

## ENGINEERING MATHEMATICS – III

CODE: 10 MAT 31  
Hrs/Week: 04  
Total Hrs: 52  
Marks:100

IA Marks: 25  
Exam Hrs: 03  
Exam

### PART-A

#### Unit-I: FOURIER SERIES

Convergence and divergence of infinite series of positive terms, definition and illustrative examples\*

Periodic functions, Dirichlet's conditions, Fourier series of periodic functions of period  $2\pi$  and arbitrary period, half range Fourier series. Complex form of Fourier Series. Practical harmonic analysis. [7 hours]

#### Unit-II: FOURIER TRANSFORMS

Infinite Fourier transform, Fourier Sine and Cosine transforms, properties, Inverse transforms

[6 hours]

#### Unit-III: APPLICATIONS OF PDE

Various possible solutions of one dimensional wave and heat equations, two dimensional Laplace's equation by the method of separation of variables, Solution of all these equations with specified boundary conditions. D'Alembert's solution of one dimensional wave equation.

[6 hours]

#### Unit-IV: CURVE FITTING AND OPTIMIZATION

Curve fitting by the method of least squares- Fitting of curves of the form  $y = ax + b$ ,  $y = ax^2 + bx + c$ ,  $y = ae^{bx}$ ,  $y = ax^b$

Optimization: Linear programming, mathematical formulation of linear programming problem (LPP), Graphical method and simplex method.

[7 hours]

## **PART-B**

### **Unit-V: NUMERICAL METHODS - 1**

Numerical Solution of algebraic and transcendental equations: Regula-falsi method, Newton - Raphson method. Iterative methods of solution of a system of equations: Gauss-seidel and Relaxation methods. Largest eigen value and the corresponding eigen vector by Rayleigh's power method.

[6 hours]

### **Unit-VI: NUMERICAL METHODS – 2**

Finite differences: Forward and backward differences, Newton's forward and backward interpolation formulae. Divided differences - Newton's divided difference formula, Lagrange's interpolation formula and inverse interpolation formula.

Numerical integration: Simpson's one-third, three-eighth and Weddle's rules (All formulae/rules without proof)

[7 hours]

### **Unit-VII: NUMERICAL METHODS – 3**

Numerical solutions of PDE – finite difference approximation to derivatives, Numerical solution of two dimensional Laplace's equation, one dimensional heat and wave equations

[7 hours]

**Unit-VIII:            DIFFERENCE EQUATIONS AND Z-TRANSFORMS**

Difference equations: Basic definition; Z-transforms – definition, standard Z-transforms, damping rule, shifting rule, initial value and final value theorems. Inverse Z-transform. Application of Z-transforms to solve difference equations.

**[6 hours]**

**Note: \* In the case of illustrative examples, questions are not to be set.**

**Text Books:**

1. B.S. Grewal, Higher Engineering Mathematics, Latest edition, Khanna Publishers
2. Erwin Kreyszig, Advanced Engineering Mathematics, Latest edition, Wiley Publications.

**Reference Book:**

1. B.V. Ramana, Higher Engineering Mathematics, Latest edition, Tata Mc. Graw Hill Publications.
2. Peter V. O’Neil, Engineering Mathematics, CENGAGE Learning India Pvt Ltd.Publishers

**MINING ELECTRICAL ENGINEERING**

<b>Sub Code</b>	<b>: 10 MN 32</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hrs/week</b>	<b>: 04</b>	<b>Exam Hours</b>	<b>: 03</b>
<b>Total Hrs.</b>	<b>: 52</b>	<b>Exam Marks</b>	<b>: 100</b>

**PART-A**

**UNIT 1:**

**Introduction:** Scope and importance of electrical engineering in mining, Role of electrical engineer in mining. Indian Electricity Rules Applicable to Mining.

**6 Hours**

**UNIT 2:**

**Introduction to Electric Drives:** Electrical drives, advantages of electric drives, parts of electrical drives, choice of electrical drives, status of DC and AC drives.

**6 Hours**

**UNIT 3:**

**Industrial Applications:** Precautions, Electric winder, Types of electric drivers for mine hoists, DC hoist drives, AC hoist drives, Shearer and Conveyors in longwall mining method, Auxiliary motors, Methods of Fan drives – toothed gearing, belt drive, rope drive.

**7 Hours**

**UNIT 4:**

**Starting and Braking of Motors:** Introduction to motor starting, DC motor starters, starting of polyphase induction motors, electric braking of DC motors and AC motors.

**7 Hours**

**PART-B**

**UNIT 5:**

**Speed Control of Motors:** The methods of speed control, speed control of DC shunt motors, ward Leonard Control, Dynamics of induction motor starting, load equalization, speed control of squirrel cage induction motors, speed control of slip-ring induction motors.

**7 Hours**

**UNIT 6:**

**Protective Devices:** Air break switches, Air circuit breakers, oil circuit breakers. Principles of underground signaling. Types of motor enclosures in mines.

**6 Hours**

**UNIT 7:**

**Typical Power Equipment in Mines:** Power distribution in mines, Surface and Underground power distribution in mines, Main Lighting equipment, Surface auxiliaries, Underground Cables, Underground plant, Flameproof apparatus, Intrinsically safe apparatus.

**7 Hours**

**UNIT 8:**

**Mine Illumination:** General lighting in mines, lighting in opencast mines, standards for mine lighting, Illumination measurements: luminance measurements, reflectance measurements. Design of lighting system in mines.

**6 Hours**

**TEXTBOOKS:**

1. **“Electric Motors: Applications and Control.”** Chapter 3 & 4, M.V. Deshpande, Wheeler Edition, 1990.
2. **“Elements of Mining Technology, vol. II,”** Chapter 8, vidyasewa Prakasham, Nagpur. 8<sup>th</sup> edition 1995.

**REFERENCE BOOKS:**

1. **“Environmental Engineering in Mines”** V.S. Vutukuri & R.D. Lama, Chapter 13.3, Cambridge University Press, 1986.
2. **“Fundamentals of Electrical Drives,”** G.K. Dubey, Narosa Publishing House, 1995.
3. **“Universal Mining School Reports”,** Cardiff, Mining publication London, 1<sup>st</sup> Ed., 1977.
4. **“The Indian Electricity Rules 1984”,** Chapter X.

**Scheme of Exam:** One question to be set from each chapter. Students have to answer any **FIVE** full questions out of **EIGHT** questions. Choosing at least **TWO** questions from **PART- A** and two questions from **PART- B**.

## MINING GEOLOGY –1

<b>Sub Code</b>	<b>: 10 MN 33</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hrs/week</b>	<b>: 04</b>	<b>Exam Hours</b>	<b>: 03</b>
<b>Total Hrs.</b>	<b>: 52</b>	<b>Exam Marks</b>	<b>: 100</b>

### PART-A

#### UNIT 1:

**Physical Geology:** Geology and its role in Mining, Earth as a planet-internal structure and composition of the earth. Geological work of atmosphere, rivers, lakes, glaciers, sea and ground water, influences of these process on mining and engineering. Earthquakes and seismic hazards and their relation with volcanoes. Engineering protection against earth quakes.

**7 Hours**

#### UNIT 2:

**Mineralogy:** Physical properties of minerals, study of minerals and their chemical composition, occurrence and uses of Quartz and its varieties, Felspar, carbonates mica, garnet, olivine, Pyroxenes and amphiboles.

**7 Hours**

**Petrology:** Broad classification of rocks into Igneous, Sedimentary and Metamorphic rocks with examples. Structures, classification of Igneous rocks, classification of sedimentary rocks depending upon the grain size, Metamorphic agents and kinds.

**6 Hours**

#### UNIT 3:

**Study of Textural, Structural and Mineralogical characters of the following rocks:** Igneous Rocks: Granite, diorite, gabbro, dunite, pegmatite, porphyries, dolerite, basalt, Rhyolite, Obsidian and Pumice.

- a. Sedimentary Rocks: Conglomerate, Breccia, Sandstone, Limestone & Shale.
- b. Metamorphic Rocks: Gneiss, Schist, Quartzite Marble & Slate.

**6 Hours**

## **PART-B**

### **UNIT 4:**

**Principles of Stratigraphy:** Geological Time Scale, Correlation, Catastrophism, Geological Clock, Law of order of superposition, Uniformitarianism, fossil and their uses.

**6 Hours**

### **UNIT 5:**

**Stratigraphy of India:** Physiogeographic divisions of India with special reference to Dharwar, Cuddapah, vindhyans, gondwanas and tertiary system with their economic importance.

**7 Hours**

### **UNIT 6:**

**Introduction to Structural Geology:** Primary & Secondary Structure, Dip& strike, True Dip& Apparent Dip, Compass clinometers.

**6 Hours**

### **UNIT 7:**

**Structural Geology:** Structural features of rocks, interpretation of topographic maps. Classification of folds, faults, joints and unconformities, their recognition in the field and importance in mining operations.

**7 Hours**

### **TEXTBOOKS:**

1. "Engineering and General Geology," Parbin Singh. Katson publisher, Ludhiana, 1<sup>st</sup> Ed. 2002.
2. "A Text Book of Geology," P.K.Mukerjee. The World Press Pvt. Ltd., Calcutta.2000

### **REFERENCE BOOKS:**

1. **“Principles of Petrology”** G.W.Tyrrill, B.I. Publications Pvt. Ltd., New Delhi.1999.
2. **“Geology of India,”** Wadia, D.N., Tata Mc. Graw Hill Publilshing co. Ltd., 2000
3. **“Structural Geology,”** Marland & Billings, Prentice Hall of India Pvt. Ltd., New Delhi.2000.

**SCHEME OF EXAM:** One question to be set from each chapter. Students have to answer any **FIVE** full questions out of **EIGHT** questions. Choosing at least **TWO** questions from **PART- A** and two questions from **PART- B**.

**MECHANICS OF MATERIALS**  
(Common to ME/IP/IM/AU/MA/MN/AE)

<b>Sub Code</b>	: 10 ME 34	<b>IA Marks</b>	: 25
<b>Hrs/week</b>	: 04	<b>Exam Hours</b>	: 03
<b>Total Hrs.</b>	: 52	<b>Exam Marks</b>	: 100

**PART – A**

**UNIT 1:**

**Simple stress and strain:** Introduction, stress, strain, mechanical properties of materials, Linear elasticity, Hooke’s Law and Poisson’s ratio, Stress-Strain relation – behaviour in Tension for Mild steel and non ferrous metals. Extension / Shortening of a bar, bars with cross sections varying in steps, bars with continuously varying cross sections (circular and rectangular), Elongation due to self weight, Principle of super position.

**7 Hours**

**UNIT 2:**

**Stress in composite section:** Volumetric strain, expression for volumetric strain, elastic constants, simple shear stress, shear strain, temperature stresses (including compound bars).

**6 Hours**

**UNIT 3:**

**Compound stresses:** Introduction, plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr’s circle for plane stress.

**7 Hours**

**UNIT 4:**



**Thick and thin cylinders:** Stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume), Thick cylinders subjected to internal and external pressures (Lame's equation), (compound cylinders not included).

**6 Hours**

**PART – B**

**UNIT 5:**

**Bending moment and Shear force in beams:** Introduction, Types of beams, loads and reactions, shear forces and bending moments, rate of loading, sign conventions, relationship between shear force and bending moments, shear force and bending moment diagrams for different beams subjected to concentrated loads, uniform distributed load (udl) and couple for different types of beams.

**7 Hours**

**UNIT 6:**

**Bending and shear stresses in beams:** Introduction, theory of simple bending, assumptions in simple bending, relationship between bending stresses and radius of curvature, relationship between bending moment and radius of curvature, moment carrying capacity of a section, shearing stresses in beams, shear stress across rectangular, circular, symmetrical I and T sections (composite / fletched beams not included).

**7 Hours**

**UNIT 7:**

**Deflection of beams:** Introduction, differential equation for deflection, equations for deflections, slope and moments, double integration method for cantilever and simply supported beams for point load, UDL, UVL and Couple, Macaulay's method.

**6 Hours**

**UNIT 8:**

**Torsion of circular shafts and Elastic stability of columns :** Introduction, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts, power transmitted by solid and hollow circular shafts. Introduction to columns, Euler's theory for axially loaded elastic long columns, derivation of Euler's load for various end conditions, limitations of Euler's theory, Rankine's formula.

**6 Hours**

**Text books:**

1. **“Mechanics of Materials”** by R.C.Hibbeler, Printice Hall, Pearson Edu., 2005
2. **“Mechanics of materials”**, James.M.Gere, Thomson, Fifth edition 2004
3. **“Mechanics of materials”**, S.I. Units, Ferdinand Beer & Russell Johnstan, TATA Mac GrawHill-2003.

**Reference books:**

1. **“Strength of Materials”**, S.S.Bhavikatti, Vikas publications House – Pvt. Ltd., 2<sup>nd</sup> Ed., 2006.
2. **“Mechanics of materials”** K.V. Rao, G.C. Raju, First Edition,2007
3. **“Engineering Mechanics of Solids”** Egor.P. Popov, Pearson Edu. India, 2<sup>nd</sup>, Edition, 1998.
4. **“Mechanics of Solids”**, Mubeen, Pearson Edu. India, 2002
5. **“Strength of Materials”**, W.A. Nash, Sehaum’s Outline Series, Fourth Edition-2007.

**Scheme of examination:**

One Question to be set from each chapter. Students have to answer any FIVE full questions out of EIGHT questions, choosing at least 2 questions from part A and 2 questions from part B.

## MINE CONSTRUCTION AND DEVELOPMENT

Sub Code	: 10 MN 35	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

### PART-A

#### UNIT 1:

**Introduction of Mining Engineering:** Significance to Mining industry in national economy and infrastructure building, Basic mining terminologies, sequence in opening up a deposit, prospecting and geo-technical investigations. Selection criteria for underground or open cast mining methods. Classification of mining methods.

**6 Hours**

#### UNIT 2:

**Opening up of Deposits:** Types, size and location of entries into underground coal and other minerals. Introduction to surface mining methods. Box cut and formations of benches in mines.

**6 Hours**

#### UNIT 3:

**Shaft Sinking operations:** Preliminary geo-technical investigations for a shaft sinking project. Surface arrangements for sinking shafts, tools and equipment. Unit operations of drilling, blasting, mucking, defuming, temporary and permanent lining. Construction of insets and shaft stations.

**7 Hours**

#### UNIT 4:

**Special & Mechanized Methods of Shaft Sinking:** Methods of sinking shaft in water – logged, pressurized strata in loose and running soils. Mechanized Sinking, multi-deck Platforms, and Shaft borers, Blind Shaft Boring & Pilot Shaft Boring. Drop Raise Method.

**7 Hours**

## **PART-B**

### **UNIT 5:**

**Widening and Deepening of Existing Shafts:** Need for widening and deepening operating shafts. Different methods for widening and deepening shafts – cycles of operations, equipment needed.

**6 Hours**

### **UNIT 6:**

**Development of Workings:** Drivage of cross cuts, drifts, inclines and raises by conventional and mechanized methods. Ventilation, supporting, lighting and transporting arrangements.

**7 Hours**

### **UNIT 7:**

**Mine Supports:** Need for support excavations. Types of support: timbers, stone, concrete, steel and hydraulic supports. Yielding and rigid supports. Fore poling, roof stitching, roof bolting. Supports for roadways, faces and junctions.

**7 Hours**

### **UNIT 8:**

**Tunneling Methods:** Conventional and mechanized methods of tunneling. Tunnel boring machines and shield tunneling.

**6 Hours**

### **TEXTBOOKS:**

1. **“Elements of Mining Technology, Vol. I,”** D.J. Deshmukh, Vidyasewa prakashan, Nagpur. 7<sup>th</sup> Ed. 1996.
2. **“Introductory Mining Engineering,”** Hartman H.L., John Wiley Sons. 1<sup>st</sup> Ed. 2004.

### **REFERENCE BOOKS:**

1. **“Underground Mining Methods Handbook,”** W.A. Hustrulid, Published by S.M.E. of the American Institute of Mining, Metallurgical and Petroleum Engineers Inc., New York, 1982.

2. “Universal Mining School Volumes,” Cardiff Gt. Britain, 1931.

**SCHEME OF EXAM:** One question to be set from each chapter. Students have to answer any **FIVE** full questions out of **EIGHT** questions. Choosing at least **TWO** questions from **PART- A** and two questions from **PART- B**.

### COMPUTER AIDED MACHINE DRAWING

Sub Code	: 10 MN 36	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Hrs.	: 52	Exam Marks	: 100

#### PART – A

**Introduction:**

Review of graphic interface of the software. Review of basic sketching commands and navigational commands. Starting a new drawing sheet. Sheet sizes. Naming a drawing. Drawing units, grid and snap.

**2 Hours**

**UNIT 1:**

**Orthographic views:** Conversion of pictorial views into orthographic projections of simple machine parts with section. (Bureau of Indian Standards convention to be followed for the drawings) Hidden line conventions. Precedence of lines.

**4 Hours**

**UNIT 2:**

**Thread forms:** Thread terminology, sectional views of threads. ISO Metric (Internal & External) BSW (Internal & External) square and Acme. Sellers thread, American Standard thread. Etc. **Fasteners:** Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw.

**6 Hours**

**UNIT 3:**

**Keys & Joints:**

Parallel, Taper, Feather key, Gibhead key, Woodruff key

**Riveted Joints:** single and double riveted lap joint, butt joint (Chain and Zigzag. using snap head rivet) cotter joints, knuckle joint (pin joint) for two rods.

**5 Hours**

**UNIT 4:**

**Couplings:**

Protected type flange coupling, pin type flexible coupling, and universal coupling, Oldham's coupling, Muff coupling. Etc.

**5 Hours**

**PART – B**

Assembly Drawings

**(Part drawings should be given)**

Drawing formats, title block, revision block, tolerance block, release block, BOM, (Bill of Materials) drawing details, and drawing notes.

1. Screw jack (Bottle type)
2. Tailstock of lathe
3. Steam stop valve
4. Machine vice
  
5. Petrol Engine piston
6. I.C. Engine connecting rod
7. Fuel Injector
8. Plummer block (Pedestal Bearing)
9. Feed check Valve
10. Tool Head of shaper
11. Rams bottom safety valve

**30 Hours**

**Text books:**

1. "A Primer on Computer Aided Machine Drawing-2007", Published by VTU, Belgaum.
2. "Machine Drawing" by Sri N.D.Bhat & V.M.Panchal.

**Reference Book:**

1. "A Text Book of Computer Aided Machine Drawing", S. Trymbaka Murthy, CBS Publishers, New Delhi, 2007.
2. "Machine Drawing with Auto CAD" Goutam Pohit & Goutham Ghosh, 1<sup>st</sup> Indian print Pearson Education, 2005.

3. “Auto CAD 2006, for engineers and designers” Sham Tickoo. Dream tech 2005.

**Note:**

**Internal assessment: 25 Marks**

All the sheets should be drawn in the class using software. Sheet size should be A3 size. All sheets must be submitted at the end of the class by taking a printout. The students shall score minimum of 60% marks in Internal Assessment to be eligible for taking the final examination.

**Scheme of Examination:**

1. From part A four questions to be set i.e. One question from each Unit 1, 2, 3 & 4. Student has to answer any TWO questions from PART – A. 20 marks for each questions i.e. 2x20=40
2. From Part B 2 Questions to be set from 11 Assemblies students has to answer any ONE Question For 60 Marks.

i.e.	<b>PART-A 2x20= 40 Marks</b>
	<b>PART-B 1x60= 60 Marks</b>
	<b><u>Total =100 Marks</u></b>

**MINING GEOLOGY LABORATORY – I**

<b>Sub Code</b>	<b>: 10 MNL 37</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hrs/week</b>	<b>: 03</b>	<b>Exam Hours</b>	<b>: 03</b>
<b>Total Hrs.</b>	<b>: 42</b>	<b>Exam Marks</b>	<b>: 50</b>

**PART A**

I. Megascopic study of minerals: Physical properties chemical composition, mode of occurrence, Distribution, identification and uses with reference to mining importance.

**Experiment No. Experiment Name**

1. Quartz group of minerals
2. Feldspar group of minerals
3. Mica Group of Minerals
4. Carbonates – Calcite group and magnesite group of minerals
5. Ferro magnesium minerals

II. Megascopic study of rocks: Mineral composition, texture, petrogenesis, Engineering properties, distribution and uses,

<b>Experiment No.</b>	<b>Experiment Name</b>
6.	Igneous rocks
7.	Sedimentary rocks
8.	Metamorphic Rocks

### **PART B**

III. Study of important structures of Igneous, Sedimentary and Metamorphic rocks.

IV. Geological Maps: Interpretation of topographic, geological and structural maps & tracing of outcrop maps.

<b>Experiment No.</b>	<b>Experiment Name</b>
9.	Interpretation & description of topographic maps
10.	Interpretation & description of Geological maps
11.	Interpretation & description of structural geological maps – Dipping strata
12.	Interpretation & description of structural geological maps – Folded strata
13.	Interpretation & description of structural geological maps –Faulted strata
14.	Interpretation & description of structural geological maps – Unconformities
15.	Tracing of out crop maps.

**Part A:- Any one question 20 marks**

**Part B:- Any one question 20 marks**

**Viva question:- 10 marks**



## MINING ELECTRICAL ENGINEERING LABORATORY

<b>Sub Code</b>	<b>: 10 MNL 38</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hrs/week</b>	<b>: 03</b>	<b>Exam Hours</b>	<b>: 03</b>
<b>Total Hrs.</b>	<b>: 42</b>	<b>Exam Marks</b>	<b>: 50</b>

### PART A

1. Measurement of
  - a) Resistance by voltmeter and Ammeter method.
  - b) Inductance and Power factor of choke by ammeter voltmeter, wattmeter method.
2. Open circuit characteristics of a D.C. Generator.
3. Load test on shunt generator.
4. Load test on compound generator.
5. Speed control of shunt motor

### PART B

6. Load test on shunt motor
7. O.C. and S.C. test on a single-phase transformer and predetermination of efficiency and regulation.
8. Load test on a single phase Induction motor.
9. Load test on 3-phase Induction motor.
10. Calibration of energy meter

**Part A: - Any one question 20 marks**

**Part B: - Any one question 20 marks**

**Viva question: - 10 marks**

## ENGINEERING MATHEMATICS – IV

**CODE: 10 MAT 41**  
**Hrs/Week: 04**  
**Total Hrs: 52**  
**Marks:100**

**IA Marks: 25**  
**Exam Hrs: 03**  
**Exam**

### **PART-A**

#### **Unit-I: NUMERICAL METHODS - 1**

Numerical solution of ordinary differential equations of first order and first degree; Picard's method, Taylor's series method, modified Euler's method, Runge-kutta method of fourth-order. Milne's and Adams - Bashforth predictor and corrector methods (No derivations of formulae).

**[6 hours]**

#### **Unit-II: NUMERICAL METHODS – 2**

Numerical solution of simultaneous first order ordinary differential equations: Picard's method, Runge-Kutta method of fourth-order.

Numerical solution of second order ordinary differential equations: Picard's method, Runge-Kutta method and Milne's method.

**[6 hours]**

#### **Unit-III: Complex variables – 1**

Function of a complex variable, Analytic functions-Cauchy-Riemann equations in cartesian and polar forms. Properties of analytic functions.

Application to flow problems- complex potential, velocity potential, equipotential lines, stream functions, stream lines.

**[7 hours]**

#### **Unit-IV: Complex variables – 2**

Conformal Transformations: Bilinear Transformations.  
Discussion of Transformations:  
 $w = z^2$ ,  $w = e^z$ ,  $w = z (a^2 / z)$ . Complex line integrals-  
Cauchy's theorem and Cauchy's integral formula.

[7 hours]

### **PART-B**

#### **Unit-V: SPECIAL FUNCTIONS**

Solution of Laplace equation in cylindrical and spherical systems leading Bessel's and Legendre's differential equations, Series solution of Bessel's differential equation leading to Bessel function of first kind. Orthogonal property of Bessel functions. Series solution of Legendre's differential equation leading to Legendre polynomials, Rodrigue's formula.

[7 hours]

#### **Unit-VI: PROBABILITY THEORY - 1**

Probability of an event, empirical and axiomatic definition, probability associated with set theory, addition law, conditional probability, multiplication law, Baye's theorem.

[6 hours]

#### **Unit-VII: PROBABILITY THEORY- 2**

Random variables (discrete and continuous), probability density function, cumulative density function. Probability distributions – Binomial and Poisson distributions; Exponential and normal distributions.

[7 hours]

## **Unit-VIII: SAMPLING THEORY**

Sampling, Sampling distributions, standard error, test of hypothesis for means, confidence limits for means, student's t-distribution. Chi -Square distribution as a test of goodness of fit

**6 hours]**

### **Text Books:**

1. B.S. Grewal, Higher Engineering Mathematics, Latest edition, Khanna Publishers
2. Erwin Kreyszig, Advanced Engineering Mathematics, Latest edition, Wiley Publications.

### **Reference Book:**

1. B.V. Ramana, Higher Engineering Mathematics, Latest edition, Tata Mc. Graw Hill Publications.
2. Peter V. O'Neil, Engineering Mathematics, CENGAGE Learning India Pvt Ltd.Publishers

## **THERMODYNAMICS AND FLUID MECHANICS**

<b>Sub Code</b>	<b>: 10 MN 42</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hrs/week</b>	<b>: 04</b>	<b>Exam Hours</b>	<b>: 03</b>
<b>Total Hrs.</b>	<b>: 52</b>	<b>Exam Marks</b>	<b>: 100</b>

### **PART-A**

#### **UNIT 1:**

**Basic concepts of thermo dynamics:** Thermo dynamic system, classification of Thermo dynamic system. Thermodynamic property-extensive and intensive properties. thermodynamic state, thermodynamic process. Reversible, irreversible process, Quasi-static process. Thermodynamic equilibrium, zeroth law of thermodynamics.

**6 Hours**

**UNIT 2:**

**Energy and I and II Laws of thermodynamics:** Energy-classification, stored energy and energy in motion. Work and heat-definition, work done at the moving boundary. comparison between work and heat. I and II Laws of thermodynamics : Statements, Cycles processes , Problems.

**7 Hours**

**UNIT 3:**

**Air Compressors:** single stage and multistage reciprocating air compressors. Expression for work done during single stage air compression with and without clearance volume. Volumetric efficiency. Simple problems on single stage compressors.

**7 Hours**

**UNIT 4:**

**Fluid Mechanics:** Definition and properties of Fluids, ideal and real fluid units, systems of measurement. Fluid properties-density, specific weight, specific volume, specific gravity, viscosity, compressibility, surface tension and capillarity.

**6 Hours**

**PART-B**

**UNIT 5:**

**Pressure and it's Measurements for Liquids:** pressure, atmospheric pressure, gauge and absolute pressure, measurement of pressure, piezometer tube, double column u-tube manometer, differential and inverted U-tube measurements, Bourdon's pressure gauge and diaphragm pressure gauge and dead weight pressure gauge.

**7 Hours**

**UNIT 6:**

**Dynamics of Fluid Flow:** Bernolli's theorem for liquids, Assumptions, Hydraulic gradient line and total energy line.

**6 Hours**

**UNIT 7:**

**Flow through pipes:** Loss of head due to friction in pipes. Discharge measurements in pipes. Venturimeter, Orifice meter. Flow through orifices and notches.

**6 Hours**

**UNIT 8:**

**Centrifugal and Reciprocating pumps:** working principle of single stage centrifugal pump and single acting and double acting reciprocating pumps. Vane pumps and submersible pumps.

**TEXTBOOKS:**

1. “Engineering thermodynamics”, Nag P.K., , Tata McGraw Hill publications. 2<sup>nd</sup> Ed. 2002
2. “A Text Book of Fluid Mechanics and Hydraulic Machines,” Bansal. Laxmi publications. 2006

**REFERENCE BOOKS:**

1. “Fundamentals of Classical Thermodynamics”, Van wylen Gordon et. Al, John Wiley Intl. publications, New York. Thermodynamics. 2000
2. “Thermal Engineering,” R.K.Rajput, Laxmi publications, New Delhi. 2002
3. “Hydraulics and Fluid Mechanics,” Modi P.N. and Seth, S.M., Standard Publishers, New Delhi. 1999.

**SCHEME OF EXAM:** One question to be set from each chapter. Students have to answer any **FIVE** full questions out of **EIGHT** questions. Choosing at least **TWO** questions from **PART- A** and two questions from **PART- B**.

**MINING GEOLOGY – II**

<b>Sub Code</b>	<b>: 10 MN 43</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hrs/week</b>	<b>: 04</b>	<b>Exam Hours</b>	<b>: 03</b>
<b>Total Hrs.</b>	<b>: 52</b>	<b>Exam Marks</b>	<b>: 100</b>

**PART-A****UNIT 1:**

**Geology in Mining Industry:** Pure/Applied/ Mining Geology, Geology in Mining – Delineation of deposits, Limits of Economic Mining, Role of Mine Geologist, Geological Work in Operating Mine.

**6 Hours****UNIT 2:**

**Economic Geology:** Scope of economic geology, classification of mineral deposits – ore mineral, gangue minerals and tenor of ore.

**6 Hours**

**UNIT 3:**

Study of Various processes of formation of mineral deposits- Magmatic, Hydrothermal, weathering, Sedimentation, evaporation, Oxidation and Supergene enrichment and metamorphic deposits.

**7 Hours**

**UNIT 4:**

**Distribution of Minerals with reference to Origin, Occurrence and Uses:** Iron, Copper, Lead & Zinc, Chromite, Manganese, Beach sand, Diamond & uranium, Refractory minerals, ceramic minerals and building stones.

**7 Hours**

**PART-B**

**UNIT 5:**

**Mineral Fuel (Coal):** Coal, physical and chemical characteristics, variation and rank. Important constituents of coal, origin of coal, structural features of coal seams, Chief characteristics of Indian coals. Important Coal fields of India.

**6 Hours**

**UNIT 6:**

**Petroleum & Natural Gas:** Origin, composition, accumulation, structural features, migration of petroleum and Natural Gas, Major oil fields of India.

**6 Hours**

**UNIT 7:**

**Exploration Geology:** Principles of mineral exploration, stages of mineral Exploration. Geological, Geophysical and geo-chemical methods of mineral exploration. Remote sensing techniques for prospecting and exploration of mineral deposits. Factors involved in planning and drilling in detail exploration. Core Drilling and Core recovery.

**7 Hours**

**UNIT 8:**

**Mining Geology:** Methods of sampling, assaying and estimation of ore reserves. Guides for location of ore deposits with particular reference to structural and stratigraphical guides. Field techniques equipment, Methods of surface, sub-surface mapping, Interpretation and use of field data.

**7 Hours**

**TEXT BOOKS:**

1. “Economic Mineral Deposits,” Bateman A.M John Wiley and sons, 2<sup>nd</sup> Ed. 1999.
2. “Mining Geology “, Mckinistry, , Asia Publication. 2<sup>nd</sup> Ed. 2005.

**REFERENCE BOOKS:**

1. “Ore Deposits of India”, Gokhale & Rao T.C., Thompson press. India, Faridabad.1999.
2. “Courses in Mining Geology”, Arogyaswamy, Oxford & IBH Pvt. Ltd.3<sup>rd</sup> Ed. 1999

**SCHEME OF EXAM:** One question to be set from each chapter. Students have to answer any **FIVE** full questions out of **EIGHT** questions. Choosing at least **TWO** questions from **PART- A** and two questions from **PART- B**.

**MINING MACHINERY-I**

<b>Sub Code</b>	<b>: 10 MN 44</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hrs/week</b>	<b>: 04</b>	<b>Exam Hours</b>	<b>: 03</b>
<b>Total Hrs.</b>	<b>: 52</b>	<b>Exam Marks</b>	<b>: 100</b>

**PART-A**

**UNIT 1:**

**Transmission of Power:** Relative merits and field of application of power generation by steam, by electricity, compressed air, oil and gas with special mention to distribution and utilization. Track laying and maintenance.

**6 Hours**

**UNIT 2:**

**Compressed Air:** Sources of power for compressors, Transmission and distribution of compressed air in mines, Compressed air drills, Equipments using compressed air. Safety appliances.



**6 Hours**

**UNIT 3:**

**Mine Transportation:** Elements of Mine transport system and classification, Techno economic indices of Mine transport system, Rope haulage: Different types—direct, endless, main & tail, gravity, Limitations, applications merits & demerits of different haulages, haulage calculation,

**7 Hours**

**UNIT 4:**

**Ropes:** Types and details of construction of different types of ropes and their respective uses in mines. Care and storage of ropes, Rope splicing and socketing, Safety factor for ropes used in winding.

**7 Hours**

**PART-B**

**UNIT 5:**

**Locomotives:** Types-Diesel, Electric battery, Electric, Trolley wire, compressed air and steam locomotive, its limitations and their applications.

**6 Hours**

**UNIT 6:**

**Conveyors:** Types of conveyors-belt, chain shaker, high angle conveyor, cable belt, rope belt and steel plate, its limitations and their applications, problems on calculation of power requirement and capacity of conveyors.

**7 Hours**

**UNIT 7:**

**Winding:** Elements of winding system and Compressed air winders, Types of winding drums, Method of balancing the loads, Duty cycle, Mechanical, Electrical, manual and automatic breaking system of winders, Koepe winding and Multirope winding.

**7 Hours**

**UNIT 8:**

**Study of Layouts:** Study of respective layouts for all the systems of transportation. Study of pit top and pit bottom layouts, Maintenance Management of Mining Machinery. Skip and cage winding. Winding from different levels in a shaft. Winding calculations.

**6 Hours**

**TEXT BOOKS:**

1. “Elements of mining technology Vol III”, D.J.Deshmukh, Vidyasewa prakashan, Nagpur, 7th Ed. 2000.
2. “Mine Transport”, Karerlin, Orient Longmans, 1967.

**REFERENCE BOOKS:**

1. “Coal Mining Practice”, I.C.F.Stathem, The Caxton publishing Company Ltd, 2000.
2. “Universal Mining School reports Vol I and Vol II,”, Cardif, Great Britain 1999.
3. “Mine Pumps Haulage and winding.”, S.Ghatak, Coal field publishers, Asansol, 2001..

**SCHEME OF EXAM:** One question to be set from each chapter. Students have to answer any **FIVE** full questions out of **EIGHT** questions. Choosing at least **TWO** questions from **PART- A** and two questions from **PART- B**.

**MINE SURVEYING – I**

<b>Sub Code</b>	<b>: 10 MN 45</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hrs/week</b>	<b>: 04</b>	<b>Exam Hours</b>	<b>: 03</b>
<b>Total Hrs.</b>	<b>: 52</b>	<b>Exam Marks</b>	<b>: 100</b>

**PART-A**

**UNIT 1:**

**Basic Concepts:** Plane and Geodetic survey, classification survey, conventional Signs, conventional instruments, linear measurements, error in chaining, problems.

**6 Hours**

**UNIT 2:**

**Chaining Surveying:** Principles, instruments, methods, obstacles, offsets, booking and plotting, problems.

**7 Hours**

**UNIT 3:**

**Compass Surveying:** Types of bearing, calculations of angles and bearings, prismatic and surveyor compass (dial), local attraction, estimation, dip and declination, errors, problems

**7 Hours**

**UNIT 4:**

**Plane table survey:** Equipments and accessories, methods, two-point problem and three point problem, errors, strength of fix and Lehman's rule.

**6 Hours**

**PART-B**

**UNIT 5:**

**Leveling:** Principles and definition, types of levels, adjustments, reduction of levels curvature and refraction, sensitivity of bubble, problems.

**7 Hours**

**UNIT 6:**

**Contouring:** Contour, contour interval and characteristics, methods, interpretation, of contours and Uses of contours.

**6 Hours**

**UNIT 7:**

**Theodolite:** Definition and terms, parts, temporary adjustments, Permanent adjustments, horizontal and vertical angles, miscellaneous operations, errors.

**6 Hours**

**UNIT 8:**

**Theodolite Traversing:** Method of traversing, checks, plotting, closing error, balancing, co-ordinate calculation, degree of accuracy, problems.

**7 Hours**

**TEXTBOOKS:**

1. "Surveying Vol I & II" B.C.Punmia, Laxmi publications, 1999.
2. "Mine Surveying Vol I & II" Ghatak, Coal Field Publishers, 1998.

**REFERENCE BOOKS:-**

1. "Surveying Vol I," S.K.Duggal, Tata McGraw Hill Publications, New Delhi, 2000

2. “Elementary Plane and Mine Surveying,” V.Borshch , Kom powets, Bfedarer M .Kolesnikova, Mir publications, Moscow, 1986 .

**SCHEME OF EXAM:** One question to be set from each chapter. Students have to answer any **FIVE** full questions out of **EIGHT** questions. Choosing at least **TWO** questions from **PART- A** and two questions from **PART- B**.

### DRILLING AND BLASTING ENGINEERING

Sub Code	: 10 MN 46	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Hrs.	: 52	Exam Marks	: 100

#### PART-A

##### UNIT 1:

**Principles of drilling:** Principles of rock drilling, drillability, drillability index, factors affecting the drillability. Mechanics of drilling. Selection of drills, care of drills. Energy correlation of drills.

**6 Hours**

##### UNIT 2:

**Drill Bits:** Various types of drill bits and their design aspects. Study of bit life, factors affecting the bit life. Thrust feed and rotation, alignment and deviation in drilling.

**6 Hours**

##### UNIT 3:

**Explosives:** Historical Development, properties of explosives, Low and High explosives, Liquid oxygen explosives (LOX), ANFO, Slurries, Emulsion explosives, Heavy ANFO, permitted Explosives, testing of permitted explosives, Bulk Explosives system-PMS, SMS.

**7 Hours**

##### UNIT 4:

**Firing of Explosives:** Safety fuses, Detonating cord and accessories, Detonators, Exploders. Electric firing and non-electric firing, Electronic Detonators, NONEL blasting.

**7 Hours**

#### PART - B

##### UNIT 5:

**Blasting Methods:** Preparation of charge, stemming and shot firing. Choice and economical use of explosives, Misfires, blown out shots, incomplete detonation, their causes, Prevention and remedies.

**6 Hours**

**Handling of Explosives:** Surface and underground transport of explosives, bulk transport in quarries. Storage and handling of Explosives. Magazines, Accidents due to explosives. Precautions and safety measures during transportation. Substitutes for explosives and their applications-hydrox, Cardox, Hydraulic coal burster, airdox, pulsed infusion shot firing.

**7 Hours**

**UNIT 6:**

**Mechanics of Blasting:** Factors affecting rock breakage, Crater theory and its applications, theories of rock breakage using explosives. Theory of shaped charge, detonation pressure, Coupling, shock waves impedance, critical diameter etc. calculation of charge and powder factor.

**7 Hours**

**UNIT 7:**

**Effects of Vibration:** Vibrations due to blasting and damage criteria, controlled blasting methods, design of blasting rounds, Air overpressure and Fly Rock. Economics of blasting.

**6 Hours**

**TEXT BOOKS:**

1. **“Explosives and Blasting Practices in Mines,”** S.K. Das, Lovely Prakashan, Dhanbad, 1993.
2. **“Explosives and Blasting Techniques,”** G.K. Pradhan, Minetech Publication, 1996.

**REFERENCE BOOKS:**

1. **“Surface Mining”**, G.B. Mishra,, Chapter 1, Dhanbad Publishers, ,Dhanbad, 1978.
2. **“Rock Fragmentation by Blasting,”** B.Mohanty, Chapter4, A.A. Balkema, Rotterdam, 1996.
3. **“Advances in Drilling and Blasting”** V.R. Sastry, Chapter 1 and 2, Allied Publishers Ltd., 1993.
4. **“Principles of Rock Drilling”** U.M. Rao Karanam and B.Mishra, Chapter 1 and 2 Oxford and IBH, 1998.
5. **“Drilling and Blasting of Rocks”**, Carlopez Jimeno, et. al.,. Chapter 7, A.A. Balkema, Rotterdam, Brookfields, 1995.

6. “Engineering Rock Blasting operations”, Sushil Bhandari, Chapter 3 and 6, A.A. Balkema, Rotterdam, Brookfields, 1997

**SCHEME OF EXAM:** One question to be set from each chapter. Students have to answer any **FIVE** full questions out of **EIGHT** questions. Choosing at least **TWO** questions from **PART- A** and two questions from **PART- B**.

### **MINING GEOLOGY LABORATORY-II**

<b>Sub Code</b>	<b>: 10 MNL 47</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hrs/week</b>	<b>: 03</b>	<b>Exam Hours</b>	<b>: 03</b>
<b>Total Hrs.</b>	<b>: 42</b>	<b>Exam Marks</b>	<b>: 50</b>

#### **PART A**

I. Megascopic study of ore minerals: Physical properties, chemical composition. Mode of occurrence, distribution, uses of ore minerals in mining industry.

Experiment No.1-Iron, Manganese, Copper, Lead, Chromium, Aluminium ores.

II. Microscopic study of ore minerals: Optical properties. Texture, Alteration, Identification of ore minerals.

Experiment No.2-Iron, Manganese, Copper, and Lead ores.

III. Dip and Strike problems:

Experiment No.3- To determine true dip when two apparent dips are known.

Experiment No.4- To determine the amount of apparent dip when true dip and direction of apparent dips are given.

Experiment No.5-To determine the direction of apparent dip when true dip and amount of amount of apparent are known.

#### **PART B**

IV. Thickness calculations:

Experiment No.6-When the ground is horizontal. Experiment

No.7-When the slope is in the direction of dip. Experiment

No.8-When the slope is against the direction of dip.

V. Bore Hole problems (Three point problems).

Experiment No.9-On level Ground.

VI. Ore Reservation Estimation.

Experiment No.10-Bedded deposits, vein deposits and Load deposits.

<b>Part A:- Any one question</b>	<b>20 marks</b>
<b>Part B:- Any one question</b>	<b>20 marks</b>
<b>Viva question:-</b>	<b>10 marks</b>
<b>Total</b>	<b>50 marks</b>

**MINE SURVEYING LABORATORY-I**

<b>Sub Code</b>	<b>: 10 MNL 48</b>	<b>IA Marks</b>	<b>: 25</b>
<b>Hrs/week</b>	<b>: 03</b>	<b>Exam Hours</b>	<b>: 03</b>
<b>Total Hrs.</b>	<b>: 42</b>	<b>Exam Marks</b>	<b>: 50</b>

**PART A**

- 1) Demonstration of mine survey instruments such as clinometer, abney level, box sextant, ediograph, pentagraph, Ceylon ghat tracer and planimeter.
- 2) Setting of regular figures using chain and tape.
  - a)Setting of pentagon
  - b)Setting of Hexagon
  - c)Setting of Octagon
- 3) Setting of regular figures using compass and tape.
  - a)Setting of pentagon
  - b)Setting of Hexagon
  - c)Setting of Octagon
  - d)Inaccessible Distance

**PART B**

- 4) Plane table methods.
  - a)Radiation methods
  - b)Intersection Method
  - c)Two point problem
  - d)Three point problem
- 5) Reduction of levels.
  - a)R.L by H.I.Method
  - b)R.L by Raise and Fall Method

- 6) Theodolites traversing and co-ordinate calculation.  
a)Balancing of the traverse.(closed traverse)

<b>Part A:- Any one question</b>	<b>20 marks</b>
<b>Part B:- Any one question</b>	<b>20 marks</b>
<b>Viva question:-</b>	<b>10 marks</b>
<b>Total</b>	<b>50 marks</b>