



KAKATIYA UNIVERISTY
DEPARTMENT OF MINING ENGINEERING
M.TECH (MINE PLANNING) PTPG SYLLABUS

GEO MECHANICS

UNIT I

Physico-mechanical properties of rocks: Physical properties: Density, porosity, void ratio, moisture content, permeability. Mechanical Properties: Preparation of rock samples, determination of mechanical properties of rocks: compressive strength, tensile strength, shear strength, modulus of elasticity, poisson's ratio, triaxial strength of rocks, cohesion, angle of internal friction. Cavability Index, Brinnels hardness. Its related calculations.

Rock mass classification: Core recovery, Rock quality designation, Rock mass rating, Q System, Geological strength index, Coal mine roof rating, Slack durability index, Strength Indices: Impact strength index, Protodyaknov strength index, Point load strength index and Its related calculation.

UNIT II

Stress strain analysis: Stress, strain and strength. Analysis of stress and strain in two and three dimensions. Principal stress, stress ellipsoid and stress directors surface. Determination of principal stress and strain invariants. Differential equilibrium equations; compatibility equation of stress and strains. Stress and strain transformation. Mohrs circle diagram for different condition. Plane stress and plane strain condition.

UNIT III

Rock behavior: Confining pressures, effect of water, time, temperature. Insitu stress and their estimation; flat jack method, over coring method and hydro fracturing method. Horizontal and vertical stress, intact rock strength and deformability; measuring devices for load, stress and strain. Dynamic loading of rocks.

Permeability and pressure: Groundwater flow within soil and rock masses; Permeability conditions; Influence of groundwater soil and rock mass behavior; Measurement of groundwater pressure and permeability

UNIT IV

Rock failure theories: Coulomb, Mohrs – Coulomb, Hoek and Brown, Griffiths and Drucker – Prager and Its related calculations.

Rock bursts: Type, effect and causes of rock bursts; Mechanics of rock burst; Prediction of rock burst; Control of rock burst incidence and damage.

UNIT –V

Design of the mine structures: Stability of pillar, stope pillars, barrier pillars and panels; design of longwall panel. Design of open pit workings: ultimate pit, production fronts, production highwall, internal dump and external dump.

Subsidence: Types, causes and impacts of subsidence; factors influencing subsidence; subsidence control, prevention and monitoring.

Text / Reference books:

1. Deb D and Verma AK. Fundamentals and application of rock mechanics. PHI publication, New Delhi. 2016.
2. Deb D. Finite element method: concepts and application in geo-mechanics, 2nd edition. PHI publication, New Delhi. 2012.
3. Obert L and Duvall WI. Rock mechanics and design of structures in rock. Wiley, Newyork. 1967.
4. Brady HG and Brown ET. Rock mechanics for underground mining, 3rd edition. Springer. 2006



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UNDERGROUND MINE PLANNING AND DESIGN OF COAL AND METAL MINES

UNIT - I

Introduction: Exploration, resource, reserve, grade, thickness and size of the deposit, the various reserve estimation techniques. Characteristics of planning process, scope of mining activities, stages of mine planning, feasibility report, detailed project report, mining plan, mine closure plan, mine environmental plan and other plans.

UNIT – II

Underground coal mining methods: Classification of methods of mining coal; factors governing choice of coal mining methods. The various underground coal mining techniques: bord and pillar, blasting gallery, continuous miner, longwall and other special techniques. Criteria for selection of different mining equipment.

UNIT – III

Design of underground coal mining methods: Pillar mining systems: design of panels, rooms and pillars; design and methods of pillar extraction with bord and pillar, blasting gallery and longwall mining: methods and design considerations for exploitation of thick seams by inclined slicing, horizontal slicing and cross-inclined slicing methods; sub-level caving and integrated caving methods. Design and methods of exploitation of contiguous seams, exploitation of seams under water bodies and seams liable to bumps. Design and method of underground hydraulic mining. Underground gassification of coal.

UNIT - IV

Underground metal mining methods: Classification of exploitation methods; choice of mining systems - geomechanical, techno-economical, environmental and safety considerations. Factors governing the choice of methods. The different underground stoping methods: breast stoping, under hand and overhand, room and pillar, sublevel, square set, shrinkage , cut and fill methods and other stoping methods.

UNIT – V

Design of underground metal mining methods: General engineering design; design methods in mining; input parameter for design - geological and other rock mass parameters; empirical, observational and analytical methods of design; design of excavations in massive elastic, stratified and jointed rocks.

Design of stoping layouts for mining of different types of ore deposits. Unit operations of stoping. Mining in rockburst prone areas. Novel and innovative mining methods: hydraulic, thermal, hydrochemical and biochemical methods; marine mining and nuclear device mining systems.

Text / Reference books:

1. Mathur SP. Mine planning for coal. M G Consultants, Bilaspur. 1993.
2. Bhattacharya J. Principles of mine planning. Allied Publishers Pvt Limited, New Delhi. 2003.
3. Hustrulid W and Kuchta M. Open Pit Mine Planning and Design. A A Balkema Rotterdam. 1995.
4. Vorobjev BM and Desmukh RT. Advanced coal mining vol-II. Asia Publishing house, Bombay, revised edition. 1966



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ENVIRONMENTAL CONTROL IN MINES

UNIT – I

Environment Pollution I: Environmental Pollutants due to surface and underground Mining – Air, Water, Noise, Sources and Classification of pollutants including dust and their effect on human health, Sources, hazards, sampling and analysis, standards, instrumentation and measurement of pollutants including dust. Control and preventive measures for air pollution including dust.

UNIT – II

Environment Pollution II: Environmental Pollution due to Water - Sources and Classification of pollutants and their effect on human health, hazards, sampling and analysis, Water pollution standards, Noise standards – Measurement – Noise Impact Index assessment, Control and preventive measures for water, noise pollution. Pollution due to vibrations, their monitoring, prevention and control.

UNIT – III

Environmental Parameters and Standards: Baseline data. ISO principles and series. Environmental quality objectives, Emission and ambient standards: minimum national standards and International environmental standards – ISO 14000.

UNIT – IV

Environmental Impact Assessment (EIA): Framework for EIA, EIA methodologies and their applicability. Uncertainties in EIA.

Environmental Management Plan (EMP): Frame work of EMP, Legislative requirements of EMP; Preparation and appraisal of EMP report.

UNIT - V

Environmental legislation: Environmental laws, the Environmental (Protective) Act, 2004, The Water Act (1974), The Air act (1981), The Forest Act 1927, The forest conservation act 1980, Power and responsibilities of regulatory agencies and occupation consent to establish and operate wild life protection act and rules, Environmental clearance procedure for a mining Project.

Text / Reference books:

1. Hartman HL. Mine ventilation and air conditioning. Wiley, Newyork. 1999.
2. Mishra GB. Mine environment and ventilation. Oxford University Press. 1992.
3. McPherson MJ. Subsurface ventilation and environmental engineering. Chapman and Hall publication, London. 1993.
4. Manahan S E. Environmental science and technology. 1966
5. Mackenthun KM. Basic concepts in environmental management. Lewis publications, London. 1998.
6. Shyam D and Armin R. Environmental law and policy in India. Oxford University Press, New Delhi. 2001.



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GEO STATISTICS

UNIT - I

Introduction to mineral exploration: Significance and necessity; Prospecting and exploration criteria; Exploration strategy and design - stages of mineral exploration; theory and methods of sampling; resources and reserves - terminology and classification schemes; conventional methods of ore estimation.

UNIT - II

Classical statistical distributions: normal and lognormal, and their applications in resource evaluation.
Geostatistics: definition; schools of thought; stationarity assumptions and regionalized variables; what, when and why of Geostatistics.

UNIT - III

Semi-variogram and co-variogram: definitions, characteristics, and computations in one, two and three dimensions; mathematical models; associated difficulties viz. anisotropy, non-stationarities, regularisation, presence of nugget effect and presence of trend. Extension, estimation and dispersion variance; calculation by discretisation and auxiliary functions.

Kriging: definition and derivation of Kriging system of equations. Practice of semi-variogram modeling; practice of Kriging - steps and procedure. An introduction to advanced Geostatistics.

UNIT - IV

Advanced Geostatistics: Practical difficulties associated with semi-variography, viz. anisotropy, non-stationarity, regularisation, misclassified tonnage; grade control plan. presence of nugget effect and presence of trend. Extension, Estimation and Dispersion variances: definitions, methods of calculations and applications; Screen Effect.

UNIT - V

Geostatistical applications: optimization of exploration drilling; calculation of mineral inventory; establishment of grade-tonnage relations; misclassified tonnage; grade control plan. Geo statistical conditional simulation - theory and approach. Geo statistical case studies of selected mineral deposits.

Text / Reference books:

1. Sarma DD. Geo statistics with applications in earth sciences. Springer publications. 2009.
2. Journel AG and Huijbregts C J. Mining geo statistics. Academic press. 1981.
3. Andereson F. Geo statistics by example approach using R. 2006.



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MINE ECONOMICS AND INVESTMENT

UNIT I

Introduction: Mineral industry and its role in national economy; world and national mineral resources; Mining A unique investment environment; special risk factors in mine investment and evaluation; national mineral policy, International aspects of mineral industry and geopolitics, Export and Import of minerals, Demand and Supply of minerals, Conservation and substitution of minerals, low grade ores, use of scrap, Substitution of minerals, Changing pattern of mineral substitution, mineral and mineral based industries, Conservation of mineral resources.

UNIT II

Ore reserve estimation: Methods of sampling, sampling frequency; analysis of sampling data, estimation of reserves, Classification of coal and ore reserves, strategic, critical and essential minerals, present and future mineral supplies of the world, Geo-statistical methods,. Grade variation, variogram modelling, Krigging, Application of Remote Sensing in mineral prospecting and ore reserve estimation

UNIT III

Mine valuation: Approaches to Mine Valuation, Time value of money; annuity; redemption of capital, net present value; selecting a discount rate, depreciation; inflation; rates of return; Hoskold's Two rate method; cash flows and discounted cash flow; profitability index – their implications in mine economic evaluation.

UNIT IV

Project appraisal: Methods of project evaluation – payback, annual value, benefit / cost ratio, ERR and IRR, etc., Mine investment analysis – objectives, criteria, alternatives, handling risk, static and dynamic methods; evaluation of exploratory mining areas and operating mines; mine project financing, its risks and constraints; Royalties, duties and mineral taxation; critical impact of depreciation, depletion, type of funding, reserves, life, etc. on mine profitability, International Investment and Trade in mineral materials and products, Small mines and their socio-economic significance.

UNIT V

Finance and accounting: Sources of mine funds – shares, debentures, fixed deposit, sinking fund, capital gearing, P& L account, balance sheet, Project operating strategy, Project alternatives, Contract mining bidding, Exploration and mine development funding, Operating Mine financing, Mergers and acquisitions, typical case studies of mine feasibility. Cost estimation of individual mining operations and overall mining cost, cost control methods, capital and operating cost of mining projects, including wages, incentives, material, etc.; assets; liabilities, Price forecasting and sensitivity analysis.

REFERENCES

1. Deshmukh RT. Mineral and mine economics. Mira publications, Nagpur. 1986.
2. Gentry DW and O'Neil TJ. Mine investment analysis. Society for Mining, Metallurgy and Exploration, Inc., Littleton, Colorado. USA.
3. Sloan DA. Mine management. Chapman and Hall, London. 1983.
4. Hartman HL. SME Mining Engineering Handbook, Vol. I. Society for Mining, Metallurgy and Exploration, Inc., Littleton, Colorado.



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GEO MECHANICS LAB

1. Sample collection and Specimen preparation.
2. Determination of moisture content, density, voids ratio and porosity of rocks.
3. Determination of compressive strength, modulus of elasticity and poisson's ratio of rocks.
4. Determination of tensile strength of rocks.
5. Determination of shear strength, angle of internal friction and cohesion of soil.
6. Determination of point load strength index of rocks.
7. Determination of protodyknov's strength index of rocks.
8. Determination of slake durability index of rocks.
9. Determination of cohesion and angle of internal friction of rocks using triaxial test.
10. Determination of hydraulic conductivity of sand.