JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech. in MINING ENGINEERING
COURSE STRUCTURE & SYLLABUS (R18)

Applicable From 2018-19 Admitted Batch

I YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA101BS	Mathematics - I	3	1	0	4
2	PH102BS	Engineering Physics	3	1	0	4
3	CS103ES	Programming for Problem Solving	3	1	0	4
4	ME104ES	Engineering Graphics	1	0	4	3
5	PH105BS	Engineering Physics Lab	0	0	3	1.5
6	CS106ES	Programming for Problem Solving Lab	0	0	3	1.5
7	*MC109ES	Environmental Science	3	0	0	0
		Induction Programme				
		Total Credits	**13**	**3**	**10**	**18**

I YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA201BS	Mathematics - II	3	1	0	4
2	CH202BS	Chemistry	3	1	0	4
3	ME203ES	Engineering Mechanics	3	1	0	4
4	ME205ES	Engineering Workshop	1	0	3	2.5
5	EN205HS	English	2	0	0	2
6	CH206BS	Engineering Chemistry Lab	0	0	3	1.5
7	EN207HS	English Language and Communication Skills Lab	0	0	2	1
		Total Credits	**12**	**3**	**8**	**19.0**

II YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA301BS	Probability and Statistics & Complex Variables	3	1	0	4
2	MN302ES	Fluid Mechanics and Hydraulic Machines	3	1	0	4
3	ME302ES	Mechanics of solids	3	0	0	3
4	MN304PC	Mine Surveying	3	1	0	4
5	MN305PC	Development of Mineral Deposits	3	0	0	3
6	MN306PC	Mine Surveying – I Lab	0	0	2	1
7	AE306ES	Mechanics of Solids Lab	0	0	2	1
8	MN307ES	Fluid Mechanics and Hydraulic Machines Lab	0	0	2	1
9	*MC309	Constitution of India	3	0	0	0
		Total Credits	**18**	**3**	**6**	**21**

II YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MN401ES	Mining Geology	3	0	0	3
2	EE401ES	Basic Electrical and Electronics Engineering	3	0	0	3

3	MN403PC	Mine Mechanization - I	3	1	0	4
4	MN404PC	Drilling and Blasting	3	1	0	4
5	MN405PC	Mine Environmental Engineering - I	3	0	0	3
6	EE409ES	Basic Electrical and Electronics Engineering Lab	0	0	2	1
7	MN407ES	Mining Geology lab	0	0	3	1.5
8	MN408PC	Mine Surveying – II Lab	0	0	3	1.5
9	*MC409	Gender Sensitization Lab	0	0	2	0
		Total Credits	**15**	**2**	**10**	**21**

III YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MN501PC	Introduction to Industrial Engineering	3	0	0	3
2		Professional Elective - I	3	0	0	3
3	MN502PC	Mine Environmental Engineering -II	3	1	0	4
4	MN503PC	Mine Mechanization-II	3	1	0	4
5	MN504PC	Surface Mining Technology	3	1	0	4
6	MN505PC	Mineral Processing Engineering Lab	0	0	3	1.5
7	MN506PC	Mine Environmental Engineering Lab	0	0	3	1.5
8	MN507PC	Mine Mechanization Lab	0	0	2	1
9	*MC510	Intellectual Property Rights	3	0	0	0
		Total Credits	**18**	**3**	**8**	**22**

III YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1		Open Elective – I	3	0	0	3
2		Professional Elective – II	3	0	0	3
3	MN601PC	Introduction to Instrumentation	3	1	0	4
4	MN602PC	Underground Coal Mining Technology	3	1	0	4
5	MN603PC	Rock Mechanics Engineering	3	1	0	4
6	MN604PC	Ground Control & Instrumentation Lab and Computer Applications in Mining Lab	0	0	3	1.5
7	MN605PC	Rock Mechanics Engineering Lab	0	0	3	1.5
8	EN608HS	Advanced Communication Skills Lab	0	0	2	1
9	*MC609	Environmental Science	3	0	0	0
		Total Credits	**18**	**3**	**8**	**22**

IV YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Open Elective – II	3	0	0	3
2		Professional Elective – III	3	0	0	3
3		Professional Elective - IV	3	0	0	3
4	MN701PC	Underground Metal Mining Technology	3	0	0	3
5	MN702PC	Mine Legislation	3	0	0	3
6	MN703PC	Industrial Oriented Mini Project/ Summer Internship	0	0	0	2*
7	MN704PC	Seminar	0	0	2	1
8	MN705PC	Project Stage - I	0	0	6	3
		Total Credits	**15**	**0**	**8**	**21**

IV YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Open Elective – III	3	0	0	3
2		Professional Elective - V	3	0	0	3
3		Professional Elective - VI	3	0	0	3
4	MN801PC	Project Stage - II	0	0	14	7
		Total Credits	**9**	**0**	**14**	**16**

***MC - Environmental Science – Should be Registered by Lateral Entry Students Only.**
***MC – Satisfactory/Unsatisfactory**

Note: Industrial Oriented Mini Project/ Summer Internship is to be carried out during the summer vacation between 6th and 7th semesters. Students should submit report of Industrial Oriented Mini Project/ Summer Internship for evaluation.

Professional Elective - I

MN511PE	Environmental Management in Mines
MN512PE	Tunneling Engineering
MN513PE	Mining of Deep-Seated Deposits

Professional Elective - II

MN611PE	Computer Applications in Mining
MN612PE	Mineral Processing
MN613PE	Material Management in Mines

Professional Elective – III

MN711PE	Advanced Surface Mining
MN712PE	Rock Fragmentation Engineering
MN713PE	Risk Assessment and Management

Professional Elective – IV

MN721PE	Rock Slope Technology
MN722PE	Mine Systems Engineering
MN723PE	Dimensional Stone Technology

Professional Elective – V

MN811PE	Mine Planning and Design
MN812PE	Geo-statistics
MN813PE	Rock Excavation Engineering

Professional Elective -VI

MN821PE	Mine Economics
MN822PE	Mineral Exploration
MN823PE	Mine Subsidence Engineering

MN711PE: ADVANCED SURFACE MINING (PE - III)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives:

- To introduce the various techniques for mine planning, geotechnical investigation and equipment management.
- To appreciate the modern trends in opencast mines, safety and environment

Course Outcomes: The students will have insight about the advanced techniques for mine planning, geotechnical investigation and equipment management and also will understand the modern trends in opencast mines, safety and environment.

UNIT - I

Pit Planning: Development of economic block model; Pit cut-off grade and its estimation; Ultimate pit configuration and its determination – hand method, floating cone technique, Lerchs-Grossmann algorithm, and computer assisted hand method. Addition of haulroad on pit plan; Pit layouts. Open-pit optimisation techniques for mine geometry and output, mine development phases, quality control Output and manpower planning; calendar planning, mine scheduling, production scheduling, truck dispatch system; Feasibility Report, DPR-contents and preparation.

UNIT - II

Geotechnical Parameters: Influence of pit slope on mine economics; Highwall slope stability analysis and design methodology; stability analysis and design methodology for waste dumps; Application of geotechnical investigation for design of ultimate pit slope and other design parameters. Numerical problems on slope stability analysis including mine waste rock dumps and tailing dumps.

UNIT - III

Production and Equipment Planning: Determination of mine size and sequencing by nested pits; Cash flow calculations; Mine and mill plant sizing; Production scheduling. Stockpiling and blending, Spreaders and Reclaimers; computerized truck dispatch. Selection of mining system vis-à-vis equipment system; Computations for the capacity and number of machines vis-à-vis mine production. Machine availability, productivity, maintenance scheduling, preventive maintenance, control and monitoring inventory. Workshops for HEMM. Power supply arrangements in opencast mines.

UNIT - IV

Health, Safety and Environmental Management: Occupational health hazards due to mine dust, poor lighting and ventilation, noise and vibration, radioactive emission; Impact of surface subsidence; Accidents in Surface mining and their prevention; Sources of water, assessment of drainage requirements, sump design and drainage patterns - pumping systems. Pre-drainage through diversion channels and boreholes; Water pollution, Methods of reclamation of mined out areas, dumps and tailing ponds, environmental audit. Socio-economic factors in surface mines.

UNIT V

Modern Trends in Opencast Mines: Recent developments in mining methods and layouts. In pit crushing & conveying, continuous surface mining. Selective extraction and dumping. Extraction of seams developed/extracted by underground methods. Deep Open pit Mining; Placer mining and solution mining – scope of applicability, sequence of development and machinery; Closure of surface mines.

TEXT BOOKS

1. Hartman, H. L. (Editor), SME Mining Engineering Handbook, 3rd edition, Vol I & II, Society of Mining Engineers, New York, 2011.
2. Hustrulid, W. and Kuchta, M., (eds)., Fundamentals of Open Pit Mine Planning & Design, Elsevier, 1995

REFERENCE BOOKS:

1 Proceedings of National Seminar on Surface Mining, IME Publications/ Calcutta, 1995
2 Das, S.K., Surface Mining Technology, Lovely Prakashan, Dhanbad, 1994
3 Das, S.K., Modern Coal Mining Technology, Lovely Prakashan, Dhanbad, 1994
4 Kennedy, B.A., Surface Mining – 2nd Edition, SME, New York, 1990

MN712PE: ROCK FRAGMENTATION ENGINEERING (PE - III)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives: To familiarize the students with highly specialized subject of design of rock breaking techniques with more emphasis on computational models, controlled blasting, instrumentation for monitoring blasting operations in mines.

Course Outcomes: Although shotfirer supervisor the drilling and blasting operation statutorily any mines, students are expected to have detailed knowledge on rock fragmentation techniques. This course enables the student to have clear perception of rock fragmentation techniques and its field applications.

UNIT- I

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, drillibality of rocks, drilling performance and costs.

UNIT- II

Mechanism of rock breaking machines, Pneumatic and Hydraulic rock hammers. Mechanics of rock fragmentation and fracture by explosive action, Types of explosives, Blasting accessories, blasting parameters, design of blasting rounds for opencast and underground mines, Blastability of rocks, blasting efficiency, mean fragment size.

UNIT- III

Computational models of blasting, transient ground motion, misfires, blown out shots, incomplete detonation – their cases and remedial measures.

UNIT- IV

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

UNIT- V

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.

TEXT BOOKS:

1. P. Pal Roy Rock Blasting effect and operation, A A Barkolna 2005
2. S. K. Das Explosive and Blasting Practices in Mines Lordy Prakashan, 1993

REFERENCE BOOKS:

1. B. H. Garg: Blasting Operation, McGraw Hill, 1981
2. CP Chugh, Drilling Technology Handbook, Oxford & IBH, 1977

MN713PE: RISK ASSESSMENT AND MANAGEMENT (PE - III)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Pre-requisites: Under graduate Physics and Maths.

Course Objectives: Upon completion of the course, the students shall be able to know the components of safety risk assessment, Epidemiological studies along with safety audit and management in mines

Course Outcomes: To understand the terminology and reason for preventing accidents, components of Risk Assessment. Apply the Safety Policies, Safety Audit and Safety Management in Mines along with Case studies

UNIT- I

Introduction to Accident Prevention and Health & Safety in Industry: Terminology, Reason for preventing accidents – moral, cost, legal.

UNIT- II

Accident statistics and trends in mining industry; Safety Risk in Opencast and Underground Mines; Risk Assessment: Concepts, Qualitative and Quantitative Approaches;

UNIT- III

Components of Risk Assessment: Risk Identification, Risk Estimation and Evaluation; Risk Analysis using FTA, HAZOP, ETA etc.; Risk Analysis Softwares; Health Risk Assessment and

UNIT- IV

Epidemiological Studies; Statistical and Economic Analysis of Accident Data; Risk Minimization Techniques in Mines; Generic approach to loss control within mining operations; Safety Policies, Safety Audit and Safety Management in Mines.

UNIT- V

Application of Virtual Reality for Safety, Training and Marketing; Case studies on Safety Risk Assessment in Mining and allied industries

TEXT BOOKS:

1. B. K. Kejriwal, Safety in Mines, Lovely Prakashan, Dhanbad, 2002.
2. N. J. Bahr, System Safety Engineering and Risk Assessment: A Practical Approach, Taylor and Francis, NY, 1997.

REFERENCE BOOKS:

1 Bhattacharya, *Accident Prevention and Safety Management in Mines*, Short Term Course, Nov. 30-3rd Dec., 2004, IIT, Kharagpur, 2004.
2 Clifton, Ericson II, *Hazard Analysis Techniques for System Safety*, John Wiley & sons, New Jersey, Canada, 2005.

MN721PE: ROCK SLOPE TECHNOLOGY (PE – IV)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives:

- To introduce the basic mechanics of rock slope failures
- To learn the types of rock failure and its influencing parameters

Course Outcome: The students will know the fundamental mechanics of rock slope failure, types of failure and its influencing parameters

UNIT - I

Basic Mechanics of Rock Slope Failure: Rock slope economics; continuum mechanics approach to slope stability; slope parameters; effect of water pressure; factor of safety of slopes; slope height vs slope angle; design of slopes.

UNIT - II

Geological and Rock Strength Properties: Geological parameters affecting slope stability; graphical representation of geological data; plotting and analysis of field measurements; physico-mechanical properties affecting slope stability, shearing on incline plane, determination of shear strength of rock and rock discontinuities; Ground water flow in rock masses; field measurement of permeability; measurement of water pressure.

UNIT - III

Plane Failure and Wedge Failure: Plane failure analysis; graphical analysis of stability; influence of ground water on stability; influence of tension crack; analysis of failure on a rough plane; rock reinforcement of slopes; Analysis of wedge failure; wedge analysis including cohesion and water pressure; Wedge stability charts for friction only; case studies. Numerical problems.

UNIT - IV

Circular and Toppling Failure: Conditions for circular failure; derivation of circular failure analysis; effect of ground water; circular failure charts; Bishop's and Janbu's methods of failure analysis; case studies. Types of toppling failure; secondary toppling modes; analysis of toppling failure; limit equilibrium analysis of toppling failures; Influence of slope curvature on stability; slope depressurisation; protection of slopes; control of rock falls; measurement and monitoring and interpretation of slope displacements. Numerical problems.

UNIT - V

Rock Slope Failure Monitoring and Slope Stabilization: Types of slope movement, Surface and Sub-surface monitoring methods inclusing instrumentation and techniques & Guidelines for monitoring programs. Causes of rock falls; Rock slope stabilization programs – stabilization by rock reinforcement & rock removal; protection measures against rock falls.

TEXT BOOKS:

1. Hoek, E and Bray, J.W., Rock Slope Engineering, Institution of Mining and Metallurgy, 1991.
2. Goodman, R.E., Rock Mechanics, John Wiley and Sons, 1989.
3. Singh, R.N. and Ghose, A.K., Engineered Rock Structures in Mining and Civil Construction, A.A. Balkema, Netherlands, 2006.

REFERENCE BOOKS:

1. Duncan C.Wylie and Chris Mah, Rock Slope Engineering, 4th Edition, 4th Edition, CRC Press, 456p, 2004.
2. John Read and Peter Stacey, Guidelines for Open Pit Slope Design, 1st Edition, CRC Press, 510p, 2009.
3. William A. Hustrulid (Ed), Michael K. McCarter (Ed) and Dirk J. A. Van Zyl (Ed), Slope stability in Surface Mining, Society for Mining, Metallurgy, and Exploration, 442p, 2001.
4. John Jaeger, N. G. Cook and Robert Zimmerman, Fundamentals of Rock Mechanics, 4th Edition, Wiley-Blackwell; 4th edition, 488p, 2007.

MN722PE: MINE SYSTEMS ENGINEERING (PE – IV)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: Nil

Course Objectives: To make students familiar with scientific/Mathematical methods that are applicable to mining industry for optimizing objectives.

Course Outcomes: The student should be able to identify some technical/ economic issues where mathematical methods can be applied to find solutions

UNIT- I

Development –Definition-Characteristics and Phases-Types of models-Operations Research models – applications. Allocation: Linear Programming Problem Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method.

UNIT- II

Transportation Problem – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy. Assignment problem – Formulation – Optimal solution - Variants of Assignment Problem- Traveling Salesman problem.

UNIT- III

Sequencing – Introduction – Flow **–**Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines
Replacement: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely- Group Replacement.

UNIT- IV

Theory of Games: Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games – dominance principle – m x 2 & 2 x n games -graphical method. Inventory: Introduction – Single item, Deterministic models – Purchase inventory models with one price break and multiple price breaks –Stochastic models – demand may be discrete variable or continuous variable – Single Period model and no setup cost.

UNIT- V

Waiting Lines: Introduction – Terminology-Single Channel – Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population. CPM and PERT Introduction to and importance of CPM. Determination of Early start time, Latest start time, Total float, Independent float, critical path, project duration. Crashing of networks Introduction to PERT, importance of PERT, expected time of completion of a project, probability of completion Application of CPM and PERT in mining industry. Simulation: Introduction, Definition, types of simulation models, Steps involved in the simulation process- Advantages and disadvantages- applications of simulation to queuing and inventory.

TEXT BOOKS:

1. Operations Research /J. K. Sharma 4e. /MacMilan
2. Operations Research/Er. Prem Kumar Gupta & Dr. D. S. Gupta/S. Chand

REFERENCE BOOKS:

1. Operations Research/S. R. Yadav & A. K. /Oxford
2. Operations Research/ ACS Kumar/

MN723PE: DIMENSIONAL STONE TECHNOLOGY (PE – IV)

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives: To familiarize students with the resources of dimensional stone in India & abroad and basic concept of mining techniques for all types of dimensional stones, processing techniques, multiwire technology and study about environmental impact in surrounding.

Course Outcomes: Dimensional Stone Technology is important to get idea to excavate blocks of marble, granite, sandstone etc. Students get a benefit of detailed understanding of various techniques of dimensional stone mining including diamond wire saw, blind cut technique etc. Also get the benefit of processing techniques such as gang saws, automatic tiling plant, multiwire machine for slab making etc. and environmental impact due to mining and processing activities.

UNIT- I

Resources of Marble, Granite, Slate, Sandstone and Limestone as Dimensional stones in India vis a vis world, uses, marketing, export. Geological, mineralogical and physico-mechanical properties of dimensional stones, Criteria for selection of dimensional stone deposit, Procedure for obtaining mining lease and preparation of project proposal.

UNIT- II

Mining: Conventional mining of Sandstone, Limestone, Marble and Granite; Recent developments- wire saw including blind cut technique, chainsaw, belt saw, hydraulic splitting, flame jet cutting, water channeling etc; Blasting techniques in dimensional stone mines: various types of explosives used, controlled blasting for providing horizontal & vertical cut; Splitting by swelling material.

UNIT- III

Insitu splitting technique used in compact limestone (Kota stone) for utilization of waste as dimensional stone. Various types of loaders cranes and hydraulic excavator used in dimensional stone mines; Quarry layouts. Hole making technique using hole-finder and laser beam. Application and development of diamond tools, formation of stone block and their handling

UNIT- IV

Processing: Dressing- Mono block dresser; Sawing- gang saws, circular saws; Preparation and mounting of blades/discs and segments; slab repair by resin Polishing - Manual, Mechanical; Various types of polishing machines; Abrasives- type, use and selection, shaping; Tile preparation; Automatic tiling plant, slurry handling and treatment including water supply. Multiwire technology.

UNIT- V

Environmental impacts of mining and processing of dimensional stones; Secondary use of quarried land and waste of the industry; Land reclamation, Environmental management plan, Environment Protection measures.

TEXT BOOK:

1. S. S Rathore., G. S. Bhardwaj and S. C Jain: Dimensional Stone Technology.

REFERENCE BOOKS:

1 S. S., Rathore and V.; Laxminarayana “Safety and Technology in Marble Mining and Processing in New Millennium” Proc. Of National Workshop held March 10-11 200 Udaipur
2 S. S. Rathore, Y. C. Gupta and R. L Parmar; “Recent Development in Machinery and Equipment for Dimensional Stone Mining” held Dec. 13-14, 2003 at Udaipur.

MN701PC: UNDERGROUND METAL MINING TECHNOLOGY

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives:

- To introduce concepts of metal mining and metal mining terminology.
- To study development and operations of metal mines.
- To study about special methods of metal mining methods.
- To know the various statutory aspects like CMR, MMR and the relevant DGMS circulars related to this course.

Course Outcomes: The students will have basic concept on metal mining methods, mine design, development and operations of metal mines. They will also know about novel methods of metal mining and its applications.

UNIT - I

Basics: Metal Mining Terminology; Typical modern metal mine features; exploration, estimation of block wise and mine wise reserves and actual production, typical pre-stoping ore block constructional features; classification of mining/ stoping methods.

UNIT - II

General Mine Design: Mode of mine and stope entry; Layouts; Determination of optimum production level; sequence of extraction, production scheduling; Basic design – Level Intervals, ore pass, common ore pass, size of blocks ore handling in stope and other openings, overview of constructional features – X cuts, Raises, Winzes etc.

UNIT - III

Stoping – General Concepts: Techno-economic characteristics impacting choice of method; typical unit cost parameters; optimum size of a mine and stope. stope layout, design, equipment selection; preparing a stoping block; sequence of stoping; organization; production cycle; unit cost calculation; comparison of methods and costs

UNIT - IV

Stoping Methods: Unsupported methods – Stope and pillar, room and pillar, shrinkage, sublevel stoping etc. supported stoping– cut and fill, stull, square set, rill, etc. caving methods – Top slicing, sublevel caving, block caving. Case studies of Indian and foreign underground metal mines. Comparison of various methods of stoping and costs.

UNIT - V

Novel & Innovative Techniques and Special Applications: Hydraulic mining, slurry mining, solution mining, nuclear mining; Rapid excavation; Radial – axial splitter; Thermal fragmentation; shock wave breaking; Deep mining; narrow contiguous veins; shaft and remnant pillars; VCR; Ring drilling; Large Blast hole stoping.

TEXT BOOKS:

1. Hartman, H.L., Introductory Mining Engineering, John Wiley and Sons, New York, 1987.
2. Hustrulid, W.A. Ed., Underground Mining Methods Handbook Society of Mining Engineering AMIE, New York, 1990.

REFERENCE BOOKS:

1. BICCARD J C, Gold mining in Witwatersrand, The Transvaal chamber of mines, Volume I, II, 1946
2. Hartman, H. L. (Editor), SME Mining Engineering Handbook, 3rd edition, Vol I & II, Society of Mining Engineers, New York, 2011

MN702PC: MINE LEGISLATION

B.Tech. IV Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives: Introduces mining laws and legislation to the students with basic knowledge on mining engineering aspects. The students will be explained about the provisions of Indian electricity rules, vocational training rules, The Mines rescue rules, The Mines and Minerals (Development and Regulation) Act etc.

Course Outcomes: As the outgoing students career is mainly dependent on mining industry, exposure to state and central laws related to mining are highly solicited. This course gives an opportunity for the students to understand the statutions requirement for coal/metal mining by opencast/underground methods.

UNIT- I

Introduction to mining laws and legislation, General principles of mining laws, development of mining legislation in India. The Mines Act, 1952, Bye-laws, Circulars, and standing orders (in brief).

UNIT- II

The Mines Rules, 1955; The Mines Vocational Training Rules, 1966; The Mines Rescue Rules, 1985. The Mines Crèche rules,1966; The Mines Maternity benefit Act, 1961; Payment of Wages Act, 2005; The Employee's (Workmen's) Compensation Act, 2010; NCWB agreement (in brief).

UNIT- III

Coal Mines Regulations, 1957; Metalliferous Mines Regulations, 1961, and the associated technical circulars.

UNIT- IV

Indian Electricity Rules, 1956; General provisions of Mines and Minerals (Regulation and Development) Act 1957; The Mineral Concession Rules, 1960; The Mineral Conservation and Development Rules, 1988.

UNIT - V

General cases of accidents in mines and their prevention. Classification of accidents, accident enquiry reports, cost of accidents, occupational diseases. Safety management in mines, role of management, labour, union and government, safety audit, risk identification and management, safety conferences

TEXT BOOKS

1. The Mines Act, 1952
2. The Mines Rules, 1955
3. The Mines Vocational Training Rules, 1966
4. The Employee's (Workmen's) Compensation Act, 2010
5. Indian Electricity Rules, 1956
6. Coal Mines Regulations, 1957
7. Metalliferous Mines Regulations, 1961
8. Mines and Minerals (Regulation and Development) Act 1957

REFERENCE BOOKS:

1. Legislation in Indian Mines: A Critical Appraisal vol. 1&2 – Rakesh and Prasad.
2. The Mineral Concession Rules, 1960
3. The Mineral Conservation and Development Rules, 1988.

MN811PE: MINE PLANNING AND DESIGN (PE - V)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives:

- To understand the planning of opencast & underground mines and equipment utilization.
- To study project implementation and monitoring

Course Outcomes: The students will have knowledge on planning of opencast mining, underground mining and equipment utilization. They will also know about project implementation and monitoring methods.

UNIT - I

Introduction: Technical factors in mine planning, methodology of mine planning, short range & long range, Optimization Techniques in Mine Planning; mine plan preparation; Choice between surface and underground mining.

UNIT - II

Opencast Mining: Development of Ultimate Pit Configuration (open pit limits) and its determination – hand method, floating cone technique, Lerchs-Grossmann algorithm and computer assisted hand method; Selection of initial mine cuts and geometrical considerations; location of surface structures, division of mining area into blocks, mine design, Impact of various parameters like depth, dip, stripping ratio, geology and strength of mineral and overburden on mine planning; Selection of Mining Systems; Determination of optimum mine size and sequencing by nested pits; Lanes algorithm for estimation of optimum mill grade and production planning; calendar plan, production scheduling, economic productivity indices. Quality Control-Ore Blending; Planning for mine closure.

UNIT - III

Underground Mining: Design of mine entries – shafts, inclines, design of stopes – size, level interval, etc, design of coal mining district, mine boundaries; design of shaft pillars and protective pillars, planning of production capacity , optimization of mine size – mine production capacity, layout of development drives / raises / winzes etc, length of faces, etc, planning of support systems, ventilation, layout of drainage system; Production planning & Production scheduling, selection of depillaring / stoping method, manpower management economic/ productivity indices, Productivity and quality control; Techno- economic analysis, Planning for mine closure.

UNIT - IV

Equipment Planning: Latest technological developments in increase in both types and capacities of equipment used in mining operations. Planning and selection of equipment, their capacities and population for different mining conditions. Maintenance planning and scheduling including spare management; Equipment information – performance monitoring and expert systems.

UNIT V

Project Implementation and Monitoring: Pre-project activities – feasibility report, environmental clearance, detailed project report, sources of funds, import of technology, selection of contracts and contract administration, time management, cost control material management system, project quality assurance, social responsibility, government orders and guidelines. Environmental impact assessment and preparation of environmental management plan.

TEXT BOOKS:

1. Jayanth Bhattacharya, Principles of Mine Planning-Allied Publishers, Delhi 2003.
2. Hustrulid, W. and Kuchta, M., (eds)., Fundamentals of Open pit Mine Planning and Design, Elsevier, 1995.

REFERENCE BOOKS

1. Ehrenburger, V and Fajkos, A., Mining Modelling, Elsevier, 1995.
2. Bawden, W.F., and Archibald., J.F., Innovative Mine Design for the 21st Century Elsevier, 1993.
3. Christoper J. Bise, Mining Engineering Analysis, 2nd Edition, Society for Mining, Metallurgy, and Exploration, 2003.
4. Pazdziora, J., Design of Underground Hard Coal Mines, Elsevier, 1988.

MN812PE: GEO-STATISTICS (PE - V)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives: To introduce and differentiate the classical statistics and geostatistics for precise resource evaluation, reserve calculations and ore body modelling as important components of mining operations.

Course Outcomes: Students understand the procedures for sampling, estimation reserves of mineral resources and ore body modelling using geostatistics as outcome of this course, which is highly beneficial for the mining engineers for mine planning and development of mine.

UNIT- I

Introduction to geostatistics and statistical estimates using population and samples; Concept of Random variables; Probability and Lognormal distribution. Basics of Geostatistics: Regionalised variable and data analyses.

UNIT- II

Semi-variogram and variance estimation: Calculation of experimental semi-variograms; Mathematical models of semi-variogram and application in mineral exploration. Extension, Estimation Variance and Dispersion variance

UNIT- III

Introduction to Kriging: Linear, Ordinary and Simple kriging; Solving kriging system of equations for Point and Block Kriged Estimates and Kriging Variance with some examples number of samples. nugget effect. Influence of Nugget effect on kriging weights; Properties of kriging.

UNIT- IV

Geostatistical evaluation of mineraldeposits, orebodymodelling, calculation of mineral resource inventory, grade-tonnage relationships, role of kriging variance in optimization of exploration drilling and misclassified tonnages.

UNIT- V

Basics of Geostatistical Conditional Simulation.

TEXT BOOKS:

1. Geostatistics with Applications in Earth Sciences- D D Sharma-Springer
2. Multivariate Geo-statistics: An Introduction with Applications- Hans Wackernagel-Springer

REFERENCE BOOKS:

1. Solved Problems in Geo-statistics- Oy Leuangthong , K. Daniel Khan, Clayton V. Deutsch-Wiley
2. Mineral Resource Estimation- Mario E. Rossi, Clayton V. Deutsch-Springer

MN813PE: ROCK EXCAVATION ENGINEERING (PE - V)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives: To understand the rock mechanics, rock cutting technology, rock cutting tools and rock excavating machine

Course Outcomes: The students will have knowledge about mechanism of rock excavation process, influences of rock properties in excavation, rock cutting technology and types of excavating machines.

UNIT - I

Introduction: Concepts, historical developments in rock excavation systems, factors affecting the rock fragmentation, mechanism of rock breakage and fracture; their application to rock fragmentation methods– explosive action, cutting, ripping and impacts.

UNIT - II

Rock Properties: Rock properties related to excavation process; application of compressive, tensile and tri- axial strengths, index tests and abrasivity, anisotropy, elasticity, porosity, laminations, bedding and jointing in rock fragmentation process.

UNIT - III

Rock Cutting Technology: Mechanism of drilling – rotary, percussive, rotary percussive, mechanics of rock cutting, theory of single tool rock cutting, crack initiation and propagation, breakage pattern, rock excavation by cutting action – picks, discs, roller cutters, water jet cutting, methods of evaluation of drillability and cuttability index of rocks.

UNIT - IV

Rock Cutting Tools: Rock cutting tool materials, different types, relative applications and their choice, tool shape and size, specific energy consumption, tool wear, effect of operational parameters on tool performance, maintenance and replacement of cutting tools of excavating machines.

UNIT - V

Rock Excavating Machines: Excavating machines, principles, operation, applicability and technical indices of road headers, TBM'S coalface machines and bucket wheel excavators.

TEXT BOOKS:

1. Hartman, H.L., Introductory Mining Engineering, John Wiley and Sons, New York, 1987.
2. Clark, G.B., Principles of Rock Fragmentation, John Wiley and Sons, New York, 1987.

REFERENCE BOOKS:

1. Hartman, H. L. (Editor), SME Mining Engineering Handbook, 3rd edition, Vol I & II, Society of Mining Engineers, New York, 2011.
2. Chugh, C.P., Diamond Drilling, Oxford-IBH, 1984.

MN821PE: MINE ECONOMICS (PE - VI)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives:

- Study of estimation and valuation of mineral deposits
- Study of project appraisal
- Study of finance and accounting

Course Outcome: The students will have knowledge on estimation and valuation of mineral deposits. They will possess about project appraisal, finance and accounting.

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.

UNIT - II

Ore Reserve Estimation: Methods of sampling, sampling frequency; analysis of sampling data, estimation of reserves, introduction to geo-statistica l methods, classification of reserves.

UNIT - III

Mine Valuation: Time value of money; annuity; redemption of capital, net present value; depletion allowance; depreciation; inflation; escalation; rates of return; Hoskold's Two rate method; capital and operating cost including wages, incentives, material, etc.; assets; liabilities; cash flows and discounted cash flow; profitability index – their implications in mine economic evaluation.

UNIT - IV

Project Appraisal: Methods of project evaluation – pay back, annual value, benefit/cost ratio, ERR and IRR, etc., evaluation of exploratory mining areas and operating mines; mine project financing, its risks and constraints; mine taxation; critical impact of depreciation, depletion, type of funding, reserves, life, etc. on mine profitability.

UNIT - V

Finance and accounting: Sources of mine funds – shares, debentures, fixed deposit, sinking fund, capital gearing, P & L account, balance sheet, typical case studies of mine feasibility. Cost estimation of individual mining operations and overall mining cost, cost control methods.

TEXT BOOKS:

1. Deshmukh, R.T., Mineral and Mine Economics, Mira Publications, Nagpur, 1986.
2. Arogyaswamy, R.N.P. Courses in Mining Geology, Oxford and IBH Publishing Co., 1994.

REFERENCE BOOKS:

1. Sloan, D.A., Mine Management, Chapman and Hall, London, 1983.
2. Chatterjee, K.K., Mineral economics, Wiley Eastern, 1992.
3. Park, R.J., Examination and Valuation of mineral property
4. How to read a balance sheet ILO 1992.

MN822PE: MINERAL EXPLORATION (PE - VI)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives: Expose the mining engineer to various aspects of prospecting and exploration methods for search of important ore minerals using different geological, geophysical and geochemical techniques.

Course Outcomes: Students can understand the procedures for exploration of mineral deposits, estimation of mineral resources as outcome of this course, which is highly beneficial for the mining engineers in the industry.

UNIT - I

Geological Prospecting and Exploration: Definitions and Principles; Methods of Prospecting; Methods of Exploration.

UNIT- II

Sampling: theory and methods; Geological plans and sections for orebody evaluation; Exploration drilling, drill core logging and sampling Cut-off grade concepts and applications; Resources and Reserves. Estimation of reserves – methods and practice.

UNIT- III

Geochemical Exploration: Introduction, Geochemical cycle, geochemical mobility and association of elements. Pathfinder and target elements for geochemical exploration. Principles of geophysical exploration methods.

UNIT- IV

Primary and secondary dispersions of elements; Determination of background, and geochemical anomalies; Geo-chemical methods of mineral exploration: Procedures for geochemical sampling; Interpretation of geochemical surveys. Indian case studies.

UNIT- V

Collection of data along Geological (G), Feasibility (F) and Economic (E) axes during various stages of exploration.

TEXT BOOKS:

1. Reedman, J H. Techniques in Mineral Exploration: 1979. Applied Science Publishers Ltd, UK
2. Peters, W.C. Exploration and Mining Geology (2nd Ed.); 1987. John Wiley & Sons, New York.

REFERENCE BOOKS:

1. Sharma, N L and Agarwal Y K. Tables for Mineral Identification.
2. A.M. Evans. 1997: Ore Geology and Industrial minerals- An introduction (III edn.) Geo- science, Texas.

MN823PE: MINE SUBSIDENCE ENGINEERING (PE - VI)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: NIL

Course Objectives: To familiarize the student with the specialized knowledge on mechanism, prediction, control of subsidence due to underground mining.

Course Outcomes: Students will get an opportunity to understand the effects of underground mining on the surface and subsurface structures, design of methods to minimize the damage to structures and laws governing mining subsidence.

UNIT- I

Introduction: Strata movement at the mining horizon, convergence in mine working, factors influencing convergence in mine working.

UNIT- II

Subsidence Mechanism**:** Zones of movement in the overlaying beds, vertical and horizontal movement, subsidence trough, angle of draw, angle of break, sub-surface subsidence.

UNIT- III

Subsidence Prediction: Different methods of surface subsidence prediction – graphical, analytical, profile function, empirical and theoretical models.

UNIT- IV

Time Influence and Impact on Structures: Influence of time on subsidence, example from long wall and bord and pillar working. Calculation of ground movement over time. Types of stress on structures, stress-strain behaviour of soils, mining damage to buildings, industrial installations, railway lines, pipes, canals, etc.,

UNIT- V

Subsidence Control, Governing Laws and Standards: Measures to reduce mining damage, mining methods to minimize damage. Laws governing mining damage, different standards suggested for mining and building ground in respect of subsidence. Case studies of Mine subsidence

TEXT BOOKS:

1. Whiltaker B.N. Reddish D.J. - Subsidence occurrence prediction and control
2. Kratzsch. H, Mine Subsidence Engineering.

REFERENCE BOOKS:

1. B. Singh – Mine Subsidence
2. Peng.S. – Surface subsidence Engineering