TS ECET - 2024
SYLLABUS FOR MINING ENGINEERING

MATHEMATICS (50 Marks)

Unit-I: Matrices

Matrices: Definition of Matrix, Types of matrices-Algebra of matrices-Transpose of a matrix-Symmetric, skew symmetric matrices-Minor, cofactor of an element-Determinant of a square matrix-Properties-Laplace‘s expansion-singular and non-singular matrices-Adjoint and multiplicative inverse of a square matrix-System of linear equations in 3 variables-Solutions by Cramer‘s rule, Matrix inversion method-Gauss-Jordan method.-Partial Fractions: Resolving a given rational function into partial fractions. Logarithms: Definition of logarithm and its properties, meaning of ‘e’, exponential function and logarithmic function.

Unit–II: Trigonometry

Properties of Trigonometric functions– Ratios of Compound angles, multiple angles, sub multiple angles – Transformations of Products into sum or difference and vice versa. Properties of triangles: sine rule, cosine rule, tangent rule and projection rule. Solution of a triangle when (i) three sides (SSS), (ii) two sides and an included angle (SAS), (iii) one side and two angles are given(SAA). Inverse Trigonometric functions, Hyperbolic functions.
Complex Numbers: Definition of a complex number, Modulus, amplitude and conjugate of complex number, arithmetic operations on complex numbers - Modulus-Amplitude form (Polar form) - Euler form (exponential form).

Unit–III: Analytical Geometry

Straight Lines–different forms of Straight Lines, distance of a point from a line, angle between two lines, intersection of two non-parallel lines and distance between two parallel lines. Circles-Equation of circle given center and radius, given ends of diameter-General equation- finding center and radius, center and a point on the circumference, 3 non-collinear points, center and tangent, equation of tangent and normal at a point on the circle. Conic Section – Properties of parabola, ellipse and hyperbola – Standard forms with vertex at origin and axis along co-ordinate axes only, simple problems.

Unit–IV: Differentiation and its Applications

Functions and limits – Standard limits – Differentiation of sum, product, quotient of functions, function of function, trigonometric, inverse trigonometric, exponential, logarithmic, Hyperbolic functions, implicit, explicit and parametric functions–Derivative of a function with respect to another function-Second order derivatives – Geometrical applications of the derivative(angle between curves, tangent and normal)–Increasing and decreasing functions–Maxima and Minima(single variable functions) using second order derivative only physical application – Rate Measure - Partial Differentiation–Partial derivatives up to second order–Euler’s theorem.

Unit–V: Integration and its Applications

Indefinite Integral – Standard forms – Integration by decomposition of the integrand, integration of trigonometric, algebraic, exponential, logarithmic and Hyperbolic functions– Integration by substitution –Integration of reducible and irreducible quadratic factors – Integration by parts– Definite Integrals and properties, Definite Integral as the limit of a sum – Application of Integration to find areas under plane curves and volumes of Solids of revolution– Mean and RMS values, Trapezoidal rule and Simpson's 1/3 Rule for approximation integrals.

Unit–VI: Differential Equations

Definition of a differential equation-order and degree of a differential equation- formation of differential equations-solution of differential equation of the type first order first degree, variable-separable, homogeneous equations, exact, linear differential equation of the form dy/dx+Py=Q, Bernoulli's equation, 2^{nd} order linear differential equations with constant coefficients both homogeneous and non-homogeneous and finding the Particular Integrals for the functions e^{ax}, sin ax, cos ax, ax^2 +bx+c (a,b,c are real numbers).

Unit–VII: Laplace Transforms

Laplace Transforms (LT) of elementary functions-Linearity property, first shifting property, change of scale property, multiplication by t^n and division by t - LT of derivatives and integrals, Unit step function, LT of unit step function, second shifting property, evaluation of improper integrals, Inverse Laplace transform (ILT)-shifting theorems, change of scale property, multiplication by s^n and division by s, ILT by using partial fractions and convolution theorem. Applications of LT to solve linear ordinary differential equations up to second order with initial conditions.

Unit–VIII: Fourier Series

Fourier series, Euler's formulae over the interval (C, C+2π) for determining the Fourier coefficients. Fourier series of simple functions in (0, 2π) and (–π, π). Fourier series for even and odd functions in the interval (–π, π) – Half range Fourier series – sine and cosine series over the interval (0, π).

PHYSICS(25 Marks)

Unit-I: UNITS, DIMENSIONS AND MEASUREMENTS

Physical quantity – Fundamental and derived quantities, unit – definitions – system of units – Advantages of S.I. units.
Dimensions and dimensional formula – definitions, units and dimensional formulae for physical quantities, Dimensionless quantities, Principle of homogeneity, Applications of dimensional analysis – Checking the correctness of physical equations – conversion of unit from one system to another system – problems on density, force and energy.

Unit-II: VECTORS

Scalar and Vector quantities – definition and examples, representation of a vector, Classification of vectors - Proper vector, Equal vectors, Unit vector, Negative vector, null vectorand Position vector, Resolution of avector.
Lami's theorem, Parallelogram law of vectors – statement- expression for magnitude and direction of resultant vector –derivation-, Representation of a vector in unit vectors **i**, **j** and **k**. – numerical problems.
Scalar product of vectors- application to work done by force and power – properties of scalar product. – Numerical problems.
Vector product of vectors– Right hand thumb rule and righthand screw rule - application to torque - properties of vector product - Application to area of parallelogram and triangle -numerical problems.

Unit-III: MECHANICS

Concept of Friction - Normal reaction, Angle of friction, Motion of a body over a rough horizontal surface - expressions for Acceleration, Displacement, Time taken to come to rest - derivations, inclined plane - Motion of a body over a smooth inclined plane and rough inclined plane–forces acting on the body -angle of repose, Application of friction – brake systemin bicycle– numerical problems
Projectile motion – definition – examples, Horizontal projection - Oblique projection, Expression for path of a projectile in oblique projection –derivation, Maximum height, Time of ascent, Time of descent, Time of flight, Horizontal range and maximum horizontal range in oblique projection– derivations, numerical problems
Circular motion – definition of angular displacement, angular velocity, angular acceleration, frequency and time period, Relation between linear and angular velocity – derivation – related numerical problems,Central force – examples, Expressions for centripetal and centrifugal forces (no derivation), Applications of centripetal and centrifugal forces - Banking of roads and its expression, bending of cyclist and principle of centrifuge - related numerical problems.

Unit-IV: PROPERTIES OF MATTER

Elasticity – Elastic body –definition - examples, Stress and Strain – definitions and expressions, types of stress and strain, elastic limit - Hooke's law – statement – modulus of elasticity, significance of stress and strain curve -Young's modulus – Derivation, numerical problems.
Surface tension - Capillarity –angle of contact – definition- examples for capillarity- Formula for Surface tension based on capillarity (no derivation), effect of temperature and impurity on surface tension, applications and illustrations of surface tension, numerical problems.
Viscosity - Newton's formula for viscous force – derivation - Coefficient of viscosity - Poiseuille's equation (formula only), Effect of temperature on viscosity of liquids and gases, applications of viscosity, numerical problems.
Concept of fluid motion –streamline and turbulent flow,Reynold's number, equation of continuity, Bernoulli's theorem (only formula) and applications - related problems.

Unit-V: CONSERVATION LAWS AND ENERGYSOURCES

Work, Power and Energy – explanation, Potential Energy and Kinetic energy–examples – expressions for Potential energy and Kinetic energy– derivations, Work-Energy theorem – derivation, Law of conservation of energy – examples, Law of conservation of energy in the case of freely falling body – proof – Illustration of conservation of energy in the case of simple pendulum, related problems

Unit-VI: HEAT

Heat – thermal expansion of solids – Coefficients of expansions, Boyle's law – statement, concept of absolute zero - Absolute scale of temperature, Charles' laws, Ideal gas equation – derivation - value of universal gas constant 'R', Gas equation in terms of density, Isothermal and Adiabatic processes - Differences between isothermal and adiabatic processes, Internal energy and External work done, Expression for work done – derivation, first law of thermodynamics –application of first law to isothermal and adiabatic processes, second law of thermodynamics, specific heats of a gas, related numerical problems.

Unit-VII: SIMPLE HARMONIC MOTION

Periodic motion - Simple Harmonic Motion (SHM)– definition – examples, Conditions for SHM, Time period, frequency, amplitude and phase of a particle in SHM, Expressions for Displacement, Velocity, Acceleration, Time period and frequency of a particle executing SHM – derivations,
Ideal simple pendulum – time period of simple pendulum –derivation, laws of simple pendulum, Second's pendulum- related numerical problems

Unit-VIII: SOUND

Stationary waves, beats - applications of beats, echo –definition - applications - relation between time of echo and distance of obstacle,
Doppler effect in sound (no derivation, formulae only) – list the applications – ultrasound and radar in medicine and engineering- –derivation- Reverberation and time of reverberation - Sabine's formula - Free and forced vibrations - Resonance - Conditions of good auditorium, noise pollution – causes, effects and methods to minimize noise pollution, related numerical problems.

Unit-IX: MAGNETISM AND ELECTRICITY

Basics of magnetism, Coulomb's inverse square law in magnetism, moment of couple on a bar magnet placed in a uniform magnetic field – derivation, expression for magnetic induction field strength at a point on the axial line of a bar magnet –derivation,
Kirchhoff's laws in electricity, Wheatstone bridge – balancing condition, application of Wheatstone bridge –Meter bridge,
Concept of electromagnetic induction - self-induction and mutual induction, Faraday's Laws, Lenz's law, principle and working of transformer-types of transformers, types of magnetic materials – dia, para and ferromagnetic materials, related numerical problems.

Unit-X: OPTICS

Light theories-dual nature, reflection, refraction, and interference,
Photo electric effect - Einstein's photo electric equation – Work function and threshold frequency - laws of photo electric effect - applications of photo electric effect – photo cell.

Unit-XI: MODERN PHYSICS

LASER – definition, Spontaneous emission and Stimulated emission –principle and working of LASER, characteristics of LASER- types of LASER, applications of LASER,
Total internal reflection, critical angle, conditions for total internal reflection, Principle and working of Optical fiber –types- Applications of optical fiber –
Nanotechnology, nano particles and nano materials-applications and devices, Superconductivity-basic concept-applications of Superconductors.

Unit-XII: SEMICONDUCTOR PHYSICS

Energy bands in solids- valence band- conduction band – forbidden gap – Energy band diagram of conductors, insulators and semiconductors – concept of Fermi level - Intrinsic semiconductors - examples - Concept of holes in semiconductors - Doping - Extrinsic semiconductors - P-type and N-type semiconductors, PN Junction diode – Forward Biasing and Reverse Biasing - Volt-Ampere (V-I) characteristics - Applications of PN diode - Diode as rectifier (half wave rectifier), Light Emitting Diode – principle and working, solar cell – principle and working.

CHEMISTRY (25 Marks)

UNIT-I: FUNDAMENTALS OF CHEMISTRY

Atomic Structure: Introduction – Atomic number – Mass number- Isotopes and Isobars - Bohr's Atomic Theory - Orbitals - Shapes of s, p and d orbitals – Aufbau principle - Hund's rule - Pauli's exclusion principle - Electronic configuration of elements.
Chemical Bonding: Introduction – Electronic theory of valency - Types of chemical bonds - Ionic, Covalent, Co-ordinate covalent, Metallic and Hydrogen bonds with examples - Properties of Ionic and Covalent compounds - Types of Hydrogen bonds – Effect of hydrogen bonding on physical properties.
Oxidation-Reduction: Electronic concept of Oxidation, Reduction - Oxidation Number - Calculations.

UNIT-II: SOLUTIONS AND COLLOIDS

Introduction - Solution – Solubility - Classification of solutions based on physical state- Atomic weight, Molecular weight, Equivalent weight - Mole concept – Molarity and Normality - Numerical problems on mole, molarity and normality – Colloids - Types of colloids - Lyophilic and Lyophobic colloids – Protective colloids - Gold number - Properties of colloids - Industrial applications of colloids.

UNIT-III: ACIDS AND BASES

Introduction - Theories of acids and bases and limitations - Arrhenius theory - Bronsted -Lowry theory - Lewis's acid base theory - Ionic product of water - pH and related numerical problems - Buffer solutions-buffer action - Applications of buffer solutions- Ostwald's theory of indicators.

UNIT-IV: ENVIRONMENTAL SCIENCE

Introduction - Environment - Scope and importance of environmental studies - Important terms - Concept of ecosystem - Producers, consumers and decomposers - Food chain - Food web - Carbon and nitrogen cycles - Biodiversity, definition and threats to Biodiversity - Forest resources - Deforestation – Green Chemistry – E-waste – Management of e-waste.

UNIT-V: WATER TECHNOLOGY

Introduction - Soft and hard water - Causes of hardness – Types of hardness - Disadvantages of hard water using in industries - Degree of hardness - Softening methods - Permutit process and Ion exchange process - Drinking water - Municipal treatment of water for drinking purpose – Osmosis and Reverse Osmosis - Advantages of Reverse Osmosis – Desalination by Electro dialysis – Defluoridation – Nalgonda Technique.

UNIT-VI: ELECTROCHEMISTRY

Conductors, insulators, electrolytes – Types of electrolytes - Arrhenius theory of electrolytic dissociation - Electrolysis – Electrolysis of fused NaCl and aqueous NaCl –Applications of electrolysis - Faraday's laws of electrolysis - Numerical problems.

UNIT-VII:METALLURGY

Characteristics of metals - Distinguish between metals and non-metals - Mineral, Ore, Gangue, Flux, Slag - Concentration of ore - Construction and operation of Reverberatory furnace and Blast furnace - Methods of extraction of crude metal - Roasting, Calcination and Smelting – Alloys - Purpose of making alloys - Composition and uses of Brass, German Silver, Nichrome, Stainless Steel and Duralumin.

UNIT–VIII: CORROSION

Corrosion - Factors influencing the rate of corrosion – Dry and wet theories of corrosion – Composition cell, Stress cell and Concentration cell - Rusting of iron and its mechanism - Prevention of corrosion – Protective coatings - Cathodic protection - Paint – Constituents of paint – Functions of constituents of paint.

UNIT–IX: POLYMERS

Polymers - Polymerization - Types of polymerizations – Addition polymerization and Condensation polymerization - Plastics - Types of plastics - Advantages of plastics over traditional materials - Disadvantages of using plastics - Preparation and uses of the some plastics; 1. Polythene 2. PVC 3. Teflon 4. Polystyrene 5. Urea formaldehyde 6. Bakelite - Compounding and moulding of plastics – Natural rubber – Vulcanization of natural rubber - Elastomers – Preparation and uses of Butyl rubber, Buna-S rubber and Neoprene rubber - Fibres - Preparation and uses of Nylon 6,6 and Polyester (Polyethylene terephthalate) - Biodegradable polymers and their general applications.

UNIT–X: FUELS AND LUBRICANTS

Definition and classification of fuels - Characteristics of good fuels - Calorific value - HCV and LCV - Calculation of oxygen required for combustion of methane and ethane – Preparation method, composition, calorific value, and uses of some gaseous fuels; a) CNG b) LPG c) Water gas, d) Producer gas, e) Coal gas, and f) Bio gas – Explosives – Classification of explosives – Applications of explosives – Lubricants – Classification and functions of lubricants.

UNIT-XI: ELECTROCHEMICAL CELL AND BATTERIES

Galvanic cell - Standard electrode potential - Reference electrodes - Types of reference electrodes - Electro chemical series - EMF of cells and batteries -Types of batteries - Fuel cells.

UNIT–XII: ENVIRONMENTAL STUDIES

Introduction - Classification of air pollutants based on origin and physical state of matter - Air pollution – Causes, effects and controlling methods of air pollution - Water pollution – Causes, effects and controlling methods of water pollution – Soil pollution – Causes of soil pollution – General effects of soil pollution - Controlling methods of soil pollution – Carbon Trading - Causes and effects - Control measures.

MINING ENGINEERING (100 Marks)

UNIT I: ELEMENTS OF MINING ENGINEERING:

Introduction to Mining: -Various definitions of Mining- Mining operations. Modes of entry into the deposit-application, limitations. Various methods of extraction of deposits in coal, Non-coal, steps involved in extraction.

Concepts of Mining Methods: Definitions used in Mining methods -Out crop, Cover, over-burden, back, vein, lode, ore shoot, coal measures, pit top, pit-bank, pit-bottom, shaft-station, reserve station, rest station, mineral reserves, tunnel, cross cut, level, drive, staple pit, inset, gallery, heading, blind heading, face, dip, closures, slice, split, stook, barrier, sump, shaft, auxiliary shaft. Classification of coal seams based on the thickness depth, inclination, gassiness. Classification of methods of working coal in respect of underground and open cast mining. Definition of terms with suitable sketches Horizon Mining; Placer Mining-Hydraulic Mining Dredging, leaching.

Drilling Methods: Classification of drilling methods-Principle of working, method of selection, application, limitations -Various drill tools, drill bits and their field application - flushing methods-feed mechanism. Methods of core recovery - single tube, double tube and wire-line tube barrels with sketch reasons for deviation of bore holes, bore hole survey.

Explosives: Uses of explosives in mining industry, classification based on strength, speed and application. Low and high explosives, their composition, properties - explosives used in underground in opencast workings, their composition. Permitted explosives, their classification- various accessories used to perform blasting operation. Procedure to carryout blasting operation in Underground mines, precautions to be taken. Methods of dealing misfire and blown out shots.

Shaft sinking: Purpose of Shaft Sinking, Uses, factors for selection of site, different stages of sinking through subsoil, temporary, permanent supporting, Drilling, Blasting patterns used during shaft sinking, Ventilation and lighting system while sinking shaft, special methods of shaft sinking-widening of shaft.

Mine Gases: Atmospheric and mine air – composition, changes, reasons Classification of mine – poisonous, inflammable and noxious, their physical and chemical properties physiological effects, occurrence. Testing for the presence of mine gases, flames safety lamp-Principle constructional details, transfer of heat in the lamp, Accumulation and percentage tests- Listing of detectors.

UNIT II:MINING GEOLOGY:

Definitions: Geology, scope, uses of geology in Mining field, Branches of geology, Age of the earth and its determination methods origin of the earth-Nebular hypothesis of Kant and Laplace.

Physical Geology: Internal structure of earth, weathering, erosion, denudation, Attrition, Abrasion, Geological work of wind, river and their end products. Earthquakes, its propagation, intensity, causes and effects of earthquakes. Volcanoes and its classification.

Mineralogy: Define terms Mineral and Mineralogy. Physical (or megascopic) properties of minerals. Form, Color, Streak, Cleavage, Luster, Fracture, Specific gravity and Hardness. Important Mineral groups- Silica, Olivine, Amphiboles, Pyroxene, Feldspar and Mica Group. Optical mineralogy: Ordinary light, polarized light, Refractive index, Isotropic and an isotropic minerals; Double refraction, Ordinary ray, Extraordinary ray, Birefringence, Optic axis, Uniaxial minerals and Biaxial minerals

Petrology: Definitions in Petrology -Lava, Magma, Petrology, rocks, Igneous rock, Sedimentation

and Metamorphism. Magmatic differentiation, reaction series of Bowen. Classification of Rocks. Igneous, Sedimentary and Metamorphic rocks. Forms, textures and structures of Igneous Rocks. Important Igneous rocks- Granite, Rhyolite, Gabbro, Basalt and Dolerite. Formation and Classification of Sedimentary Rocks – Structural features of Sedimentary rocks. Important Sedimentary rocks– Breccia, Conglomerate, Sandstone, Shale and Limestone. Formation of Metamorphic rocks and agents for metamorphism. Kinds of metamorphism Important Metamorphic rocks – Gneiss, Schist, Marble, Slate and Quartzite.

Structural Geology: Primary and secondary structure of rock formation. Definitions- Bedding, Dip, True Dip, Apparent Dip, Strike, Overlap, Inlier and Outlier. Fold and its components. Classification and various kinds of folds. Fault and its terminology. Different Kinds of faults. Classification and description of joints. Distinguish between joints and faults. Unconformities and their types. Recognition of Unconformities.

Stratigraphy: Definition principles of stratigraphic correlation and objectives. Geological time scale. Indian stratigraphic scale Physiographic divisions. Economic minerals occurring in following systems– Archeans- Cuddapah – Vindhyan – Gondwana systems. Stratigraphy of India.

Economic Geology: Define the terms- Ore, gangue, tenor, associated mineral, resources, proved, probable and possible reserves. Different process of Mineralization. List the industrial uses of following Metallic Minerals- Corundum, Chromite, Hematite, Magnetite, Bauxite, Barites, Chalcopyrite, Malachite and Kyanite. List the industrial uses of following Non-Metallic Minerals- Mica, Graphite, Calcite, Gypsum, Apatite, Ball clay, China clay, Fire clay and Quartz. List the industrial uses of following Precious and Atomic Minerals viz., Diamond, Topaz, Uranium, Zirconium, Monazite and Beryllium. Theories of Coal formation. Importance of Petroleum as fuel. Origin, migration and accumulation of Petroleum. Mineral wealth of India.

Geological prospecting: Objectives of prospecting techniques – Guides for location of mineral deposits – Geological prospecting techniques. Geophysical methods–Electrical, Gravity, Seismic and Radiometric methods

UNIT III: UNDERGROUND COAL MINING TECHNOLOGY

Bord and Pillar:

Bord and Pillar method –definition, heading, cleat, applicability's, merits, demerits, limitations, Panels-definitions, types, applicability's, general considerations, factors influencing the size of the panel, merits and demerits, method of development in Bord and Pillar mining-with three Headings, along the dip, along strike, with the help of cross-cuts, the cleat and its influence on direction of working, with side discharge loader, with load haul dumper.

Method of Depillaring- terms, conditions of Caving, arrangements during planning and before commencement, Sequence of operations, terminology-split, rib, chowkidar pillar, goaf Under Ground Gasification, Blasting Gallery Method edge line of extraction, diagonal line of extraction, step diagonal line of extraction, knife edge line of extraction, straight line of extraction, method of extraction-by caving under weak roof condition, induced blasting , local fall, main fall, Air Blast-dangers, precautions, stowing method, hydraulic profile in hydraulic sand stowing-preparatory arrangements, precautions, against danger of water below goaved areas, extraction of contiguous seams. Working over the Goaf of a Lower Seam.

Long wall Advancing Method and short wall mining method: Terminology-gate roads, main gate, tail gate, stable, pack wall, Long wall Advancing –with AM 50,with Dosco Road Header, by continuous miner, factors governing, mechanized mine with Long wall Advancing by caving

,mechanized mine with Long wall Advancing by stowing, machinery employed, continuous mining method. Shortwall mining method.

Long wall Retreating Method and Thin seam Mining: Long wall Retreating-definition, single unit and double unit faces, mechanized mine with Long wall face retreating with caving, mechanized mine with Long wall face retreating with stowing, cutting operations- push sumping method, Inclined sumping method, Top coal caving method-applicability's, merits, demerits description of method, coal plough-over-passing, uni and bi- directional methods, cutting operations

Thick Mining Methods: Thick Seam Mining- difficulties, different methods, principles, Inclined Slicing, applicablities, merits, demerits method of working by caving, by stowing, Horizontal Slicing, applicablities, merits, demerits, method of extraction by caving, by stowing method, Sub-Level caving- applicablities, merits, demerits, method of extraction, Room and Pillar method, applicablities, merits, demerits, method of extraction, Horizon Mining- applicablities, merits, demerits, method of extraction.

Special mining methods. Hydraulic Mining- applicable conditions, merits, demerits, breaking of coal, layouts of hydraulic mining in thick seams, in steep seams, Under Ground Gasification-principle, process of gasification, linkage between holes, Blasting Gallery Method- applicable conditions, merits, demerits, development work, supporting and loading operations, drilling and blasting pattern in BG mines, machinery used, mechanized layout of BG mine, spacers, production calculation in BG mines.

UNIT IV: OPENCAST MINING

Introduction to Opencast Mining Duration: Definition, different forms– Different terminology with sketches –major coal and metal OC mines-Geo mining situation under which surface Mining adopted, major coal and metal opencasts – Limitations – merits and demerits –-Preparation of ground, de-vegetation – clearance – Formation of OB Benches – Coal benches – Drilling – blasting – loading – transportation – back filling.

Drilling and blasting in OC mines: Classification of drill holes – vertical and inclined drilling – merits-demerits various parameters-drill parameters-application- estimation of charges for blasting round of holes, blasting tools-shot firing procedure-patterns-blasting techniques –transportation-storage –charging of bulk explosives- use of NONELS- electronic detonators, boosters firing procedure –use of bulk explosives.

–control blasting techniques –applicability-conditions for adopting sleeping hole – secondary blasting techniques – dangers due blasting in OC mines preventive measures.

Transportation system in open cast mines: Factors influencing the selection of transporting system - Types of Transport system (Dumpers, belt conveyors, rails, Pipeline transport, high angle sand witch conveyors and aerial rope ways) - Types of Dumpers - construction of dumper - Belt conveyors in OC Mines - Applicable conditions, merits and demerits of In-pit Crusher Technology - Inpit Crushers - Applicable conditions, merits and Working of Spreaders used in OC mines.

Machinery Employed in open cast mines: Criteria for selection of Equipment in OC mine - Classification of HEMM deployed in OC mines (Drills, Excavators, Transport equipment, Road making equipment etc). - Application of various HEMM in OC Mines - Classification of excavators - Types of shovels - Components and their functions of shovels - Operating parameters of shovel – operating ranges, Operation and place of application of Shovel-bucket fill factor, Swell factor, bucket factor, swing factor, cycle time, loading time - Simple Numerical problems on shovel capacity - Draglines – types-Main components and their functions - Operation and place of application - Simple

numerical problems - shovel Vs Dragline - Main components and their functions, Operation and place of application, Simple Numerical problems of Bucket wheel Excavator - Applicable conditions, merits and demerits of surface miner.

Opencast mine Planning and Design: Factors effecting design of layouts (shape, size, dip of the deposit, depth of the pit, thickness of overburden surface topography, desired production, mechanization, transport system, mode of waste disposal) - Layout of shovel dumper combinations in opencast mines - Layout of Dragline mining in opencast mines - Layout of surface miner in opencast mines - Layout of Bucket wheel excavator in opencast mines

Environment& Ecology , Slope stability Analysis: Definition- Impact on environment due to opencast mining operations - Various environment pollutions (water, air, land pollutions) due to mining operations - Prevention and control of various environment pollutions (water, air, land pollutions) due to mining operations – Ecology and impact on ecology due to OC Mining operations - Relationship between Environment & Ecology- EIA (Environmental Impact Assessment) - EMP land Reclamation operations in opencast mines Slope stability- Factors influencing the slope stability of a bench - Define the terms: Slope angle, Angle of Repose, Over all slope of bench - Simple numerical problems to calculate the overall slope of the bench -Types of slope failures - Parameters required for slope design - Methods of preventing slope failures - Formula to calculate the factor of safety of bench slope - Simple numerical problems to calculate the factor of safety of bench slope.

UNIT V: ROCK MECHANICS AND STRATA CONTROL

Introduction: Definition of rock mechanics - Scope of Rock mechanics in mining- Application of Rock mechanics to mining field Stress Strain-Modulus of Elasticity-Relation between various Modulus of elasticity-Terms Insitu stress -Induced stress -simple numerical problems

Stress Analysis, Stress distribution in underground: Various forces acting on block in Insitu condition -- Relation between vertical and lateral stresses -Induced stresses due to Mining - Principle plane- Major Principal Stress, Minor principle Stress-Diagram normal and shear stresses in a 2D model stress distribution around a Mine workings, narrow and wider openings-Mohr's circle- simple numerical problems on lateral strain- Mohr's circle.

Physico Mechanical properties of Rocks and methods of determination Rock properties: Physical Mechanical, properties of rocks uni-axial compressive strength – confined compressive Strength (Tri axial test) -Tensile strength shear strength - strength indices of rocks - point load strength index protodyakonov's strength index - porosity - Relation between them - methods determining shear strength. Definition of rock mass, classification of rock stability - Give the RQD (Rock Quality Designation) Classifies Rocks by Mohr's Hardness scale. ,Give the RMR (Rock mass rating), factors consider for estimation of RMR, Estimation of RMR, simple numerical problems for estimation of RQD, Classification of roof rock based on RMR-Tunnel Quality Index

Theories of Rock failure, Rock Behavior and stress measuring devices: Theories of failure of Rocks. the Confining Pressures the Effect of water, time and Temperature -instruments used for measurement of stress- Flat jack method – Remote convergence recorder - Magnetic ring multipoint extensometer - Tell Tale Bore hole extensometer- Coal Bumps and Rock bursts-State the causes of Rock bursts and bumps. List the preventive measures against bumps and bursts.

Subsidence: Define term Subsidence- related terms of subsidence- the angle of draw-positive and negative- Factors influencing angle of draw- List the factors effecting subsidence - List the effects of subsidence- protective measures on surface and underground to minimise damages due to mining operations -method of subsidence measurement.

Strata control: Supports Necessity - Materials used - Classification of supporting Systems- Applicability of various types of supports - Size, Shape of supports - Principle of roof bolting, stitching Merits and demerits of bolting - Rigid and Yielding props constructional details of Friction, Hydraulic props - Method of setting Various supports at different situations - Fore poling. safari supporting- Junction Supports - Clearance of Heavy roof Collapse - Systematic Supporting - withdrawal of supports.

UNIT-VI: MINE MECHANIZATION

Wire ropes: Usage, chemical composition, infield tests of wire, classification of wire ropes, applicability of different ropes - causes of deterioration, precautions, selection parameters - computation of numerical problems on size - Weight and strength of wire ropes. Capping and recapping of wire ropes, classification - description of capping methods - splicing – methods of splicing

Underground transportation System: Purpose of transportation, comprehensive classification of transportation - rope haulage - direct Rope Haulage System, merits, demerits and applications - safety Devices in Direct Rope Haulage system-Endless Rope Haulage System, merits, demerits and applicability's safety devices-Rope clips, tensioning arrangements in endless haulage-Main and tail haulage system-factors of selection for rope haulage - computation problems for determination of H.P., Tub capacity, number of tubs. Classify locomotive haulage systems, merits, demerits, applicability of different system – classify aerial rope ways, the applicable conditions of aerial ropeways- Computation of Simple numerical problems on number of carriers and length of haul.

Coal Drills, Power loaders and Long wall Face Machinery: Hand held drills – classification Electric Rotary drills: Hammer Drills, Air leg, Power Loader – Types of loaders, field of applications, working operation. Long wall face machinery Principle, design and application of long wall face machinery shearer, AFC, Lump breaker, power pack, chock shield supports used in long wall mining, DERDS- their applications- principle of working of AFC (Armoured Face conveyor) - names the constituent parts of AFC-application of Twin Bord AFC, bottom closed AFC - principle of lump breaker- purpose of power pack- classification of Powered supports in long wall mining – Hydraulic control system.

Mine Cables, FLP and Intrinsically Safe Apparatus: Mine Cables -– Classification – Types – Constructional details – Cable jointing – Care and maintenance – Distribution of three phase electric power in underground mines – Cables used for signalling – Mining Telephones and Switch gear (G.E.P). Flameproof, intrinsically safe apparatus and signalling - Outlines the necessity, FLP vs intrinsically safe apparatus field of application, Frame proofing – constructional features methods of intrinsic safety field of application. Method of signalling in mines –electrical signalling, Mining telephones operation.

Mine Winding System: Winding in shafts, equipments required – purpose of head gear –Shaft fittings –purpose of each fittings, guides – Head gear pulley, keps – detaching hook's, - guides ropes in winding, cage and skip winging – Cage winding and skip winding, Types of winding systems- Drum and koepe / friction winding- safety devices/equipment used on winding system-principles of koepe /friction winding- safety equipment used in drum winding- principle of braking in winding - suspended calliper brake-electrical braking.

Mine Pumps: Pumping - Various terms of pumping, classification of pumps - centrifugal pump fittings - Turbine pump, fittings – End thrust - submersible pump - fittings merits limitation - Selection of pumps - computation of numerical problems on Head, Quantity, H.P of mine pumps.

UNIT VII: MINE SURVEYING:

Understand Evaluate the preliminaries of Surveying: Definition and objectives of surveying, primary divisions, classifications, and principle of surveying. To know the difference between plan and map, importance of scale and representative fraction, general requirements of mine plans, care and maintenance of plans and sections according to mining laws.

Basics concepts linear measurements (chain and tape): Perform Different objectives of chain surveying, Ranging, Cross staff survey, Plotting the chain triangulations for measuring the areas, corrections in chain surveying and simple problems on it.

Concepts of angular measurements (compass surveying): Introducing the concepts of angular measurements with the adoption of compass surveying, differences between angle and bearing, terminologies and parts of prismatic compass, solving the problems of bearings, angles and also introduced the concepts of traverse. Errors and its distribution of a closed traverse.

Levelling: Introduction to levelling. Learning the concept of elevations and depressions of ground surface by introducing the different methods of levelling, definition of different terms in levelling, and brief lines about dumpy level and inverted staff. Applications and problem solving in levelling and contouring. Importance of reduced levels and problem on it by different methods, definitions of curvature and refraction, problem solving on reciprocal leveling, and importance of HFL and contouring

Theodolite survey: Introducing the concepts of angular measurements with the adoption of theodolite surveying, different terminologies used in theodolite and its parts, measurements of horizontal and vertical angles and introducing the concepts of repetition and reiteration methods. Rectangular Co ordinates- calculation of latitude and departure – problems on Rectangular Coordinates – calculation of Areas – Bowditch Rule.

Setting out Curves: Classification – Definitions – elements of simple curve – Method of setting out curves – by chord and offset –chard and angle – solves problem

Correlation Survey: Purpose – methods of correlation – Direct Traversing – Co – planning – Weisbach Triangle

Tacheometer: Purpose – methods of correlation – Direct Traversing – Co – planning – Weisbach Triangle–Problems.

Dip, Strike, Fault problems: Definitions of Dip, Strike, Fault, True Dip, Apparent Dip-Relation among them- Solving the problems relating to them – determines the rate and direction of true dip or strike of a mineral bed- Solving the problems related to strike and fault – calculate the length of drift, passing through the fault-Bore hole problems- cross measure drift problems.

Modern Surveying Equipment's: Modern surveying Equipment- Principle of working of - EDM – GPS –advantages of DGPS – Total station Instrument – applicability in Mines. – key components of GIS – Remote sensing- Applicability.

UNIT VIII: UNDERGROUND METAL MINING TECHNOLOGY

Basic Concepts of Metal Mining: Definitions of various terms used in metal mines- Mineral-Ore-Ore body-Gangue-Ore forming minerals- Rock forming minerals-Foot wall-Hanging wall-– Load – Comparison between coal Mining and Metal Mining. Classification of the Non coal deposits – Classification of mineral deposits basing on depth, inclination, regularity, geometry.

Development of Metal Mining Method:Drivage- purpose - methods of drivages (conventional and

mechanized)- conventional methods - method of drivage of winze - Crown pillar- sill pillar- Ore pass-Ore bin- Raise- Winze-Level- Level interval- Back-terms with sketch- Ore chute- Ore shoot-Cross-cut – Vein – Sub level -shaft station – ore passage drives (ore pass, ore bin).

Raising Methods: Conventional methods of raising(open and compartmental)- applicabilities - open raising – merits demerits - compartmental methods of raising (two and three compartment)-applicability Sketch and explain two compartmental raising method- merits - demerits - applicability of three compartmental raising- explain - merits demerits - mechanised methods of raising- (Swedish ladder, Jora raising, Alimak climber, long hole drilling, raise boring.)-Jora raising-applicabilities - explain - merits - demerits -List the applicabilities - explain - Alimak raise climber-explanation - merits – demerits, applicabilities of Long hole raising method-reaming –methods – merits of bored raises-drop raising.

Stoping Methods: Classification of Stoping Methods by mode of attack, supported/Un supported and other methods Stoping- preparatory arrangements stope development - classifications of Stoping methods- factors governing the selection of stoping methods. Classification of stoping methods with respect to its attack - Breast stoping with a sketch- applicability- merits - demerits - method underhand stopping with a sketch- applicabilities - merits -demerits - limitations - method of Overhand stoping with sketch- applicabilities - limitations –merits-demerits-Comparison, Classification of stoping methods basing on the method of support used.- method Open stopes.-applicabilities-limitations - the method of Filled stoping method.- applicabilities – limitations-Sketch and explain Cut and fill stoping - applicabilities - merits –demerits-limitations-hydraulic fill stoping- applicabilities -merits-demerits limitations. Method of Shrinkage stoping with a sketch-applicabilities - merits –demerits limitations- method of Sub-level stoping with a sketch-applicability's-merits-demerits-limitations vertical crater method-applicabilities-merits-demerits-limitations-ringholedrilling-

Sampling:Term sampling – objectives of sampling – general principle-Mining situations – classification – channel sampling – applicability's – personnel required – Equipment required - chip sampling applicabilities – Bulk sampling – applicabilities – Drill sampling – churn drill sampling-rock drill sampling- core drill sampling- Radio metric sampling – Stope sampling – Conveyor sampling wagon sampling – truck sampling- technique of coning and quartering with sketch-purpose – application- salting- preventive measures – Assaying- Assay value- Assay value –Assay plan- Assay average- objectives of Assay plans – shown on assay plans- formula to compute Assay values – solution of simple problems on Assay values.

Deep Mining and its Associated Problem: Sources of heat-vapour relative humidity – mixing ratio – absolute humidity – methods of measuring humidity –instruments humidity – temperature. – instruments for measuring relative humidity – density of mine air – factors which changes density of mine air – specific gravity, specific heat, enthalpy – heat and humidity on miner – heat stroke and its effects, Preventive measures – changes in Cardiac-vascular systems – changes in water and chloride metabolism – preventive measures – metal fatigue on miner – working in deep mines – fall of efficiency of miner in hot and humid deep mines – cooling power of mine air – instruments for measuring cooling power of mine air- methods that improve the cooling power of mine air.

UNIT-IX: UNDERGROUND MINE ENVIRONMENTAL ENGINEERING

Mine Environmental System and Ventilation : Define the term Ventilation-Purpose of Ventilation - various ventilation systems used in Mine Classifies the systems of ventilation-Natural and Mechanical Define the term mechanical ventilation -Down cast and up cast shafts-Natural ventilation

and Mechanical Ventilation Conditions suitable for Natural Ventilation, factors influencing the production of Natural ventilation-Definition of N.V.P and motive column and their derivations - applications -related calculations - limitations of N.V.P Simple calculations on motive column - N.V.P - Calculations on theoretical depression - mano-metric efficiency - mechanical efficiency

Mechanical Ventilation: Classification of Mechanical ventilation - centrifugal fan, constructional details of backward bladed fan - Principle of working of air screw fan- controlling the quantity of air delivered -laws relating to quantity water gauge -Definition of terms – Manometric efficiency, theoretical depression, effective depression, mechanical efficiency, overall efficiency -Factors for selection of mine fans. Mine air distribution – calculations

Distribution of Mine air and Ventilation System: Objectives of distribution and coursing the air - ventilation devices – its construction, location - application regulators- Ascensional and descensional ventilation - leakage of air, air lock, Objectives of ventilation survey - different methods of pressure – quality - quantity surveys – precautions - accessories etc.,- kata thermometer- Simple calculation on ventilation survey - quantity and pressure.

Mine Fires and Explosions: Classification, causes, preventive measure, spontaneous heating- Different methods of dealing with fire Permanent sealing of Fire. Collection of samples behind fire seals – Interpretation of samples – Coward's diagram, calculation of CO/O2 deficiency rations, reopening of sealed off areas. Types of mine explosions-Causes and preventive measures, coal dust explosion-causes and preventive measures-treating coal dust by watering and stone dust barriers – water barriers Grahams and willet's ratio

Mine Inundation: Inundation in mines-dangers different source of water-precautions against surface and underground water-precautions –while approaching water logged area. Burn side safety boring apparatus, purpose of dams. Design of a dam construction of concrete dam. Accident due to inundation-case studies in India

Mine Rescue and Recovery : Rescue and recovery operations, operations in mines objectives and classification of rescue apparatus -Self contained breathing apparatus - Smoke helmet- constructional details - Gas mask self rescuer - purpose of resuscitating apparatus - Rescue stations-equipment required, Rescue Organization – Construction and function.