, selection & limitations, parameters influencing drilling. Directional drilling, mechanics of different types of drilling,. Exploratory & production drilling, types of drilling and Explosives and accessories, properties, classification; Selection; Storage, transport and handling and use of explosives, different types of initiation systems, mechanics of blasting, drilling & blast design for opencast and underground mines (including solid blasting), secondary blasting, misfires, vertical crater retreat blasting, adverse impacts of blasting and their control, instrumentation, testing of explosives, fragmentation studies, controlled blasting, alternatives to blasting. Different modes of entry into underground mines, their location and design. Different methods of shaft sinking including special methods-various activities, modern & mechanized techniques of shaft sinking, shaft raising, shaft boring, widening and deepening of operating shafts. Drivage of drifts and tunnels covering all associated activities including continuous and tunnel boring techniques.

UNIT – II: MINE ENVIRONMENT

Mine gasses – occurrence, properties, detection, physiological effects and permissible limits, Mine climate and control, Heat and humidity, Natural Ventilation, Distribution of air current in mines, Resistance of mine roadways, Mine fans and their characteristics, testing, use of multiple fans. Ventilation and illumination survey, Ventilation planning in mines. Mine illumination, methane drainage Flame safety lamps, ventilation devices, Types of ventilation, auxiliary ventilation including overlap ventilation.

Ventilation network analysis and numerical problems, Pollution due to mining - Noise, air, water and land pollution, Ground vibrations, monitoring and control, Pollution standards and remedial measures, Spontaneous heating, Mine fires, Explosions – causes, prevention and control, Firefighting, reopening of sealed-off areas, Inundation – causes, prevention and control, Design of water Dams, Mine rescue and recovery, investigation after an explosion, rescue organization of a mining company, Air conditioning and air cooling, Rescue and First aid in mines.

Concept of environment and ecology, Landscape planning and analysis, Biosphere, Hydrosphere, Atmosphere, Nutrient cycling, Effect of industrialization on atmosphere, Air quality sampling and modeling, Impact of pollution on human health. Reclamation of mined out land, Tailings management and subsidence, Environmental impact assessment, Environmental management plans, Environmental audit, Environmental clearance for mining projects, Environmental legislations, Safety and environmental protection.

UNIT – III: MINING MACHINERY

Different types of motive power used in mines, Rope haulages, Wire ropes, safety devices, different types of locomotives, safety devices, free steered vehicles; Hydraulic, pneumatic and gravity transport, Mine pumps, different types, characteristics and fields of application, design of pumping systems, Rope haulage, locomotives and pumping calculations. Distribution of electrical power in mines, Electrical layouts, Mine cables, Flame-proof and intrinsically safe apparatus, Mine communication, man riding systems, different types of pumps, their characteristics and fields of applications.

Winding systems, Friction and drum winders, Multi-rope winding, safety devices, Winding accessories –winding engines, headgear, head sheave, skips, suspension gear, shaft fittings etc., duty cycles and winding calculations. Surface and pit-bottom arrangements, Coal face machinery including longwall equipment, Different types of conveyors and their construction, design and calculations, High angle conveying, Hydraulic & Pneumatic transport, Aerial ropeways, Design and construction of silos and bunkers, Stacking and blending, Condition monitoring of mining machinery.

UNIT – IV: SURFACE MINING

Suitability of surface mining and limitations, Cut-off grades, Pit limits, Stripping ratios, Design of pit slope, haul roads, benches box cuts, Opencast mine development - different methods, Earth moving machinery - shovels, draglines, continuous surface miners, bucket wheel excavators, dumpers, rippers, scrapers, rock breakers etc., Productivity and maintenance of Heavy Earth Moving Machinery. Types of slope failures, Slope stability analysis and stabilization including dumps, In-pit-crushing and conveying, Continuous surface mining. Placer mining and solution mining, conversion of underground mines to opencast mines and vice-versa. Truck dispatcher systems, Machine availability, productive and maintenance scheduling, output, manpower and calendar planning.

UNIT – V: UNDERGROUND MINING (COAL & METAL)

Coal Mining: Importance of coal as a source of energy, current status of coal mining world over, grading of coal, Choice of mining methods and classification, Bord and pillar method - design of panels, pillar extraction by caving and stowing, partial extraction, supports, Longwall method - advance and retreat, mechanized longwall, latest trends, Design of longwall workings, salvaging and relocation of equipment, punched longwall. Thin and Thick seam mining, problems, multi-slices and special methods like gallery blasting, sub-level caving, horizon mining, contiguous, hydraulic mining, underground coal gasification, shield mining of steep seams, shaft pillar extraction, introduction to coal-bed methane.

Metal Mining: Classification of mining methods, Metal mining layouts, Methods of development -shafts, raises, winzes, drifts, bins, tunnels etc., Stope preparation, Stoping methods – supported and unsupported, their selection - longwall, room and pillar,

shrinkage, sub-level, cut and fill, block caving and combined, backfilling, etc., Techno-economic analysis of mining systems, Extraction of remnant pillars, shaft pillars, Mining at great depths.

UNIT – VI: ROCK MECHANICS & GROUND CONTROL

Stress analysis, Numerical problems, Application of rock mechanics in mining, Physico-mechanical properties of rocks and rock indices, elastic constants - laboratory and in situ testing, Rock mass classification, Post-failure behaviour of rocks, Dynamic wave velocities and elastic constants, Time dependent properties of rocks, Non-Destructive testing, Rheological modeling, Theories of failure of rocks, Rock mechanics and ground control instrumentation, in situ stress measurement.

Roof examination, Different types of mine supports including FER supports, powered supports, etc. Design and selection of mine supports, Systematic supports, different methods of stowing, underground and face arrangements, Design of underground workings and stress distribution for Bord and pillar, Longwall workings, etc., Design of pillars; subsidence, measurement, prediction, control, remedial measures; Rock burst and bumps causes, prediction and control, etc.

UNIT – VII: MINE SURVEYING & MINERAL PROCESSING

Principles of mine surveying, Underground surveying methods, methods of leveling, contouring, curve setting, traversing, Triangulation and Correlation, Errors and adjustments, Preparation of mine plans and sections, Numerical problems, Modern surveying techniques, Photogrammetry and remote sensing applications, EDM, Total station, GPS, GPR, GIS Astronomical survey, stope surveying, subsidence survey.

Scope and objectives of mineral processing, Choice of methods, Sequence of operations, Comminution, crushing and grinding - Theories, types of crushers and their fields of application, power consumption for crushing and grinding, Laboratory and industrial sizing, wet and dry screening, laws of particle settlement. Different concentration techniques, jigging, tabling, flotation, wet and dry screenings, magnetic separation, electro-static separation, optical sorter, Sampling and control, Coal beneficiation - Generalized plant design and flow charts for beneficiation of coal and other important ores.

UNIT – VIII: MINE MANAGEMENT & COMPUTER APPLICATIONS IN MINING

History and development of mine management, Principles of scientific management, Functions of management, Organization structure of a mine and a mining company, Time and work study, Industrial relations, Trade union and workers participation in management, Industrial psychology, Operations research - linear programming, transportation and assignment problems, CPM and PERT. SWOT analysis, supply chain management.

Microprocessors - Operating systems, Structured and object oriented programming, Networking Database management systems, Programming for mine design problems, CAD in mining for opencast and underground mines, Management information systems, ore-body modeling, Digitization and scanning, Artificial intelligence, Expert systems, Neural networks and virtual reality applications in mining, mining software. Computer applications in mine planning, ventilation network analysis, pillar design, blast design (opencast and underground), pumping systems, mine planning, etc.

UNIT – IX: MINE LEGISLATION, SAFETY & ECONOMICS

General provisions of Mines and Mineral Regulation and Development Act, Mineral Concession Rules, Mines Act, Regulations and Rules, Bye-Laws and DGMS Technical Circulars, Mines Vocational Training Rules, Land Acquisition, Explosives Act, Indian Electricity Rules, Workmen's Compensation Act, Rescue Rules, Mine accidents, classification and occupational diseases, accident statistics, Accident inquiry reports and cost of accidents, Mine disaster management, Safety audit and conferences. Environmental protection and conservation acts and rules, Miners diseases. Risk identification and Management.

Role of mineral industry in national economy, National mineral resources National mineral policy, Conservation of minerals, Royalty and taxation, Ore reserve estimation and geo-statistical methods, Mine valuation, Classification of reserves, net present value (NPV), Depreciation, Pricing and sale of minerals, Marketing and inventory, Costing, Wages and incentives, Book keeping, Balance sheet and profit and loss accounts, Numerical problems, Capital and revenue expenditure, DCF, profitability analysis, Economics of various mining operations, Assessment of cost of various mining operations, cost control methods.

UNIT – X: MINE PLANNING & DESIGN

Ore-body modelling, Opencast mine planning - mine cuts, surface structures, division of mining areas into blocks, Open pit optimization, Mine scheduling, Underground (coal and metal) mine planning, Location of mine entries, Optimization of mining parameters, Planning of production capacities, production planning and scheduling, productivity indices, Techno-economic analysis, Quality control and conservation, Planning and selection of equipment, Manpower and output planning, Preparation of mining projects - feasibility and detailed project reports, Sources of funding, Government policies., Mine Closure, Quality control.
