Unit - 2 (12 Hours)

Job Interviews: techniques interview preparations, conducting interviews, types. Group Discussions: Qualities of a GD member, do and don'ts of a GD. Listening Skills: Concepts of listening, barriers to listening, types of listening. Oral Presentations: Debates, One minute speaks and topics among groups in class. Soft Skills: Concepts and relevance of soft skills, practicing soft skills. Specific Soft skills: 1) Inter Personal skills. 2) Leadership, 3) Decision making 4) Emotional intelligence. Ergonomics: Definitions, Purpose, ergonomics at workplace, Safety measures.

Unit - 3 (12 Hours)

Technical Communication: Concept and introduction, Preparing resume and cover letter Drafting notice agenda, minutes of the meeting, drafting memorandum, formal letters, report writing. Concepts and methodology for writing thesis or assignment: Defining the problem, limiting it, consulting course material, preparing bibliography, foot notes. Use of quotations tables and figures, Assignments on allotted topics.

Unit - 4 (12 Hours)

Grammar: Active passive voice, tenses, prepositions, Degrees of comparison- positive, comparative, superlative. Question tag: Affirmative negative sentences, sentence constructions using 'No Sooner'; 'So that'. Comprehension, question based on passage and vocabulary questions. Vocabulary: phrasal verbs, idioms, antonyms, synonyms, sentence errors.

Prose Pieces: ChetanBhagat's Talk on "sparks" delivered in symbiosis Pune and an extract from Kalam's "My Journey"- 'Three great heroes resolve a problem'.

Recommended Reading:

1. Meenakshi Raman; Technical communication; 2nd ed.; Oxford University Press.
2. Meenakshi Raman, Prakash Singh; Business communication; 2nd ed.; Oxford University Press.
3. R. C. Sharma, Krishna Mohan; Business Correspondence & Report Writing; 3rd ed.; Tata McGraw – Hill Publishing Company Limited, New Delhi.
4. Krishna Mohan, Meenakshi Raman; Effective English Communication; Tata McGraw – Hill Pvt. Ltd, New Delhi.
5. K. Alex; Soft Skills; S. Chand Publication.

MN 3.1 ENGINEERING MATHEMATICS III

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
					Th. Duration (Hrs)	Marks					
		L	T	P		TH	S	TW	P	O	Total
MN 3.1	Engineering Mathematics - III	3	1	--	3	100	25	--	--	--	**125**

Course Objective:

1. To get the mathematical knowledge and skills necessary to support the concurrent and subsequent engineering studies.
2. Formulating problems.
3. Solving problems analytically.

Course Outcomes:

The student after undergoing this course will be able to:

1. Handle linear systems using matrices.
2. Express a periodic function as a Fourier series in terms of sine and cosine functions.
3. Use tools like Laplace transforms and Fourier transforms in formulating and solving Engineering problems.
4. Model and solve partial differential equations corresponding to vibration and Radiation phenomena.

UNIT - 1 (13Hours)

Matrices: types, determinant, inverse, elementary transformations, rank, reduction to normal,canonical forms, linear independence of vectors, system of the form A.X=O and A.X=B and their solutions, Eigen values and vectors, Cayley-Hamilton theorem with applications, minimal polynomial and diagonalization.

UNIT - 2 (13Hours)

Fourier Series: periodic function, trigonometric series, Euler‟s formulae, Drichlet‟s condition,Even and odd functions, half range series, Parseval‟s identity.

Fourier Transformations: Fourier transform, inverse Fourier transforms, applications, convolution theorem.

UNIT - 3 (12 Hours)

Laplace Transforms: definition, existence conditions, properties, inverse Laplace transforms, transform of periodic functions and Dirac-Delta function, convolution theorem, applications insolving linear differential equations with initial conditions and system of linear simultaneousequations.

UNIT - 4 (10 Hours)

Partial Differential Equations: classification, solution by method of separation of variables.

Wave Equation: derivation and solution of one-dimensional wave equation using separationvariables method.

Heat Equation: derivation and solution of one-and two dimensional using separation variablesmethod.

Recommended Readings:

1. B. S. Grewal; Higher Engineering Mathematics; Khanna Publications, New Delhi.
2. Veerarajan; Engineering Mathematics; Tata-McGraw Hill publications, New Delhi.
3. Erwin Kreyzig; Advanced Engineering Mathematics; New International Pub Ltd
4. P. Kandasamy; Engineering Mathematics; Chand & Co. New Delhi.
5. R. M. Baphana; Applied mathematics III; Technova Publication.

MN 3.2 ELECTRICAL DRIVES AND DIGITAL ELECTRONICS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
MN3.2	Electrical Drives and Digital Electronics	3	1	2	3	100	25	--	25	--	**150**

Course Objective:

1. Understand the Electrical drives which are the prime movers for mining machinery
2. Study of digital electronic circuit.
3. Concepts of electrical driveswith associated controls.

Course Outcomes:

The student after undergoing this course will be able to:

1. Equipwith basic knowledge on electrical motors.
2. Use instruments for electrical measurements.
3. Understand anelectronic circuit in Mining Machinery.

UNIT - 1 (14Hours)

D.C. Motors: Principles of electromechanical energy conversion. DC machine: construction, EMFequation. D.C motors: principles, torque equations, motor characteristics, speed control, starting.Three phase induction motor- principle, construction, slip, torque-slip characteristics, starting, speed control.

UNIT - 2 (10Hours)

Single Phase Induction Motor: Principle operation of split phase type, capacity start motors,stepper motors-types, principle; Synchros -construction, principle and applications; servo-motorsDC, 2-phase AC; drives concept, classification, characteristics and braking of DC motors.

UNIT - 3 (10 Hours)

Instruments: Working principle, construction, torque equations of the following analoginstruments: (a) PMMC (b) Moving iron (c) Electrodynamometer types, Shunts and

multipliers for PMMC type instruments and extension of range. Electrodynamometer,Wattmeter - construction,torque equation. Induction type Energy meter - construction, torque equation. Measurement ofpower and energy.

UNIT - 4 (14Hours)

Study of Logic Circuits: NOT, AND, OR, NAND, NOR, XOR and XNOR gates with schematicsymbol and truth table.

Study of Boolean Algebra: Laws, rules, and theorems, of Boolean algebra, sum of products (SOP)form, product of sum form (POS), of Boolean functions, study of K-maps restricted 4 variables only.

Combinational Logic: analysis of half adder, full adder, encoders and decoders.

Recommended Reading:

1. Malvino & Leach; Introduction to micro processors; Tata McGraw Hill Pub., New Delhi
2. Morris Mano; Digital Logic & Computer design; Prentice Hall of India, New Delhi
3. B. L. Theraja; A text Book of Electrical Technology; S. Chand Pub.
4. Millman & Halkias; Integrated electronics; Tata McGraw Hill Pub, New Delhi
5. A. K. Sawhney; A course in electrical and electronic measurement and instrumentation; Dhanpat Rai & Sons, New Delhi.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments)

1. Speed control of DC shunt / compound motor.
2. Ward Leonard method of speed control of DC motors
3. Study of 3-point starter
4. To find out various parameters of induction motors by direct load test
5. Study of DOL and star delta starter.
6. Measurement of power by two wattmeter methods
7. Measurement of energy by 1-Ø energy meter
8. Performance of Logic Gates
9. Boolean Equation
10. Reduction using Boolean Algebra

MN 3.3 MECHANICS OF SOLIDS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
MN3.3	Mechanics of Solids	3	--	2	3	100	25	--	--	25	**150**

Course Objective:

1. To know variety of stresses, strain and deformation due to external loads.
2. To perform Two Dimensional Stress and Strain Analysis.
3. To study the behavioral pattern of beams, struts, columns, cylinders etc.
4. To study various failure theories and energy methods.

Course Outcomes:

The student after undergoing this course will be able to:

1. Learn fundamental concepts of Stress, Strain and deformation of solids and understand the applications of the strength of Materials approach to analyze simple structural elements, subjected to direct tension/compression/ shear loading, bending and torsion.
2. Understand the stress analyses for systems subjected to combined loading using different theories of failure.
3. Utilize the principles of deflection in beams.
4. Understand and use the principles of Energy Methods and its applications in structural solutions.
5. Understand and practice the concepts involved in structural stability.

UNIT - 1 (12Hours)

Stress, Strain and Deformation of Bodies: Rigid bodies and deformable solids-tension, compression, and shear stresses, deformation of simple and compound bars, thermal stresses, elasticconstants, volumetric strains, thin cylinders and shells, deformation of thin cylinders and shells,stresses on inclined planes, principal stresses and principal planes, Mohr circle of stress

UNIT - 2 (12Hours)

Loading and Stresses on Beams: Types of loading, shear force and bending moment, cantilevers,simply supported beams and over-hanging beams. Theory of simple bending,

bending stress distribution, load carrying capacity, proportioning of sections, leaf springs, fletched beams, shearstress distribution

UNIT - 3 **(12Hours)**

Torsion: Torsion of circular shafts, close and open springs Struts and Columns: Struts and core of section, stability of columns, Euler‟s critical load fordifferent end conditions of column, empirical formulae for buckling loadMembers subjected to combined load: Shafts subjected to bending moment and twisting moment,members subjected to bending and directed tension/compression.

UNIT - 4 **(12Hours)**

Energy Principles: Strain energy under different loading conditions, Maxwell‟s theorem,Catigliono‟s theorems, deflection of structures using virtual load method Theories of failures: Various theories of failures and their limitations, comparisons and applications

Recommended Reading:

1. S. Ramamrutham; Strength of Materials; DhanpatRai Publishing Co. (P) Ltd.
2. S. Sreenath; Strength of Materials; Tata McGraw-Hill Education.
3. Beer Ferdinand, Johnson E. Russel; Mechanics of Materials, McGraw Hill Books.
4. S. P. Timoshenko, D. H. Young; Elements of Strength of Materials, East West
5. S. S. Bhavikatti; Strength of Materials; Vikas Publishing House Pvt Ltd,
6. R. C.Hibeller; Mechanics of materials; Pearson Press, India

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments)

1. Tension Test on Steel bars.
2. Compression Test on Concrete Cubes /Bricks/Stone etc.
3. Shear Test on Steel bar.
4. Flexure Test on Timber/ Tile.
5. Charpy Impact Test.
6. Hardness Tests.
7. Spring Test.
8. Verification of Maxwell's Theorem,
9. Verification of Principle of Superposition.
10. Torsion Test.

MN 3.4 ELEMENTS OF MINING ENGINEERING

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
MN3.4	Elements of Mining Engineering	3	1	--	3	100	25	--	--	--	**125**

Course Objective:

1. Introductionto mining industry and mineral potential.
2. Understand the Mining Terminologies.
3. Basic principlesof extraction and mining methods.
4. Operations including Drilling and blasting in rockexcavation and protection from collapse.

Course Outcomes:

The student after undergoing this course will be able to:

1. Enable students to demonstrate the importance of mining in national economy.
2. Understand the terminology associated with the discipline.
3. Be familiar with the available regulatory mechanism to enable safe and sustainable mining operations.
4. Equips the students with detail knowledge on various engineering techniques used for drilling, blasting, roof support and allied activities in mine construction for exploitation of minerals.

UNIT - 1 (12Hours)

The Mining Industry: Mining as basic industry for raw material for other industries. Differentstages in mining. Unit operations. Classification of mines. Indian mineral industry – status, organisations, activities. Introduction to National Mineral Policy.

Mineral Wealth: Availability of minerals in India and worldwide. Mineral Trade. Worldbodies/cartels in mineral trade. Concepts of exploration and prospecting. Mineral reserves as afunction of technological growth. Foreign collaboration and Foreign Direct Investment in Mining.Indian efforts for exploration abroad. Status with respect to sea bed mining.

Mining Terminology: Mining, Mine, Mineral, Rock, Ore, Ore body, Mineral deposit, Countryrock, Hangwall, Footwall, Overburden, Seam, Vein, Lode, Dip, Strike, Outcrop, Grade of ore,Tenure, Development, Adit, Shaft, Incline, Tunnel, Drift, Crosscut, Level, Raise, Winze, Sump,Stoping/Depillaring, Stope, Goaf, Caving, Subsidence, Stowing.

UNIT - 2 (12 Hours)

Drilling for Blasting: Types and principles of drilling. Principles of operation of Coal drill, Jackhammer, Wagon drill, Down the hole drill, Drill rigs. Drilling pattern in opencast mines. Drillingpattern for underground drives. Types of drill bits.

Explosives and Accessories: Basic composition of explosives. General classification and classification as per Indian Explosive Act. Properties of Common explosives. Permitted Explosives. Bulk explosives. Composition and construction of initiators such as Safety fuse, Plain Detonator, Electric Detonators, Detonating Fuse, Delay Detonators and Detonating Relay. Blastingtools. Regulations on storage and use of explosives. Explosive Magazines. Disposal of explosives.

UNIT - 3 (12 Hours)

Blasting: Theory of blasting. Charging of blast holes, stemming, decking. Direct and Inverse initiation. Delay Blasting. Firing sequence in opencast benches. Pulsed infusion shotfiring. Solid blasting in coal mines. Ring hole blasting. Various controlled blasting techniques. Calculation of explosive requirement and powder factor. Concept of spherical charge. Crater blasting. Need of ubgrade drilling. Secondary blasting. Safety aspects in blasting with respect to flying fragments, danger zone, misfires, blown out and blown through shots. Concept of under-water blasting. Latestdevelopments in blasting. Mine regulations on blasting.

UNIT - 4 (12 Hours)

Roof Supports: Concept of Pressure Arch Theory. Yielding and non-yielding supports. Descriptionof different types of supports. Fore poling in loose rocks. Roof testing. Prop setting. Support of roadway junctions. Support of roadways with excess height. Side lagging. Hydraulic and FrictionProps. Prop withdrawal. Mining legislation on supports.

Recommended Reading:

1. D.J.Deshmukh, Elements of Mining Technology-Vol I, Central Techno Publications,Nagpur, 7th Ed, 2001.
2. H.L.Hartman, Introductory Mining Engineering, John Wiley, New York, 1987.

3. G. K. Pradhan, Explosive and Blasting Technology, Mintech Publications, Bhubaneshwar.
4. Shevyakov, Mining of Mineral Deposits, Foreign Language Publishing House, Moscow.
5. S.Krishnaswamy, India‟s Mineral Resources, Oxford & IBH Pub. Co., New Delhi.

MN 3.5 MACHINE DRAWING AND CAD

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
					Th. Duration (Hrs)	Marks					
		L	T	P		TH	S	TW	P	O	Total
MN3.5	Machine Drawing and CAD	1	1	3	4	100	25	25	--	--	**150**

Course Objective:

1. To visualize mechanical component and convert it into a drawing.
2. To gain knowledge in two dimensional drafting.
3. To understand conventional symbols used in machining and mechanical details as per IS.
4. To assemble and disassemble the mechanical parts.

Course Outcomes:

The student after undergoing this course will be able to:

1. Visualize and draw intersections of various solids.
2. Understand and draw various types of joints and power transmitting joints.
3. Explain concepts and applications of limits, fits and tolerances.
4. Draw assembly and part drawings of various mechanical components.

UNIT - 1 (8Hours)

Assembly Drawing: Assembly of machine parts. Preparation of assembly drawing of simple machine parts such as couplings; joints, engine parts, etc., Drawing of parts and subassembly from assembly drawing. Limits, fits and tolerances for design and drawing of components andassemblies. Introduction to computer graphics, Graphic display devices.

UNIT - 2 (8Hours)

Computer-Aided Drawing: Familiarising with the menu. Absolute, relative and polar co-ordinate system. Drawing basic objects: point, line, circle, arc, ellipse, polygon, rectangle, multi line, doughnut.Drawing with precision: drawing construction lines and rays, calculating areas, calculating distance and angle, use of measure, divide, inquiry command.

UNIT - 3 (8Hours)

Section Drawings: Convention for sectioning of machine components in computer graphics, Section of simple machine components. Use of interactive menu-driven software for preparation of line drawing; graphic coordinate system; interactive computer graphic draw erase, move, rotate, mirror and hatch; introduction to mathematical concept for line, circle and curve drawing; Scan conversion, real time scan conversion, Run length encoding, Character display, Window clipping, Geometric transformations, Visible line and visible surfaces.

UNIT - 4 (8Hours)

Disassemble Drawings with Bill of Materials: Drill jig, Connecting rod, Crane hook, Tailstock ofmilling machine, Hydraulic control valves etc.

Recommended Reading:

1. N. Siddheshwar, P. Kannaiah and V V S Sastry, Machine Drawing, Tata-McGraw Hill.
2. K.C. John, A text book of Machine Drawing, PHI Learning Pvt. Ltd., New Delhi
3. N. D. Bhat, Machine Drawing, Charotar Publishing Company
4. IS Code SP 46 -1988
5. P. S. Gill, Machine Drawing, SK Kataria& Sons, New Delhi
6. K. L. Narayana, P. Kannaiah and K. Venkata Reddy, Machine Drawing, New Age International Publishers
7. K. R. Gopalkrishna, Machine Drawing, Subhash Publications

List of Experiments:

(The term work marks to be awarded based on the assessment of assignments conducted)

1. At least, TWO sheets on assembly and TWO sheets on disassembly should be done on drawing sheets during the practical sessions.
2. At least THREE sheets on assembly and THREE sheets on disassembly should be done using the standard drafting software (Auto CAD).
3. Sketch book should comprise of free hand sketches of Joints and Power Transmission Units.

MN 3.6 MINING GEOLOGY - I

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
MN 3.6	Mining Geology - I	3	1	2	3	100	25	--	25	--	**150**

Course Objective:

1. To get Basic Knowledge and skills in various aspects of geology.
2. Study of rocks and minerals and geological structures.
3. Mapping the geological features in an area

Course Outcomes:

The student after undergoing this course will be able to:

1. Understad various terminologies in geology.
2. Identify rocks and minerals by verifying the physical properties.
3. Understand the structure of earth and ore formations.

UNIT - 1 (12Hours)

Physical Geology: Role of Geology in Mining Engineering- scope and applications. Internal structure and composition of the earth. Introduction to plate tectonics and types of plates. Earth process- weathering, grades, drainage patterns and geomorphic features. Role of running water, wind, glaciers. Ground water- origin, occurrence. Earthquakes and volcanoes (Engineering importance only). Mountains, planes and plateaus in shaping the earth.

UNIT - 2 (12Hours)

Mineralogy: Mineralogy of industrially important metallic and non-metallic minerals. Theories of ore formation including secondary enrichment processes. An outline of ore microscopy. Physical properties of minerals- study of Quartz, Feldspar, Mica, Pyroxenes, Amphiboles, olivine and garnet groups. Preliminary treatment on strategic, critical and essential minerals. Elements of crystallography and mineralogy.

Petrology: Petrology of igneous, sedimentary and metamorphic rocks including formation, texture, structure, composition, description and classification. Deformation of rocks and

resulting structures, Physical properties of rocks including porosity, permeability and capillarity. An introductions to modern theories of tectonism.

UNIT - 3 (12 Hours)

Structural Geology: Structural features of rocks- true dip, apparent dip and strike. Study of Geological structures- definition and classification of faults, folds, identification procedure. Joint systems- types. Non-conformities and their types- recognition and engineering importance.Stereographic projections, and fracture analysis applied to mining operations. Geology of fuels. Importance of structures in oil accumulation. An outline of structural settings for ore deposits.

UNIT - 4 (12 Hours)

Stratigraphy: Principles of stratigraphy, geological time scale, fossils and their uses: major geological formations of peninsular India-geographical distribution, classification, Lithology and economic importance of Dharwar system, Cuddapah system, Vindhayan system, Gondwana system and Deccan trips. Stratigraphy of Goa, Study of regional geology: interpreting geological maps and plans, practical site investigation procedures, collection of structural (geological) data.

Recommended Reading:

1. Parbin Singh; Engineering and General Geology; S. K. Kataria & Sons Publ.; 2008
2. P.K. Mukherjee; A Text Book of Geology; World Press.
3. Chenhakesavulu; Text book of Engineering Geology; 2nd edition; Mcmillan Publishers, India; 2011.
4. Gokhale N.W: Manual of Geological maps, CBS Pub, New Delhi, 2000
5. K. M. Bangar; Principles of Engineering Geology; Standard Publ. Dist., 2013

List of Experiments:

At least 8 experiments should be conducted from the list of experiments.

1. Megascopic Identification and Description of Silicate Group of Minerals.
2. Megascopic Identification and Description of Non-Silicate Group of Minerals.
3. Megascopic Identification and Description of Ore Minerals.
4. Megascopic Identification and Description including the petrogenesis of Igneous Rocks
5. Megascopic Identification and Descriptionincluding the petrogenesis of

Sedimentary Rocks

6. Megascopic Identification and Description including the petrogenesis of Metamorphic Rocks
7. Exercises on topographical maps for calculating the bearings, trends and understanding the scale.
8. Exercises on geological maps and drawing sections for horizontal and dipping series of beds intruded by vertical dykes.
9. Exercises on geological maps and drawing sections for dipping series traversed by vertical strike and dip faults.
10. Exercises on geological maps and drawing sections for folded series of beds.
11. Exercises on geological maps and drawing sections for two series of beds seperated by an unconformity.
12. Graphical solution of structural problems on strike, dip, thickness and width of outcrop of rock strata

MN 4.1 MINE DEVELOPMENT

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
MN 4.1	Mine Development	3	1	--	3	100	25	--	--	--	**125**

Course Objective:

1. To study of the ore body and calculation of reserves.
2. To studey various methods to access to ore body.
3. To study various techniques for Mine development.

Course Outcomes:

The student after undergoing this course will be able to:

1. Use various exploration practices.
2. Plan for suitable type of mine openings for a given geological, topographical andmining conditions.

UNIT - 1 (12 Hours)

Exploration and Boring: Stages in exploration such as locating mineralised area, initial exploration, development exploration, exploitation exploration. Surface and Underground methods of exploration. Boring. Types of drill bits. Hole sizes. Diamond drilling: surface arrangements, feeding mechanism, core barrel, core box. Core sampling. Core recovery. Calyx drilling. Auger drilling. Wireline drilling. X-ray drilling. Continuous core rigs. Underground boring. Water loss in drilling.

Sampling and Reserve Estimation: Methods of sampling: stratified sampling and pattern sampling. Sample preparation for analysis. Coning and quartering. Methods of reserve estimation: area of influence, triangular, cross sectional, longitudinal section, block method and graphical methods. Cut-off grade. Average width. Computation of reserve. Mineable and workable reserves. Basic principles of reserve classification. United Nation Framework Classification.

UNIT - 2 (12Hours)

Opening Up a Mineral Deposits: Selecting location of opencast entry. Box cut, trenches and bench formation. Sequence of development. Stripping ratio. Elements of opencast bench. Determining height and width of benches. Haul roads. Development of a seam deposit in opencast mining. Opening and development for massive ore body in opencast mining. Underground entry.

Applicability and Comparison of Entries. Selection of site. Shape and size of underground entries. Examples of opening up gently dipping ore body, inclined deposits, steeply inclined deposits and scattered deposits. Comparison of coal mining and metal mining. Development into panels/blocks. Factors determining panel/block size. Basic principles of coal mine/ metal mine development. Mine regulations on mine entries.

UNIT - 3 (12 Hours)

Shaft Sinking: Marking centre of shaft. Drilling and blasting in shaft sinking. Shaft centering arrangement. Dealing with water. Ventilation and lighting during shaft sinking. Special methods of shaft sinking: Caisson method, Piling method, Freezing method and Cementation method. Deepening and widening of shaft. Mine regulation on shaft.

UNIT - 4 (12 Hours)

Tunnelling: Selection of size and shape of drift, level and crosscut. Basic cyclic operations. Types of drilling, loading and hauling machines used in tunnelling. Drainage and ventilation. Temporary and permanent supports. Maintaining gradient and direction. Tunnel borers. Calculation of cycletime and rate of progress. Mine regulations on development headings.

Raising and Winzing: The unit operations. Methods of raising: two compartment method, Longhole method, Drop raising. Difficulties in raise drivage. Alimac Raise Climber. Raise borers. Supporting and ventilation of raises. Comparison of drilling, charging and blasting operations between raises and winzes. Specific problems in winzing. Safety regulations on inclined road ways.

Recommended Reading:

1. D.J.Deshmukh; Elements of Mining Technology; Vol. 1 & 2; Denett & Co.; 2010
2. R.N.P. Arogyaswamy; Courses in Mining Geology; Oxford & IBH Pub. Co., New Delhi.
3. R. T. Deshmukh; Mineral and Mine Economics;, Myra Publications, Nagpur, 1986
4. Howard L. Hartman, Jan M. Mutmansky; Introductory Mining Engineering; Wiley, 2002.

5. Indian Bureau of Mines; Comprehensive Guidelines on Prospecting Requirements, www.ibm.nic.in

MN 4.2 FLUID MECHANICS ANDMACHINERY

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
MN 4.2	Fluid Mechanics and Machinery	3	--	2	3	100	25	--	25	--	**150**

Course Objective:

1. To understand fluids, its properties and fluid statics.
2. To analyze Kinematics and Dynamics of fluid flow.
3. To understand the concept of buoyancy and viscous flow.
4. To study boundary layer concept.

Course Outcomes:

The student after undergoing this course will be able to:

1. Understand the basic concept of fluid flow and properties of fluids.
2. Understand the principles of fluid statics, kinematics and dynamics.
3. Analyze fluid flow problems with the application of the momentum and energy equations.
4. Understand concept of buoyancy, viscosity and importance of viscosity in real flows.
5. Perform dimensional analysis for problems in fluid mechanics.
6. Understand the concept of boundary layer formation.

UNIT - 1 (12Hours)

Fluid: Definition. Types of fluids. Fluids as a continuum. Fluid properties such as Density, Specific gravity, Surface tension and capillarity. Vapour pressure. Viscosity and compressibility.Classification of fluids. Fluid statics. Absolute and gauge pressure of fluids. Measurement ofpressure. Fluid static force on immersed surfaces. Buoyant forces. Stability of floating andsubmerged bodies. Hydraulic press, cranes and lifts. Fluid kinetics. Methods of describing fluid motion. Lagrangian and Eulerian approaches. Types of motion. Rotational and irrotational flows. Vorticity and circulation. Velocity and acceleration. Local and convective acceleration. Potential flows. Velocity potential and stream function. Laplace equation. Uses and limitations of flownets. Methods of analysis of flownet.

UNIT - 2 (12Hours)

Fluid Dynamics: Forces influencing fluid motion. Types of forces. Body and surface forces. Energy and Head. Equations of fluid dynamics. Euler equation and application. Integration of Euler equation to get Bernoullis‟ equation. Momentum equation. Fluids subjected to uniform horizontal and vertical acceleration. Vortex motion. Free and forced vortex. Application of Bernoullis‟ equation in measurement of flows. Stagnation pressure. Pitot tube, Prandtl tube, venturi meter, andorifice plate. Flow nozzles, orifices, mouthpieces, notches and weirs.

UNIT - 3 (12Hours)

Pipe Flow: Transition from laminar flow to turbulent flow. Problems in pipe flow. Losses in pipe flow. Major and minor losses. Losses in transition. Losses in fittings and valves. Friction loss in pipe. Coefficient of friction. Commercial pipes in use. Different arrangements of pipes. Pipes open to atmosphere. Pipe connecting reservoirs. Branching pipes. Pipes in parallel and series. Equivalent lengths. Syphons. Pipe net work. Laminar flow in pipes.

UNIT - 4 (12Hours)

Reciprocating Pump: Construction and Principle of working, indicator diagram, Effect of acceleration and friction of liquids in suction and delivery pipes. Application of air vessels and their advantages. Coefficient of Discharge and slip of reciprocating pump.

Centrifugal Pump: Priming of pumps. Minimum starting speed. Multistage pumps. Pumps in series and parallel. Performance characteristic. Losses and efficiency of Centrifugal Pump. Operational Difficulties in Centrifugal Pump. NPSH: Mechanism of Cavitations. Working of Hydraulic Crane, Air Lift Pump, Hydraulic Ram, Hydraulic Lift and Jet pump.

Recommended Readings:

1. R. K. Bansal; A textbook of Fluid Mechanics & Hydraulic machines; Laxmi Publications (p) Ltd; 2012.
2. R. W. Fox, P. J. Pritchard, A. T. McDonald; Introduction to Fluid Mechanics; Wiley India; 7/e.
3. P. N. Modi, S. M. Seth; Hydraulics & Fluid Mechanics including Hydraulic Machines; Standard Book House, New Delhi; 2009.
4. Y. A. Cengel, J. M. Cimbala; Fluid Mechanics: Fundamentals & Applications; TMH, New Delhi; 2/e.
5. D. S. Kumar; Fluid Mechanics & Fluid Power Engineering; S. K. Kataria& sons, New Delhi; 2008.

List of Experiments:

At least 8 experiments should be conducted from the list of experiments.

1. Verification of Bernoulli‟s theorem.
2. Calibration of a Venturimeter.
3. Calibration of a orificemeter
4. Calibration V-notch
5. Calibration of rectangular notch
6. Friction in pipes-Determination of coefficient of friction for a G.I. pipe
7. Frictional loss in pipe due to bend and nozzle
8. Reynold‟s Experiment: Demonstration of Laminar and turbulent flow.
9. Visit to industry to study various hydraulic machinery used.

MN 4.3 MINING GEOLOGY - II

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
MN4.3	Mining Geology–II	3	2	--	3	100	25	25	--	--	**150**

Course Objective:

1. To study prospecting and exploration techniques ans classification and estimation of ore reserves.
2. Study of geological, geophysical and geochemical exploration techniques.
3. Study drilling methods, accessories for drilling and core logging.
4. To study Geological conditions favourable for formation of ores and occurrence and localisation of economic mineral deposits.

Course Outcomes:

The student after undergoing this course will be able to:

1. Understand and apply prospecting and exploration techniques and to estimate the ore reserves.
2. Understand and apply a combination of exploration techniques suitable for probable ore deposit
3. Understand the selection of drilling method for a deposit.
4. Have a broad overview of various mineral deposits located in different parts of India.

UNIT - 1 (12Hours)

Introduction: Different methods, scope and limitation of prospecting. Reconnaisance Survey. Alluvial sampling, Pit sampling, Procedures for obtaining Prospecting Licence. Main features of Mineral Concession Rules.

Ore Reserve Classification: Classification of reserves. Understanding the terms Resourse Potential, Resource Base, Resources, Reserves, Grade, Tenor and Specification. Geological consideration and Techno-economic considerations for classification. Prospective (hypothetical) and Prognostic (speculative) Resources as per IS-12595. The three dimensional approach of United Nations Framework Classification. The codes and

extended codes in UNFC. Advantages of UNFC. Impact of UNFC on Indian iron ore inventory. The main provisions of Mineral Conservation and Development Rules.

Ore Reserve Estimation: Basic principles of ore reserve calculation, Triangular and polygon methods, Average factor and area method, Mining block method, Cross section method, Average grade and arithmetic average, Cut off grade calculation, Accuracy of sampling.

UNIT - 2 (12Hours)

Mineral Exploration Procedures: Theories of ore formation, Stages in mineral exploration, Various exploration methods. Guides to Ore, Regional Guides, Geochemical Guides, Groundwater as a Guide, Geo-botanical and Biochemical Guides, Physiographic Guides, Mineralogical Guides, Rock Alteration, Stratigraphic and Lithologic Guides, Fracture Patterns as Guides, Contacts and Folds as Guides, Dislocated Ore Bodies, Ore Bodies Displaced by Intrusives, Coal and Oil Shale. Remote sensing. Satellite imaging. Sterioscope. Geological mapping.

Exploration Geophysics: Methods and application, Airborne versus Ground Surveys, magnetometer survey, Gravity Methods, Electrical, seismic and radiometric methods, Limitations in Mining Geophysics.

Geochemical Exploration: Geochemical cycle. Distribution of elements during magmatic, sedimentary and metamorphic process. Principles, methods and and equipments for trace element analysis. Interpretation of geochemical data.

UNIT - 3 (12Hours)

Exploratory Drilling: Types of drilling, Diamond drilling. Hole diameters. Wireline drilling. Reamer shells and TC bits. Core barrel and casing. Fishing tools. Types of drilling fluids. Sludge collection methods. Deep drilling practice. Drill hole pattern, Drill hole spacing, Bore hole deviation and its correction. Drill hole data logging. Sludge sampling,

Oil Well Drilling: Types of wells. Modern drilling techniques. Off shore drilling. Use of blowout prevention. Casing programme and design.

UNIT - 4 (12Hours)

Economic Geology: Ore, gangue, tenor, assay and grade of ore, classification of mineral deposits; ore forming processes-magmatic, hydrothermal, oxidization and supergene enrichment, residual concentration, mechanical concentration and sedimentation Principles of hydrology including transmission of ground water in rock and soils, applied to surface and underground mining operations.

Economic Indian Mineral Deposits: Origin, mode of occurrence and distribution of following metallic minerals- iron ores, manganese, copper, Chromite, bauxite, lead and zinc; non metallic deposits-asbestos, mica, Gemstones, kyanite, barite, Magnesite, graphite, kaolin, garnet and feldspars. Petroleum deposits: origin and occurrences. Resources in India and worldwide.

Recommended Reading:

1. R.N.P.Arogyaswamy; Courses in mining geology; Oxford & IBH Co., New Delhi; 1994.
2. Umeshwar Prasad, Economic geology, 2nd edition CBS pub New Delhi; 2000.
3. K.V.G.K Gokhale and T.C Rao; Economic Mineral Ore Deposits of India, Thompson Press.
4. H. L. Hartman, Jan M. Mutmansky; Introductory Mining Engineering; John Wiley & Sons; 2002.
5. Charles J. Moon, Michael K.G. Whateley & Anthony M. Evans (Ed); Introduction to Mineral Exploration. Blackwell Publ; 2006.

Term Work

(The term work marks to be awarded based on the assessment of assignment conducted)

1. Detailed study report on three field visits conducted to studymineralogy, petrology, structural geology and weathering effects.

MN 4.4 SURVEYING - I

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
MN4.4	Surveying–I	3	1	2	3	100	25	--	25	--	**150**

Course Objective:

1. Understand the importance of surveing in Mining Industry.
2. Understand basic surveying teminologies and Methods.
3. Getting familiar with surveying eqiupment and taking measurements.
4. Learn to prepare the survey plans.
5. Understand theprogress in excavation from the survey plans.

Course Outcomes:

The student after undergoing this course will be able to:

1. Use surveying eqiupment and taking measurements.
2. Interpretation and data extaraction from survey plans.
3. Prepare the survey plans.

UNIT - 1 (12 Hours)

Introduction: Basic definitions, objectives, divisions and Importance of Surveying to Engineers; Classification and Principles of Surveying, Overview of Land Surveying; Surveying measurementsand errors.

Basic Surveying Instruments: Tape and Compass, Principle of reversal, EDM and accessoriesBasic Principle, Errors, Precautions and Problems.

Level: Different types and various parts, Working Principle, Temporary and Permanent adjustments, Sensitivity of level Tube, Errors and mistakes, Levelling Staff.

Theodolite: Different types and various parts -Basic terms, Fundamental lines, Temporary and Permanent adjustments, Errors and mistakes in Theodolite.

Measurement of Distance: Basic definitions, Methods, Ranging; Errors-types, Corrections and Precautions; Field problems and their solutions.

UNIT - 2 (12 Hours)

Measurement of Angles and Direction: Basic Definitions- meridians, declination-variations, local attraction, Prismatic and Surveyors Compass: Whole circle and reduced bearings. Traversing withchain and compass. Methods; Methods of repetition and reiteration; Errors and mistakes, Corrections and Accuracy.

Plane Table Surveying: Instruments, Plane table and its accessories Telescopic alidade Basic definitions, Advantages and disadvantages; Setting of instruments, Orientation, methods, Two and Three- point problem, Accuracy in plane table survey, Errors, Precautions, Plotting of details including contours

UNIT - 3 (12Hours)

Determination of Elevation: Basic Definitions, Dumpy level and tilting level, Curvature and Refraction, Methods; Reductions of levels. Differential levelling and field book note, Reciprocal Levelling; Profile levelling, Longitudinal and cross sectioning Trigonometric Levelling: Introduction, Errors and Mistakes in levelling, Error Propagation; heights and distance with base of the object accessible, base of object inaccessible, with instrument stations in the same vertical plane as the elevated object and instrument station not in the same vertical plane as the elevated object.

UNIT - 4 (12Hours)

Contouring: Contouring: Introduction, Contour interval, methods of contouring, interpolation of contours, Uses of contour maps.

Minor InstrumentsandMeasurement of Areas and Volumes: Use of planimeter, Clinometers, box sextant, line ranger, optical prism, and Abney level. Measurement of area and volume by Trapezoidal and Simpson's rule.

Transit Theodolite : Parts and optics of transits. Temporary and permanent adjustments. Repetition andreiteration method of measuring horizontal angles.

Measurements of Vertical Angles: Traverse survey. Methods of balancing traverse. Gales Traverse table. Omitted measurements.

Recommended Reading:

1. B. C. Punmia, Ashok Kumar and Arun Kumar; Surveying Vol. I; Firewall Media; 2005.
2. Kanetkar, Kulkarni; Surveying and Levelling Vol. I; A.V.G Publications, Pune
3. N.N. Basak; Surveying and Levelling; Tata McGraw Hill Pub.

4. S. K. Duggal; Surveying; Tata McGraw Hill pub.
5. S. K. Husain, M.S. Nagaraj; Surveying and Levelling, Vol I & II; S.Chand and Co.

List of Experiments:

(Eight sheets covering chain and compass survey, plane table survey, longitudinal and Cross Sections)

1. Chain and Compass Surveying – 1 Sheet
2. Plane Table Surveying – 1 Sheet
3. Profile Levelling: Cross and Longitudinal Section of Road - 2 Sheets.
4. Contouring Sectioning of a road and contouring - 2 Sheets

MN 4.5 ROCK MECHANICS ANDGROUND CONTROL - I

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
MN4.5	Rock Mechanics and Ground Control -I	3	1	2	3	100	25	--	--	25	**150**

Course Objective:

1. Learning basic rock mechanics and its application in Mining Industry.
2. Getting knowledge of rock behaviour and properties.
3. Understand basic concepts of stress - strain analysis and slope stability.
4. Solving problems associatedwith rock pressure and rock movement.

Course Outcomes:

The student after undergoing this course will be able to:

1. Carry out various physico-mechanical tests.
2. Understand the rock behaviour.
3. Analyze ofavailable data for Rock Engineering.
4. Solve rock mechanics problem in mining and excavation projects.

UNIT - 1 (12Hours)

Introduction: Definition of some important terms used in rock mechanics. Application of rock mechanics in mining. Constraints in rock mechanics application. Introduction to stress analysis.Principal stresses and strains. Differential equations of static equilibrium. Mohr‟s circle of stressand circle of strain.

UNIT - 2 (12 Hours)

Physico-Mechanical Properties of Rock: Physical properties of rock: density, porosity, moisturecontent, permeability, swell index, Slake durability index, thermal conductivity, hardness, durability, Protodyaknov index, impact strength index, point load index. Application of technicalindices of rocks in mining practice. Effect of geological parameters on engineering properties of rock mass. Introduction to general classification of rock mass.

UNIT - 3 (12Hours)

Mechanical and Rheological Properties of Rocks: Preparation of test specimens. Laboratorydetermination of mechanical properties of rocks: compressive strength, tensile strength, shearstrength, Units of elasticity Poisson‟s ratio, tri-axial strength of rocks. Mohr‟s envelope. Effect of various parameters on the strength of rocks. In – situ strength. Effect of joints and fracture on mechanical properties of rocks. Dynamic wave velocities. Dynamic elastic constants: their determination in the laboratory and application in mining. Time dependent properties of rocks. Creep behaviour of rock: different stages. Rheological models. Acoustic properties of rocks. Determination of elastic properties of rocks and rock mass based on acoustic properties. Theories of rock failure. Hoek and Brown failure theory.

UNIT - 4 (12Hours)

Slope Stability: Types of slope failure: plane, wedge and circular. Slip circle. Effect of clayintrusions and fault planes on slope failure. Factor of safety. Stability analysis. Determining slopestability of working benches and berms. Strengthening the slopes. Dump stability. Design criteriaand monitoring system for dumps. Overburden dump stabilization.

Recommended Reading:

1. R. E. Goodman; Introduction to Rock Mechanics; John Wiley & Sons; 1989.
2. B. P. Verma; Rock Mechanics for Engineers; Khanna PUbl.; 2013
3. John A Hudson and John P Harrison, Engineering Rock Mechanics- An introduction to the principles, Pergamon Press, 1997.
4. B. H. G. Brady, S. T. Brown; Rock Mechanics for Underground Mining; Chapman and Hall; 1993
5. Obert, L and Duvall, W.I. Rock Mechanics and design of Structure in Rock John Wiley and Sons Inc., New York 1967.

List of Experiments:

(At least 8 experiments should be conducted from the list of experiments)

1. Preparation of rock specimens for laboratory tests.
2. Determination of porosity and density
3. Determination of uni-axial compressive strength of rocks.
4. Determination of point load strength index.
5. Determination of tensile strength of rock by Brazillian test.
6. Determination of Protodyakanov index of the given rock specimen.
7. Determination of slake durability index of rocks.
8. Determination of shear strength and punch shear strength.
9. Schmidt hammer test

MN 4.6 NUMERICAL TECHNIQUES AND STATISTICS

Subject Code	Name of the Subject	Scheme of Instruction Hrs/Week			Scheme of Instruction						
		L	T	P	Th. Duration (Hrs)	Marks					
						TH	S	TW	P	O	Total
MN 4.6	Numerical Techniques and Statistics	3	1	--	3	100	25	--	--	--	**125**

Course Objective:

1. To provide Engineering students with a basic knowledge of various Numerical Methods used to solve algebraic, transcendental, differential and partial differential equations, and to calculate derivatives and integrals.

Course Outcomes:

The student after undergoing this course will be able to:

1. Solve an algebraic or transcendental equation using an appropriate numerical method.
2. Approximate a function using an appropriate numerical method.
3. Solve differential and partial differential equation using an appropriate numerical method.
4. Calculate a definite integral using an appropriate numerical method.
5. Solve a linear system of equations using an appropriate numerical method.
6. Implement a numerical method using a modern computer language.
7. Understand the basic concepts of probability, random variables and probability distributions.

UNIT - 1 (13Hours)

Solutions of Equations: Solutions of non-linear equations of single variable using bisection method, false position method, Newton-Raphson method, secant method (problem solving, algorithm and computer programming), order of convergence and comparison of these methods

Finite Difference of Interpolation: Forward, Backward, Central, divided differences, Taylor‟s, shift and averaging operators , difference of polynomials, factorial polynomial, Newton forward and Backward difference interpolation, Langrange‟s interpolation,

Newton divided difference interpolation(derivation, problem solving, algorithm and computer programming), stirling‟s and Bessel‟s interpolation formula.

UNIT - 2 **(12 Hours)**

Numerical Solution of Differential Equations: Picard‟s method, Taylor series method, Euler‟smethod, modified Euler‟s, Runge-Kutta methods, Milne‟s predictor-corrector method (problemsolving, algorithm and computer programming).

Numerical Solution of Partial Differential Equations: solution of Laplace, heat and wave equation by finite difference method.

UNIT - 3 **(10 Hours)**

Numerical Integration: Newton-Cote‟s quadrature formula, trapezoidal rule, Simpson‟s 1/3 and 3/8rules, Weddle‟s rule (Problem solving, algorithm and computer programming), Romberg‟s integration (Richardson‟s extrapolation). Comparison of the above methods and error estimation.

Solution to Linear Algebraic Equations: Gauss elimination, Gauss-Jordan, Jacobi‟s, Gauss Seidal methods (problem solving, algorithm and computer programming). Comparison of above methods and concept of ill and well conditioned systems.

UNIT - 4 **(13Hours)**

Statistics: Axioms of probability, conditional probability, theorem on total probability, Bayestheorem; Random variables-discrete and continuous; E, V operators, MGF and properties, Standard distributions: discrete-binomial, geometric and Poisson; continuous-uniform-exponential andnormal; E, V operators and MGF for those distributions

Recommended Reading

1. B. S. Grewal; Numerical methods; Khanna Pub., New Delhi.
2. P. Kandasamy; Numerical Methods; S. Chand & Co., New Delhi.
3. D. C. Montgomery; Probability and statistics for Engineers; Prentice Hall of India, NewDelhi.
4. Balagurusamy; Numerical Methods; Tata McGraw Hill Pub., New Delhi.
5. Ayyub and McCuen; Numerical Methods for Engineers; Prentice Hall, 1996.