



KAKATIYA UNIVERSITY
DEPARTMENT OF MINING ENGINEERING
M.TECH (MINE PLANNING) PTPG SYLLABUS
SEMESTER – III

NUMERICAL MODELLING IN MINING

UNIT I

Introduction to elastic and plastic models : Fundamentals, elastic, plastic, homogeneous and isotropic, non-linear elastic and elastoplastic models. Need for numerical modelling in design of excavations in mines; Domain and boundary conditions; Discretisation of domain and boundary; Methods of numerical simulation for excavations in mining.

UNIT II

Finite difference methods: Concept, formation of mesh element, finite difference patterns, solutions, application to mining. Commercial Softwares for application in mining.

Explicit finite difference method; Finite difference equation; Mechanical damping, mechanical time-step determination, solution stability, advantages and their limitations. Non-linear solution methods Introduction to Numerical Modelling Packages: FLAC.

UNIT III

Finite element methods: Concept, discretisation, element configuration, element stiffness, Assembling elements to form a structural stiffness matrix; Imposing boundary conditions and solving structural equations Elements on assumed displacements, constant strain triangle, isoparametric formulation, advantages and their limitations., two and three dimensional solutions, linear and non-linear analysis, applications in geomechanics; simulation of joints in strata. Commercial Softwares for application in mining: ANSYS.

UNIT IV

Boundary element method: Concept, discretisation, formulation, merits, demerits and limitations, different methods of solution for isotropic and infinite media. Commercial Softwares for application in mining. Boundary Element Method: Introduction, formulation, advantages and their limitations.

UNIT V

Applications in mines: Design of underground structures such as accesses of the deposit, pillar during development and depillaring operations, barrier pillar and panel. Performance of longwall powered support. Design of pit and dump in opencast mines. Prediction of subsidence.

Text / Reference books:

1. Desai CS and Abel JF. Introduction to the finite element method. Van Nostrand Riehookl Co., New York. 1983.
2. D Deb. Finite element method: concepts and application in geo-mechanics. PHI publishers. 2012.
3. Zienkiewicz OC. Finite element method in engineering science. Tata McGraw Hill. 1972.
4. Segerlind LJ. Applied finite element analysis. John Wiley and Sons, New York. 1987.
5. Mukhopadyay M. Matrix finite element – computer and structural analysis. Oxford and IBH Publishing co. 1984.
6. Brown ET. Analytical and computational methods in engineering and rock mechanics. Allen and Unwin, London. 1987.



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ADVANCED MINERAL PROCESSING

UNIT - I

Introduction to Mineral Processing: scope and importance; Basic unit operations, relative merits and demerits of processing of ores. Definitions: ore, mineral, gangue, concentrate, tailing, yield, recovery and ratio of concentration etc. Properties of different minerals relevant to their processing.

UNIT - II

Comminution: Fundamentals of size reduction, purpose, liberation of minerals, degree of liberation, Comminution laws, different types of crushers (reciprocating, impact, roll, etc.) and grinding mills, their features and application. Grindability indices.

UNIT - III

Screening: Measurement of particle size. Introduction to various size separation processes and their importance, types of screens – static and dynamic, screening surfaces and screen efficiency, factors influencing screening, screening surfaces and Screen efficiency.

UNIT - IV

Classification: Movements of solids in fluid. Free settling, hindered settling, equal settling particles. Reynolds number and its importance. Types of classifiers, their principles and operations.

Gravity Separation: Washability testing and applications. Principles, construction, operation, merits and demerits of industrial gravity separators: pneumatic jigs, dense medium baths, dense medium cyclones, spirals, tables, water only cyclones etc. Medium recovery circuits for dense medium separation. Enhanced gravity separation. Comparison between the gravity separators.

UNIT - V

Performance evaluation: partition curve, misplacement, probable error in separation, imperfection, yields reduction factor, organic efficiency. Magnetic and electro-static separation: Principles, different types of magnetic and electrical separators, their features and applications.

Flotation: Fundamentals and practice of flotation, types of reagents and their importance. Critical pH curves. Flotation circuits. Factors affecting flotation performance of coal and minerals.

Text / Reference books:

1. Wills B A and Napier-Munn T J. Mineral processing technology. Elsevier publications, 7th edt. 2006
2. Jain SK. Ore processing. CBS publishers, 2nd edition. 2010.
3. Taggart A F. Hand book of mineral dressing. Wiley and sons, Newyork. 1956.



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LONGWALL MINING

UNIT I

Planning: History of longwall mining and its development, techno-economic consideration of the modified longwall retreat panels, longwall advance panels with caving method and stowing method, design of gate roadways and their size disposition, layout of panels, production and manpower planning, sublevel caving systems for thick seams, caving system in thin seams, multi-slice longwall mining, application of longwall mining for steep seams, longwall caving in metal mines.

UNIT II

Supports: Types of supports used in longwall mining in the past and present, design of powered supports for different situations, longwall face end problems, supports in longwall gate roadways during drive and extraction, pressure distribution around a moving longwall face, caving of thick seams and thin seams. Main roof fall, local fall and induced roof fall, floor heaving, precautions during main fall and surface subsidence.

UNIT III

Extraction and transport on a longwall face: Methods of mining coal on longwall faces, machines – shearers, ploughs etc., methods of cutting and face advancement, stables and sumping, gate road pillar extension. Mode of transporting coal or ore in longwall face and machinery used. Shortwall Mining – a modified longwall mining. Remotely operated longwall faces. Shifting of longwall equipment.

UNIT IV

Development and working of longwall faces: Methods of driving gate roadways, choice of selection of machinery, road headers and dinters, special problems associated with working of longwall faces - faults, roof caving, face spalling, overburden movement, subsidence control, hydraulic stowing, dealing with spontaneous heating while working thick seams in coal.

UNIT V

Environment and ancillary: Methods of ventilating longwall faces and gate roadways. Methane control, dust control and noise control, monitoring at longwall faces. Assessment of cost of ventilation. Electric and 103 hydraulic circuits. Surface and ground water effects. Strata monitoring with instruments.

Text / Reference books:

1. Peng SS. Longwall mining. 2nd edition, John Willey and Sons, New York. 2006.
2. Peng SS. Coal mine ground control. 3rd edition. John Willey and Sons, New York. 2008.
3. Singh RD. Principles and practices of modern coal mining. New Age International. 1997.
4. Singh TN. Underground winning of coal. Oxford IBH Publishers. 1999.
5. Mathur SP. Mining planning for coal. MG Consultants, Bilaspur. 1999.
6. Singh TN and Dhar BB. Thick seam mining: problems and Issues. Oxford and IBH Publishers. 1992.
7. Das SK. Modern coal mining technology. Lovely Prakashan, Dhanbad. 1994.



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DESIGN OF UNDERGROUND STRUCTURES IN ROCK

UNIT - I

Design process for excavations in rocks: General design methodology; site characterization; excavation shape and boundary stresses; identification of failure; stability analysis. Design methods in massive, stratified and jointed rock. Design of roadways, large excavations and excavation at shaft bottom.

UNIT - II

Rock support: Principles of supports; support design criteria; rock - support interaction analysis; design of support systems for bord and pillar method, blasting gallery method, continuous miner method and long wall workings.

Rock reinforcement: Rock bolt types and application; theories of rock bolting; design of rock reinforcement.

UNIT - III

Design of underground structures in swelling and squeezing rocks: Swelling and squeezing mechanism; design methods for swelling and squeezing ground. Design of underground structures in rock mass prone to rock burst and earthquake. Effect of ground vibration on underground opening; seismic design of underground structures.

Design of underground structures in soft ground: Stability of opening in soft ground; design and stabilization methods; Shotcrete for underground openings: design and method of shotcreting.

UNIT - IV

Design of hard rock mine stope: Criteria for evaluating stope layout; stope in tabular deposits. Support design for the hard rock.

Mining induced surface subsidence: Types and effects of subsidence; theories and prediction of subsidence; subsidence management; management and utilization of subsided land.

UNIT - V

Operational geotechnical management: Risk assessment methodologies and core geotechnical risks in underground mining/excavation; geotechnical risk management strategies. Preparation of strata control management plans; strata control cell; geotechnical hazard mapping; geotechnical instrumentation; role and design of geotechnical measurement and monitoring systems; underground data collection; rock fall recovery techniques; geotechnical audits, quality assurance; geotechnical variability and dealing with non-compliance; geotechnical training; safe operating procedures; geotechnical reporting and management interaction; professional responsibilities and accountabilities.

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 WL. 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.
5. Singh RD. Principles and practices of modern coal mining. New age international publications. 1997.



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REMOTE SENSING & GEOGRAPHICAL INFORMATION SYSTEM

UNIT-I

Basic principles of Remote Sensing: Definition and components, Electro Magnetic Radiation; Wavelength regions of electro-magnetic radiation; Types of remote sensing with respect to wavelength regions; Black body radiation; Reflectance; spectral reflectance of land covers.

UNIT-II

Sensors and platforms: Types of sensors: Multispectral, Hyper-spectral, Microwave, scanners-along track and across track; Platform and their types-Geostationary and Polar orbiting, platforms based on altitudes. Satellite missions –MODIS, IRS, LANDSAT, SPOT, marine/ocean observation satellites.

UNIT-III

Digital Image Processing (DIP): Interpretation of Images; Registration: Transfer of Information from Imagery to Base Map; Classification; Exposure to various Image Processing Techniques and Generation of digitally processed outputs.

UNIT-IV

Geographical Information System (GIS): Definitions, History and development of GIS, components of GIS, applications of GIS; Coordinate Systems - Geographical Coordinate Systems, Projected Coordinate System, map projections; Geospatial data - Data input-existing GIS data, creating new data; attribute data query, spatial data query, raster data query.

UNIT – V

Applications: Recent trends in RS&GIS and Environmental assessment & monitoring, Land Use and Land cover classification, Vehicle tracking system, Application of Geo-statistical methods and GIS in mineral prospecting and ore reserve estimation, Applications of GPS in Mineral Resource Surveys, Mapping and Navigation. Role of DGPS surveys in mining leases and identifying illegalities.

Text / Reference books:

1. Anji Redddy M. Remote sensing and geographical information systems. 3rd edition. 2008.
2. Kaplan ED. Understanding GPS: principles and application. British Library Catalogue. 2006
3. Lillesand TM and Kiefer RW. Remote sensing and image interpretation. John Wiley and Sons, New York, 2004.
4. ML and Chouhan TS. Remote sensing and photogrammetry: principles and applications. Vigyan Prakashan, Jodhpur. 1998.



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NUMERICAL MODELLING IN MINING LAB

1. Assessment of pre and post behavior of the entries after excavation.
2. Design of entries of the deposit.
3. Design of the mine pillar.
4. Design of the barrier pillar.
5. Design of the mine panel.
6. Design of the longwall mine workings.
7. Prediction of subsidence.
8. Design of the highwall of the opencast mine.
9. Design of the overburden dumps.
10. Performance of the powered support.