Major Core Courses (MCC)										
Course Code	**Course Name**	**Level**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**	**Pre-requisite**
2501PH01	Solid State Physics	FC	2		1	3	50	50	100	-
2501CH01	Engineering Chemistry	FC	2		1	3	50	50	100	-
2501MA01	Linear Algebra & Calculus	FC	2		1	3	50	50	100	-
2501ME02	Engineering Mechanics	FC	3		1	4	50	50	100	-
2501ME03	Engineering Workshop	FC			1	1	100		100	-
2501ME01	Engineering Graphics	FC	1		2	3	50	50	100	-
2501MA02	Differential Equations & Vector Calculus	FC	2		1	3	50	50	100	LAC
2501MN01	Introduction to Mechanical Engineering	FC	2		1	3	50	50	100	EM
2501MN02	Introduction to Mining Geology	FC	2		2	4	50	50	100	-
2501MN03	Development of Mineral Deposits	FC	3			3	50	50	100	-
2501MN04	Fundamental of Rock Mechanics	FC	3		2	5	50	50	100	-
2501MA05	Numerical Methods & Integral Transforms	IC	2	1		3	50	50	100	-
2501MA06	Complex Variables &	IC	3	1		4	50	50	100	-

	Statistical Methods									
2501MB02	Engineering Economics	IC	3			3	50	50	100	-
2501MN05	Mine Surveying	IC	3		2	5	50	50	100	-
2501MN06	Surface Mining	IC	3			3	50	50	100	DMD
2501MN07	Underground Coal Mining Technology	IC	3			3	50	50	100	DMD
2501MN08	Underground Metal Mining Technology	IC	3			3	50	50	100	DMD
2501MN09	Mineral Processing Technology	IC	2		2	4	50	50	100	-
2501MN10	Mine Hazards & Rescue	IC	3		1	4	50	50	100	-
2501MN11	Mine Environment & Ventilation Engineering	AC	2		2	4	50	50	100	-
2501MN12	Mine Machinery	AC	3			3	50	50	100	DMD, SM, UCMT, UMMT
2501MN13	Mine System Engineering	AC	3			3	50	50	100	SM
2501MN14	Mine Legislation & General Safety	AC	3			3	50	50	100	UCMT/UMMT
Total			**58**	**2**	**20**	**80**				

Solid State Physics
(Common to CE, ME, Min.E, & PT)

Course Code: 2501PH01	**L**	**T**	**P**	**C**
	2	**0**	**1**	**3**

Course Outcomes:
At the end of the course, student will be able to:

- **CO1:** Extend basic concepts of Elastic properties and bending of beams.
- **CO2:** Understand the basics of crystals and their structures
- **CO3:** Explain the basic concepts of Semiconductors and identify the type semiconductors using Hall effect.
- **CO4:** Classify the magnetic materials based on behaviour of substances.
- **CO5:** Summarize various types of electrical polarizations of dielectrics.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	1	-	-	-	-	-	1	1	-	-
CO2	2	1	-	-	-	-	-	1	1	-	-
CO3	2	1	-	-	-	-	-	1	1	-	-
CO4	2	1	-	-	-	-	-	1	1	-	-
CO5	2	1	-	-	-	-	-	1	1	-	-

UNIT – I

Elasticity of Materials: Stress – strain - Hooke's law – stress - strain curve – generalized Hooke's law with and without thermal strains for isotropic materials – different types of moduli and their relations – bending of beams – Bending moment of a beam – Depression of cantilever.

Practice:

1. Determination of rigidity modulus of a material by using Torsional Pendulum.
2. Determination of Young's Modulus of the material by method of single cantilever beam.
3. Determination of Moment of Inertia of a Fly Wheel.
4. Determination of Acceleration due to Gravity by using Compound Pendulum.

UNIT-II

Crystal Structure and X-ray diffraction: Crystal Structure Lattice and Basis – Crystal Systems – Bravais Lattice - Unit cell – Packing fraction – coordination number- Miller indices – Separation between successive (h k l) planes- Applications.

X-ray Diffraction: Bragg's law-Bragg's x-ray spectrometer – crystal structure determination by Laue's and powder method- Applications.

Practice:

1. Determine the crystal structure of the sample using data.

UNIT – III

Semi-conductor Physics: Origin of resistivity - Formation of energy bands in crystalline solids - classification of crystalline solids - Intrinsic semiconductors - Fermi level – extrinsic semiconductors - P-type and N-type -Dependence of Fermi energy on carrier concentration and temperature - Hall effect - Hall coefficient -Applications of Hall effect –Drift and Diffusion currents–Einstein's equation. – P-N junction diode -Zener Diode – Applications.

Practice:

1. Study the relation between Temperature and resistance and finding the constants A & B of a thermistor.
2. Determine the resistivity of a semiconductor by four probe method.
3. Determination of V-I characteristics and Breakdown voltage of a Zener diode.
4. Determination of Energy band gap of a semiconductor by using P-N junction diode.
5. Determination of Frequency of electrically maintained tuning fork by Melde's apparatus.

UNIT – IV

Magnetic materials: Introduction –Magnetic dipole moment– Magnetization– Magnetic susceptibility and permeability – Origin of permanent magnetic moment – Bohr magneton – Classification of magnetic materials: Dia, para & Ferro–Domain concept of Ferro magnetism Hysteresis–soft and hard magnetic materials–applications of Ferromagnetic material.

Practice:

1. Study the variation of magnetic field along the axis of a circular coil carrying current by using Stewart and Gee's apparatus.

UNIT – V

Dielectric Materials: Introduction – Dielectric polarization–Dielectric polarizability, Susceptibility, Dielectric constant - Relation between D, E, P- Types of polarizations – Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) – Ferro electric materials - Frequency dependence of polarization - Applications.

Practice:

1. Determine dielectric constant of dielectric material using charge-discharge method.

Text Books:

1. A Text book of Engineering Physics, M N Avadhanulu, P G Kshirsagar & T.V.S.Arun Murthy S Chand & Company Ltd, 11th edition, ISBN: 81-219-0817-5.
2. Engineering Physics, R K Gaur and S L Gupta, Dhanpat Rai Publications, ISBN: 978-8189928223.
3. Physics for Engineers, T.Vijaya Krishna, Cengage publications, ISBN: 978-93-5350-755-8.

Reference Books:

1. Engineering Physics, M.R. Srinivasan, New Age international publishers, 2009. ISBN: 978-1848290501
2. Text book of Engineering Physics, S. O. Pillai, New Age international publishers 2012, ISBN: 9788122520753
3. Introduction to Solid State Physics, Charles Kittel, Wiley publications 8th edition 2012, ISBN: 978-1-119-45416-8.

Web Links:

1. http://nptel.ac.in/courses/122107035/11
2. http://nptel.ac.in/courses/115102023/
3. https://phet.colorado.edu/en/simulations/category/physics
4. http://physicsgecg.blogspot.in/p/reading-materials.html

Engineering Chemistry

(Common to CE, ME, PT & Min.E)

Course Code: 2501CH01	L	T	P	C
	2	0	1	3

Course Outcomes:

At the end of the course, student will be able to:

- **CO1:** Apply the knowledge of water treatment and specifications of potable water
- **CO2:** Exemplify the principles of electrochemical cells and apply this knowledge to control corrosion
- **CO3:** Summarize the essence of polymers and fuels – for sustainable energy solutions
- **CO4:** Infer the preliminaries of engineering materials for industrial applications
- **CO5:** Explore the fundamentals of Nano materials and integrate green chemistry for promoting sustainability

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	-	1	-	-	1	-	1	1	-	-
CO2	3	-	-	-	-	-	-	1	1	-	-
CO3	3	-	1	-	-	1	-	1	1	-	-
CO4	3	-	-	-	-	1	-	1	1	-	-
CO5	3	1	-	-	-	2	-	1	1	-	-

UNIT - I

Water Technology: Soft and hard water, Boiler troubles –Priming, foaming**,** scale and sludge, Caustic embrittlement, Industrial water treatment method (Zeolite and Ion-Exchange Process) –Internal treatment of water: Carbonate conditioning, Phosphate conditioning, Colloidal conditioning, Calgon conditioning.

Specifications of water for domestic use (ICMR and WHO); Domestic water purification – Candle filtration- activated carbon filtration; Disinfection methods- Ultra filtration, UV treatment, Ozonolysis, desalination of brackish water, reverse osmosis(RO)and electro dialysis.

Practice:

1. Determination of Hardness of a ground water sample
2. Determination of Chloride content in given water sample
3. Estimation of dissolved oxygen in given water sample

UNIT - II

Electrochemistry and Corrosion: Electrodes– electrochemical cell, Nernst equation, cell potential calculations.

Primary cells – Zinc-air battery, Secondary cells: Nickel-Cadmium (Ni-Cad), and lithium-ion batteries- Working principle of the batteries including cell reactions; Fuel Cells: Principle and working of hydrogen-oxygen Fuel cell.

Corrosion: Introduction to corrosion, Dry corrosion (Pilling Bed worth rule) electro chemical theory of corrosion (Mechanism), differential aeration cell corrosion, galvanic corrosion, Factors affecting the corrosion**,** cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).

Practice

1. Conductometric titration of strong acid vs weak base
2. Potentiometric titration of red-ox
3. P^H-metric titration of Acid-Base

UNIT - III

Polymers and Fuel Chemistry: Introduction to polymers, functionality of monomers, Thermo plastics and Thermo setting plastics-: Preparation, properties, and applications of PVC, and Bakelite.

Compounding of plastics: Injection molding, and Extrusion molding.

Biodegradable polymers: Introduction and their requirements.

Fuels – Types of fuels, calorific value of fuels, numerical problems based on calorific value; Analysis of coal (Proximate and Ultimate analysis), Liquid Fuels: Refining of petroleum, Octane and Cetane number, Alternative fuels: CNG, Ethanol and biodiesel.

Practice

1. Calorific value determination by Bomb Calorimeter.
2. Preparation of a Polymer (Bakelite)

UNIT - IV

Engineering Materials: Composites-Definition, Constituents, Fiber reinforced composites, properties, and Engineering applications

Refractories-Classification, Properties, Failures of Refractories and Applications.

Lubricants-Classification, Functions of lubricants, Properties of lubricating oils (Definition): Viscosity, Viscosity Index, Flash point & Fire point, Cloud point &Pour point and Applications of lubricants.

Building materials- Portland cement, constituents, Setting and Hardening of cement.

Practice

1. Determination of total acid number by potentiometric titration
2. Estimation of Calcium in port land Cement
3. Estimation of Saponification value of Fats/Oils

UNIT - V

Nano materials and Green Chemistry: Nano Materials: Introduction to Nano materials, chemical synthesis of Nano materials: Sol-gel method, characterization of Nano materials by SEM and TEM (includes basic principle of SEM and TEM), Applications of Nano materials (waste water treatment, lubricants and engines).

Green Chemistry: Principles of Green Chemistry and applications of green chemistry.

Various green chemical approaches – Microwave synthesis, Bio catalyzed reaction (only explanation with examples).

Practice

1. Preparation of Nano particle by Green Synthesis method.

Text Books:

1. Prasanta Rath, S. Aruna Kumari Engineering Chemistry, CENGAGE Learning, 2024. (ISBN 978-93-5350-651-3) (ISBN 93-5350-651-4)
2. Shikha Agarwal, Engineering Chemistry Fundamentals and Applications, Cambridge 2nd Edition (ISBN 978-1-108-72444-9).

Reference Books:

1. H.F.W. Taylor, Cement Chemistry, Thomas Telford Publications, 2nd edition. (978-072-772-5929).
2. Dr S.S. Dara, Dr S.S. Umare, A Textbook of Engineering Chemistry, S. Chand Publication, 2022.(978-935-2-836-068).

Web Links:

1. https://nptel.ac.in/courses/105107207
2. https://nptel.ac.in/courses/113104082
3. https://nptel.ac.in/courses/113108051
4. https://archive.nptel.ac.in/courses/104/105/104105039/
5. https://nptel.ac.in/courses/118102003

Linear Algebra & Calculus

(Common to CE,EEE,ME,ECE,CSE,IT,AIML,CSE(DS),PT&Min.E)

Course Code: 2501MA01	L	T	P	C
	2	1	0	3

Course Outcomes:

At the end of the course, student will be able to:

- **CO1:** Solve the system of Linear equations
- **CO2:** Calculate Eigen values and Eigen vectors
- **CO3:** Apply differential calculus for one and several variable functions
- **CO4:** Calculate the Maximum value and Minimum value of a function of several variables
- **CO5:** Compute areas and volumes using multiple integrals

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

UNIT – I

System of linear equations: Vector Space, Linear Independence, Rank of a matrix by echelon form, normal form, Inverse of Non-singular matrices by Gauss-Jordan method, Solutions of Linear Systems: Existence, Uniqueness, Solving the system by Gauss elimination method.

Practice (Using any computational tool)

1. Variables, arithmetic operations, elementary mathematical functions.
2. Defining row vector, column vector, Arithmetic operations on matrices
3. Finding transpose of a matrix, inverse of a matrix, determinant of a matrix
4. Rank of a matrix, solving system of linear equations.

UNIT – II

Eigenvalues, Eigenvectors: Eigenvalues and properties(without proof), Eigenvectors, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), Quadratic forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation,Nature of Quadratic forms.

Practice (Using any computational tool):

1. Computing eigen values and eigen vectors, matrix diagonalization.

UNIT – III

One Variable Calculus: Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof), Problems and applications on the above theorems.

Several Variable Calculus: Limit, Continuity, partial derivatives and their geometrical interpretation.

Practice (Using any computational tool): Basics of plotting, Plot graphs of single variable functions.

UNIT – IV

Functions of several variables: Total differential and differentiability, derivatives of composite and implicit functions, derivatives of higher order and their commutativity,Euler's theorem on homogeneous functions , Taylor's and Maclaurin's expansion of functions of two variables. Jacobians, maxima and minima, constrained maxima/minima problems using Lagrange's method of multipliers.

Practice (Using any computational tool): Plot graphs of various multi variable functions.

UNIT – V

Multiple Integrals: Double integrals, triple integrals, change of order of integration, change of variables to polar, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

Practice (Using any computational tool): Plotting the region of Integration.

Students are advised to use any computational / AI Tool like Wolfrum Alpha, Symbolab, Mathway, Desmos, Geogebra etc., for the practice

Text Books:

1. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 5th Edition (9th reprint), 2021· ISBN 978-8184875607.
2. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 5th Edition, 2018. ISBN-13. 978-1292174341.

Reference Books:

1. Advanced Engineering Mathematics, Michael Greenberg, Pearson publishers, 9th edition. ISBN-13. 9788177585469.
2. Higher Engineering Mathematics, H. K. Dass, Er. R. Verma, S-Chand publishers, 3rd edition 2023.ISBN 9788121938907.

Web Links:

1. https://archive.nptel.ac.in/courses/111/104/111104137/
2. https://archive.nptel.ac.in/courses/111/107/111107108/
3. https://www.khanacademy.org/math/linear-algebra/
4. https://www.khanacademy.org/math/multivariable-calculus

Engineering Mechanics
(Common to CE, ME & Min.E)

Course Code: 2501ME02	**L**	**T**	**P**	**C**
	2	**1**	**1**	**4**

Course Outcomes:
At the end of the course, student will be able to:

- **CO1:** Solve the resultant of force system using fundamental principles of force-couple system
- **CO2:** Solve the efficiency of equilibrium force system involving friction using free-body diagrams
- **CO3:** Solve the Centre of gravity and Moment of inertia of rigid bodies using Parallel axis theorem, Perpendicular axis theorem and Pappus theorems
- **CO4:** Apply principle of Virtual work and analyze the trusses by Method of sections & Method of joints
- **CO5:** Apply D'Alembert's principle, Work-energy, Impulse-momentum principles to analyze plane motion of a rigid body.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	1	1	1	-	1
CO2	3	2	-	-	-	-	1	1	1	-	1
CO3	3	2	-	-	-	-	1	1	1	-	1
CO4	3	2	-	-	-	-	1	1	1	-	1
CO5	3	3	-	-	-	-	1	1	1	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

UNIT – I

Force systems: Classification of Forces- Vectors and Tensors- Coplanar Concurrent Forces– Resultant–Moment of Force and its Application –Couple-Varignon's theorem- Resultant of Force Systems-Free-body diagrams and equilibrium.

Practice:

1. Verification of Triangle Law, Parallelogram Law and Polygon's law
2. Verification of Law of moments by Rotation Disc
3. Verification of Law of moments by Bell Crank Lever
4. Finding the support reactions using Simply supported beam

UNIT – II

Friction: Coefficient of friction-Angle of friction- Cone of friction- Coulomb's laws – Applications of Rolling friction, Belt-pulley, Brakes, Clutches, Screw jack, Wedge-Centroid and Center of Gravity :

Concept of Centroid and Centre of Gravity- Regular and Composite areas-Pappus theorems

Practice:

1. Finding Coefficient of friction on inclined plane
2. Find the efficiency of screw jack
3. Finding the Centre of gravity of plane areas
4. Finding the efficiency of pulley system

UNIT – III

Moment of Inertia: Concept of Moment of Inertia - Parallel axis theorem- Perpendicular axis theorem- Rectangular and Polar Moment of inertia of composite areas- Radius of Gyration-Analysis of trusses by Method of Joints and Method of Sections- Principle of Virtual work

Practice:

1. Finding the Moment of inertia of Compound pendulum

UNIT – IV

Rectilinear and Curvilinear motion: Introduction to Rectilinear motion- Curvilinear motion-Tangential and Normal components-Radial and Transverse Components-D'Alembert's principle -Principle of Work-Energy

UNIT – V

Impulse-Momentum: Principle of Impulse and momentum.

Plane motion of rigid body: Introduction to plane motion of a rigid body-Translation and rotation

Text Books:

1. Engineering Mechanics-Statics and dynamics, A.K.Tayal, Umesh publications, 14th Edition, ISBN: 9789380117386
2. A textbook of Engineering mechanics, R.K.Bansal. 4th Edition, Laxmi Publications, 2016, ISBN :978-8131800782.

Reference Books:

1. Engineering Mechanics-Statics and Dynamics , R.C.Hibbeler, 15th Edition, 2022, ISBN :9780137514725
2. Vector Mechanics for Engineers - Volume I ,Beer F.P. and Johnston E.R., Statics, Volume II -Dynamics, McGraw Hill, New York, ISBN 9789353166595

Web Links:

1. https://onlinecourses.nptel.ac.in/noc23_me74/UNIT?UNIT=17&lesson=18
2. https://ocw.mit.edu/courses/1-050-engineering-mechanics-i-fall-2007/

Engineering Workshop

(Common to CE, EEE, ME, ECE, PT & Min.E)

Course Code: 2501ME03	L	T	P	C
	0	0	1	1

Course Outcomes:

At the end of the course, student will be able to:

- **CO1:** Prepare various wooden joints.
- **CO2:** Demonstrate various sheet metal models.
- **CO3:** Develop the basic knowledge of house wiring.
- **CO4:** Develop the basic knowledge of plumbing.
- **CO5:** Practice various welded joints.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	1	1	-	-	-	1	1	2	1	-	1
CO2	1	1	-	-	-	1	1	2	1	-	1
CO3	2	2	-	-	-	1	1	2	1	-	1
CO4	1	2	-	-	-	1	1	2	1	-	1
CO5	2	2	-	-	-	1	1	2	1	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	1	-
CO4	2	-
CO5	2	-

Practice:

1. To make a T-Lap joint from the given wooden workpieces.
2. To make a dovetail lap joint from the given wooden workpieces.
3. To make a taper tray using the given sheet metal.
4. To make a funnel using the given sheet metal.
5. To make a square tin using the given sheet metal.
6. To connect three bulbs by using series and parallel connections.
7. To give connection to a bulb by using staircase wiring.
8. To prepare wiring for a tube light with switch control.
9. To prepare a PVC pipe joint by using the given circuit1.
10. To prepare a PVC pipe joint by using the given circuit2.
11. To make a butt joint using the given M.S pieces by arc welding.
12. To make a lap joint using given M.S pieces by arc welding

1. To make a cross lap joint from the given wooden workpieces.

2. To make an open scoop using the given sheet metal.
3. To make a T-joint using given M.S pieces by arc welding.

Text Books:

1. Work shop Manual , P. Kannaiah & K.L. Narayana/ SciTech Publishers, 2nd edition, ISBN: 978-8183711302.
2. Elements of Workshop Technology, Vol I by S.K. Hajra Choudhury, S.K. Hajra Choudhury & Nirjhar Roy, Media Promoters and Publishers Pvt. Limited, 14th edition. ISBN: 8185099146.

Reference Books:

1. Workshop Technology, Part 1, W.A.J. Chapman, 5th edition, ISBN 9780415503020.
2. Engineering Practices Lab Manual, T. Jeyapoovan & M. Saravanapandian, Vikas Publishing House Pvt. Limited, 4th edition, ISBN: 8125929037.
3. Engineering Practices Laboratory Manual, Ramesh Babu. V., VRB Publishers Private Limited, Chennai, Revised edition, 2019-20, ISBN: 978-81-935993-8.

Web Links:

1. https://bharatskills.gov.in
2. https://www.gopracticals.com/basic-engineering/workshop/

Engineering Graphics

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

Course Code: 2501ME01	L	T	P	C
	1	0	2	3

Course Outcomes:

At the end of the course, student will be able to:

- **CO1:** Apply the principles of engineering drawing to construct Engineering curves
- **CO2:** Construct projections of points and lines.
- **CO3:** Demonstrate visualization skills of projections of planes.
- **CO4:** Demonstrate visualization skills of projections of solids and development of surfaces.
- **CO5:** Construct isometric and orthographic views of simple solids.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	1	-	2	-	-	1	1	-	-
CO2	3	2	1	-	2	-	-	1	1	-	-
CO3	3	2	1	-	2	-	-	1	1	-	-
CO4	3	2	1	-	2	-	-	1	1	-	-
CO5	3	2	1	-	2	-	-	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

Practice:

1. **Introduction to Engineering Graphics**

   Introduction to AutoCAD, Dimensioning, elements of dimensioning, system of dimensioning, and Conventions in Drawing.

2. **Construction of Cycloids and Involutes**

   a) Construction of Cycloid, Epicycloid and Hypocycloid

   b) Involute of a pentagon and circle

3. **Introduction to Orthographic Projection**

   a) Principles of Projection

   b) Orthographic Projection – Four Quadrants.

c) First angle & Third angle Projection with examples, reference plane, importance of reference lines or Plane.

d) Projections of a point situated in any one of the four quadrants.

4. Projection of straight lines-I:

a) Projections of straight lines parallel to both reference planes.

b) Projections of straight lines perpendicular to one reference plane and parallel to other reference plane

c) Projections of straight line parallel to one plane & inclined to another plane

5. Projection of straight lines-II:

a) Projections of straight line inclined to both reference planes

6. Projection of planes:

a) Regular planes perpendicular to both reference planes, Parallel to one reference plane and inclined to the other reference plane

Ex: Rectangle, Pentagon, Hexagon and Rhombus

7. Projection of planes

a) Projections of Planes inclined to both reference planes Ex: Rectangle, Pentagon, Hexagon and Rhombus.

8. Projection of solids

a) Axis Perpendicular to H.P and Axis Perpendicular to V.P

Ex: Pentagonal and Hexagonal Prisms, Pyramids, Cylinder and Cone

b) Axis Parallel to H.P and V.P

Pentagonal and Hexagonal Prisms, Pyramids, Cylinder and Cone

9. Projection of solids

a) Projection of Solids with axis inclined to one reference plane and parallel to another plane

Ex: Pentagonal and Hexagonal Prisms, Pyramids, Cylinder and Cone

10. Development of Surfaces

a) Development of Prism

b) Development of Pyramid

11. Sections of Solides

a) Prism

b) Pyramid

12. Conversion of Isometric views to Orthographic views

a) Practice figure - 1

b) Practice figure - 2

Additional Practice:

1. Conversion of Isometric views to Orthographic views

a) Practice figure - 3

b) Practice figure - 4

2. Conversion of Orthographic views to Isometric views

a) Practice figure - 1

b) Practice figure - 2

Text Books:

1. Engineering Drawing, N. D. Bhatt, Charotar Publishing House, 54th edition, 2025, ISBN : 9789385039706.
2. Engineering Drawing and Graphics , Venugopal, New Age Publications, 2nd edition, 2019, ISBN: 9788122515452.

Reference Books:

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2021, ISBN: 978-9385983177.
2. Computer Aided Engineering Graphics, T. Jeyapoovan,Vikas Publishing house, New Delhi, 1stEdition, 2023, ISBN : 9789356743199.

Web Links:

1. https://nptel.ac.in/courses/112103019/
2. https://academy.autodesk.com/authenticated-home-user
3. https://www.sciencedirect.com/book/9780080108391/engineering-drawing-from-thebeginning

Differential Equations &Vector Calculus
(Common to CE,EEE,ME,ECE,CSE,IT,AIML,CSE(DS),PT&Min.E)

Semester: 2501MA02	**L**	**T**	**P**	**C**
	2	**1**	**0**	**3**

Course Outcomes:

At the end of the course, student will be able to:

- **CO1:** Solve the linear differential equations of first order and apply in various engineering problems.
- **CO2:** Solve the linear differential equations of higher order and apply in various engineering problems.
- **CO3:** Solve the linear partial differential equations
- **CO4:** Calculate the gradient, divergence and curl.
- **CO5:** Compute work done, flux using vector integration

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

UNIT – I

Ordinary Differential Equations of First Order and First Degree: Solution of first order linear differential equations, exact differential equations and equations reducible to exact differential equations, Orthogonal Trajectories, Modelling of RL- circuit.

Practice(Using any computational tool): Solving the first order initial value problems using **odesolver** and plot the solution curves.

UNIT – II

Linear Differential Equations of Higher Order: Solution of linear differential equations with constant coefficients, method of variation of parameters, solution of simultaneous linear differential equations.

Equations reducible to Linear differential equations with constant coefficients: Cauchy's homogeneous Linear Equations, Legendre's Linear Equations. Study of oscillations arising in LCR circuit (free oscillations and forced oscillations).

Practice(Using any computational tool): Solving the second order initial value problems using odesolver and plot the solution curves

UNIT – III

Partial Differential Equations: Solution of linear PDE of first order by Lagrange's method, solution of homogeneous linear PDE of higher order with constant coefficients.

UNIT – IV

Vector Differentiation: Gradient of a scalar field, finding angle between two surfaces, directional derivative. Divergence and solenoidal fields. Curl and irrotational fields, Finding Scalar Potential.

Practice (Using any computational tool): Plotting of surfaces, 3D-plots, plotting vector fields

UNIT – V

Vector Integration: Line integrals, work done by a force, conservative force field, surface integral, flux, volume integral. Green's theorem, Stoke's theorem and Gauss divergence theorem.

Students are advised to use any computational / AI Tool like Wolfrum Alpha, Symbolab, Mathway, Desmos, Geogebra etc., for the practice

Text Books:

1. Advanced Engineering Mathematics, E. Kreyszig, John Willey & Sons,10th Edition, 2018. ISBN 978-0470458365.
2. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 44'th Edition, 2021. ISBN 978-9383214204.

Reference Books:

1. Advanced Engineering Mathematics, Dennis G. Zill, Jones & Bartlett Learning, 2018, 6th Edition.ISBN 978-1284105902.
2. Higher Engineering Mathematics, B.V. Ramana, McGraw-Hill Education, 11th Edition, 2017. ISBN 978-9339216016.

Web Links:

1. https://www.classcentral.com/course/differential-equations-engineers-13258
2. https://archive.nptel.ac.in/courses/111/106/111106100/
3. https://www.khanacademy.org/math/differential-equations
4. https://archive.nptel.ac.in/courses/111/101/111101153/
5. https://archive.nptel.ac.in/courses/111/105/111105122/

Introduction to Mechanical Engineering

	L	T	P	C
Course Code: 2501MN01	**2**	**0**	**1**	**3**

Course Outcomes:

At the end of the Course, Student will be able to:

- **CO1:** Explain different laws of thermodynamics.
- **CO2:** Explain working principle of different engine.
- **CO3:** Explain the concepts of Fluid kinematics and dynamics.
- **CO4:** Explain the different manufacturing techniques.
- **CO5:** Draw the velocity and acceleration diagrams analyzing machines and mechanisms.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	-	-	-	-	-	-	1	1	1	-
CO2	3	-	-	-	-	-	-	1	1	1	-
CO3	3	2	-	-	-	-	-	1	1	1	-
CO4	3	-	-	-	-	-	-	1	1	1	-
CO5	3	2	-	-	-	-	-	1	1	1	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT – I

Introduction to Thermodynamics: Concept of thermodynamics, definitions of system, surroundings, state, process, cycle, zeroth, and first law of thermodynamics, properties of pure substances, energy analysis of closed systems and control volumes, applications of laws of thermodynamics.

UNIT – II

I. C. Engines: Classification - working principles, valve and port timing diagrams, - engine systems fuel, carburetor, fuel injection system, ignition, cooling and lubrication, principle of wankle engine, principles of supercharging and turbocharging.

Practice:

1. Demonstration of valve time diagram for four stroke engine.
2. Demonstration of cut section model of petrol and diesel engine.

UNIT – III

Fluid Mechanics: Introduction to fluid, properties of fluids- specific gravity, viscosity and its significance, surface tension, capillarity, and vapor pressure, atmospheric gauge, vacuum pressure–measurement of pressure, Pascal's law, hydrostatic law, Bernoulli's equation.
Fluid kinematics: Flow types, Equation of continuity for one dimensional flow, Circulation and vorticity. Stream line, path line and streak lines and stream tube, Losses in pipe.

Practice:

1. Determination of loss of head due to minor losses in a pipeline.
2. Determination of loss of head due to major losses in a pipeline.
3. Determine the flow velocity of pitot tube.

UNIT – IV

Manufacturing Processes:
Introduction to manufacturing techniques, casting, forging, forming, machining, welding, joining, powder metallurgy, plastic and composite manufacturing, introduction to computer numerical control (CNC) machines, additive manufacturing. Introduction to robotics - joints & links, configurations and applications of robotics.

Practice:

1. To design and manufacture a Wooden Pattern for a given Casting.
2. To prepare a Single Strap Butt Joint on the given work pieces using spot welding equipment.

UNIT – V

Machines & Mechanisms:
Machines: Definition and significance of machines and mechanisms, History and evolution of mechanical systems, Applications.
Mechanisms: Types of mechanisms (linkages, cams, gears), Kinematic analysis of mechanisms, Velocity and acceleration diagrams, Gears and gear trains and applications.

Text Books:

1. Basic Mechanical Engineering, P.K. Nag, Tata McGraw Hill Education, 3rd Edition ISBN: 97870616266.
2. Fluid Mechanics and Hydraulic Machines, R. K. Rajput, 2nd edition. ISBN: 978817081042.
3. Manufacturing Engineering and Technology, S. Kalpakjian and S. Schmid, Pearson Education; 7th Edition, 2018. ISBN: 9780134290553.

Reference Books:

1. Fluid Mechanics and Fluid Power Engineering, D.S. Kumar. ISBN: 9788189928468.
2. Manufacturing Science, A. Ghosh & A.K. Mallik, East West Press Pvt. Ltd Publication, 3rd Edition. ISBN: 978-8176710633.
3. Theory of Machines, S.S. Ratan, McGraw Hill Education India Private Limited, 4th Edition. ISBN: 9789352606859.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc24_me16/preview.
2. https://onlinecourses.nptel.ac.in/noc24_me51/preview.
3. https://archive.nptel.ac.in/courses/113/106/113106098/.

Introduction to Mining Geology

	L	T	P	C
Course Code: 2501MN02	**2**	**0**	**2**	**4**

Course Outcomes:

At the end of the course, student will be able to:

- **CO1:** Describe the fundamental principles of geology as applicable to mining engineering.
- **CO2:** Demonstrate understanding of the classification and physical properties of minerals, rocks, and ores, as well as the distribution of mineral deposits.
- **CO3:** Interpret geological maps to identify folds, faults, and other structural features.
- **CO4:** Analyze geological formations and structures, such as folds, faults, and unconformities, to interpret their characteristics and significance in mining operations.
- **CO5:** Create geological maps and profiles, as well as to propose strategies for mineral exploration and extraction.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	-	-	-	-	-	-	-	1	1	1
CO2	2	-	-	3		-	-	-	1	1	1
CO3	1	3	-	-	3	-	-	-	1	1	1
CO4	1	3	-	-	-	-	-	-	1	1	1
CO5	2	1	2	-	-	-	-	-	1	1	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT – I

Definition of Geology: Branches of Geology, Importance of Geology in Mining, Structure of earth; Mineral, rock, and ore; Weathering and Erosion.

Practice:

1. To Study different Physical properties of minerals and their identification.
2. To prepare a geological map and its profile.

UNIT – II

Definition of mineral – Classification of minerals – Physical properties of minerals –color, lusture, texture, grain size, hardness.

Practice:

1. To determine hardness of minerals using Mohr's scale of hardness.
2. To study crystallographic models of different minerals.

UNIT – III

Classification of Mineral deposits: Mineral resources, reserve classification, mineral distribution of India and World. Grade of ore and coal.

Practice:

1. To measure strike and dip of various outcrops in the field.
2. To draw the strike lines, measure the dip of the beds.

UNIT – IV

Petrology: Classification of rocks – igneous, sedimentary, and metamorphic origin, formation, structures, textures; Study of different types of igneous, sedimentary, and metamorphic rocks.

Practice:

1. To Study different Physical properties of igneous rocks.
2. To Study different Physical properties of sedimentary rocks.
3. To Study different Physical properties of metamorphic rocks.

UNIT – V

Structural Geology: Folds, faults, dykes/sills, joints, unconformity – types, characteristics, and their significance; Strike, dip, thickness of bedded deposits.

Practice:

1. To identify folds, faults in geological maps

Additional Practice:

1. To identify unconformity in geological maps.
2. To calculate true Thickness of the bed.

Text Books:

1. Engineering Geology, Parbin Singh, S.K. Kataria & Sons, 3rd Edition, ISBN: 978-93-5014-267-7.
2. Principles of Engineering Geology, Bangar, K.M., Standard Publishers Distributors, 6th Edition, 2020, ISBN: 978-8180141157.

Reference Books:

1. Structural Geology, P.B. Marland, prentice Hall of India Pvt.Ltd.,3rd Edition. ISBN: 978-812030590.
2. A Text Book of Geology, P.K. Mukherjee, The World Press Pvt.Ltd.,9th Edion. ISBN: 978-8187567547.

Web Links:

1. https://pubs.usgs.gov/of/203/ofr-03-210/IV_Geology.pdf
2. https://profiles.uonbi.ac.ke/cnyamai/files/lecture_1_mineralogy_and_crystallography-3_review.pdf
3. http://www.d.umn.edu/~jgoodge/geol2312-1/Ch%201.pdf

Development of Mineral Deposits

	L	T	P	C
Course Code: 2501MN03	**3**	**0**	**0**	**3**

Course Outcomes:

At the end of the course, student will be able to:

- **CO1:** Summarize different stages in the life of a mine
- **CO2:** Choose a suitable location for opening to a deposit.
- **CO3:** Explain Exploratory and Production Drilling
- **CO4:** Categorize the use of explosives and blasting.
- **CO5:** Summarize material handling and transportation in mining

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT – I

Introduction to mining: Mining terminologies, Stages in the life of the mines- Prospecting, Exploration, Development, Exploitation, Reclamation, Brief overview of Surface & Underground Mining Methods.

UNIT – II

Access to mineral Deposits: Adits, shafts, incline - location, shape and size; Drilling, blasting and removal of debris. Methods of shaft sinking –conventional, mechanized and special methods; opening up of surface deposits.

UNIT – III

Exploratory and Production Drilling: Principles of drilling, Types of drill, Drill rods and drill bits – types and applications, Exploratory drilling - Drilling fluid; Production drilling – Rotary, Percussive, Rotary- percussive, pneumatic; Drill patterns.

UNIT – IV

Explosives and Blasting: Types of explosives, Properties of explosives, Detonators. Detonating cords, and detonating fuse and nonel detonator. Storage and transport of explosives, Mechanics of blasting, Primary and secondary blasting, Blast geometry and design, electrical and non electrical methods, delay blasting techniques, handling misfires.

UNIT – V

Material Handling and Transportation in Mines: LHD, SDL, shuttle car, AFC and belt conveyors; Raises, winzes, ore passes, ore chutes; shovels, dumpers, silo, bin, CHP, tippler.

Text Books:

1. Elements of Mining Technology, D.J.Deshmukh, Denett& Co., Nagpur Vol. I. ISBN: 978-8189904333.
2. Surface Mining, Dr T.N.Singh, Lovely Prakashan, Dhanbad , 2nd edition. ISBN: 978-8179561294.

Reference Books:

1. Indian Bureau of Mines, Minerals Year Book & other publications, Latest Edition.
2. Explosives and blasting techniques, G.K Pradhan, Latest edition. ISBN: 978-0470512275
3. Rock Blasting and Overbreak Control, Dr. Calvin Konya; Precision Blasting Services, Montville, Ohio 2nd edition. ISBN: 9780318198965.

Web Links:

1. http://www.miningglobal.com/operations/gifs-5-stages-mining-life-cycle
2. https://www.minecationstandards.org/fileadmin/MAS/documents/nmas-national
3. stabdards/afghanistan/AMAS_07.04_Storage_Transportation_Handling_of_Explosives. Pdf

Fundamental of Rock Mechanics

Course Code: 2501MN04	L	T	P	C
	3	0	2	5

Course Outcomes:

At the end of the course, student will be able to:

- **CO1:** Prepare rock samples for stress and strain determination in laboratory testing
- **CO2:** Evaluate the physical and mechanical properties of rocks
- **CO3:** Utilize diverse measuring devices to accurately measure and analyze the load acting on rock
- **CO4:** Analyze stress concentration around mine openings
- **CO5:** Assess the failure criteria of rock materials within mining environments

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	1	2
CO2	3	2	-	-	-	-	-	-	-	1	2
CO3	3	2	-	-	-	-	-	-	-	1	2
CO4	3	2	-	-	-	-	-	-	-	1	2
CO5	3	2	-	-	-	-	-	-	-	1	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT – I

Introduction to Rock Mechanics: Definition, scope of Rock Mechanics. Terminologies in rock mechanics. Rock mass classification- Bieniawski Classification, CMRI classification. Stress and Strain Behaviour of Rocks. Types of stress and strain, Analysis of stress and strain in two dimensions. Introduction to three dimensional stress analysis: Stress matrix, Cauchy's law, Stress invariants, Stress transformation, Determination of maximum shear stress, Octahedral stress, Compatibility equation.

Practice:

1. Preparation of rock sample.
2. Determination of porosity of rock samples.

UNIT – II

Physico–mechanical Properties of Rocks: Physical properties- Grain Size, Density, Porosity, Permeability, Moisture, Hardness, etc. Mechanical Properties- Strength properties of rocks: Compressive, Tensile and shear strength, Young's modulus, Poisson's ratio,

Dynamic elastic properties. Index properties- Protodyakonov's index, point load index. Slake durability index.

Practice:

1. Determination of hardness of rocks by rebound hammer test.
2. Determination of uniaxial compressive strength of rocks.

UNIT – III

Rock Behaviour: Static Conditions- Deformability, Creep .Dynamic loading of rocks-Stress-strain behaviour. Measuring Instruments-Stress and Strain.

Practice:

1. Determination of tensile strength of rocks
2. Determination of shear strength of rocks.

UNIT – IV

Rock Stress: In-situ stresses and their estimation, Horizontal stress and vertical stress, Stresses around mine openings of different cross sections.

Practice:

1. Determination of moisture content and degree of saturation of given rock sample.
2. Determination of impact strength index of rock sample.

UNIT – V

Theories of Rock Failures: Theories of failure of rocks and their applications. Mohr's theory, Mohr-Coulomb failure criteria, Griffiths' theory, Different modes of failure of rocks.

Practice:

1. Determination of point load index of rocks.
2. Determination of slake-durability index rocks.

Additional Practice:

1. Strength analysis of Coal.
2. Strength comparison of soft and hard rock.
3. Determination of cohesion and friction angle using triaxial testing apparatus.

Text Books:

1. Introduction to rock mechanics, R.E Goodman, john Wiley and sons. ISBN: 978-0471393034.
2. Introduction to rock mechanics, V.S Vutukuri and K. Katsuyama, Industrial publishing & Consulting Inc, Tokyo. ISBN: 978-4-87195-026-4.

Reference Books:

1. Rock mechanics for underground mining, B.H. G Brady and E.T.Brown, George Allen and Unwi Ltd. ISBN: 978-0415411601.
2. Fundamentals of rock mechanics, J.C.Jeager and N.G.W.Cook, chapman and Hall. ISBN: 978-0412298600.

3. Fundamentals and Applications of Rock Mechanics, Debasis Deb and Abiram Kumar Verma, PHI Publication. ISBN: 978-8120346294.

Web Links:

1. https://home.iitk.ac.in/~sarv/New%20Folder/Presentation1.pdf
2. Rock Mechanics for GeoEnergy Applications | GEOSTRATA Magazine | Vol 27, No 1 (ascelibrary.org)
3. Mechanical Strain and Elastic Moduli (Chapter 4) - Fundamentals of Rock Physics (cambridge.org)

Numerical Methods & Integral Transforms

(Common to EEE, Min. E & PT)

	L	T	P	C
Course Code: 2501MA05	**2**	**1**	**0**	**3**

Course Outcomes:

At the end of the Course, Student will be able to:

- **CO1:** Apply numerical methods to solve the solution of equations and interpolation of polynomials.
- **CO2:** Apply numerical methods to solve problems involving differentiation, integration and initial value problems.
- **CO3:** Compute Fourier series of a function.
- **CO4:** Compute the Fourier transform of a function.
- **CO5:** Apply Laplace transform to solve initial value problems.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT – I

Solution of Algebraic and Transcendental Equations and Interpolation:
Solution of Algebraic and Transcendental Equations: Errors in Numerical Computation, Bisection method, Method of false position, Secant method and Newton - Raphson method.
Interpolation: Unequal Intervals- Lagrange's interpolation, Newton's divided difference formulae, Equal Intervals-Newton's Forward and Backward difference formlae, Central difference, Relation between operators.
Practice(Using any computational tool): Find solution of equations and Newton's forward interpolation.

UNIT – II

Numerical Differentiation, Integration and Solutions of Ordinary Differential Equations:
Numerical Differentiation: Numerical differentiation using Newton's Forward, Backward and Newton's divided difference formula.
Numerical Integration: Simpson's 1/3rd and 3/8th rule.
Numerical solution of ordinary differential equations: Taylor's series method, Euler's method and Runge-Kutta method (second and fourth order).

Practice(Using any computational tool):Solving problems on above methods.

UNIT – III

Fourier Series: Fourier series of periodic functions, Half-range series, Change of interval and Fourier series in complex form, Parseval's formula and R.M.S Value.

Practice(Using any computational tool): Generating Fourier Series of functions .

UNIT – IV

Fourier Transforms: Fourier integral theorem (without proof), Fourier sine and cosine integral, Fourier Transform, Properties, Fourier sine and cosine transforms and Finite Fourier transforms.

UNIT – V

Laplace Transforms : Laplace Transform of Standard functions, Properties, Inverse Laplace transform, Properties, Convolution theorem, Solving ordinary differential equations and Simultaneous equations with constant coefficients by using Laplace Transforms.

Practice(Using any computational tool): Finding Laplace Transform of functions.

Students are advised to use any computational / AI Tool like Wolfrum Alpha, Symbolab, Mathway, Desmos, Geogebra etc., for the practice

Text Books:
1. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 5th Edition (9th reprint), 2021· ISBN 978-8184875607
2. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 44'th Edition (2021). ISBN 978-9383214204

Reference Books:
1. Advanced Engineering Mathematics with MATLAB, Dean G. Duffy, CRC Press. ISBN 978-1498739641
2. Higher Engineering Mathematics, H. K. Dass, Er. R. Verma, S-Chand publishers, 3rd edition 2023.ISBN 9788121938907

Web Links:

1. https://swayam.gov.in/nd1_noc19_ma21/preview
2. https://onlinecourses.nptel.ac.in/noc20_ge20/preview
3. https://onlinecourses.nptel.ac.in/noc23_ma43/preview
4. https://onlinecourses.nptel.ac.in/noc22_ma62/preview

Complex Variables & Statistical Methods
(Common to EEE, PT, Min.E)

	L	T	P	C
Course Code:2501MA06	**2**	**1**	**0**	**3**

Course Outcomes:

At the end of the Course, Student will be able to:

CO1: Examine the continuity and analyticity of functions of complex variables and Evaluate different types of complex integrals
CO2: Expand a function of complex variable as Taylor and Laurent series and evaluate residues.
CO3: Apply various Probability distributions for both discrete and continuous random variables.
CO4: Compute mean and variance of sample means with replacement and without replacement and estimating maximum errors
CO5: Apply various tests to test the hypothesis concerning mean, Proportion, variance.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT – I

Functions of a complex variable and Complex integration:
Introduction – Continuity – Differentiability – Analyticity –Cauchy-Riemann equations in Cartesian and polar coordinates – Harmonic and conjugate harmonic functions – Milne – Thompson method.
Complex integration: Line integral –Cauchy's integral theorem–Cauchy's integral formula (without proofs)

UNIT – II

Series expansions and Residue Theorem:
Radius of convergence–Expansion in Taylor's series,Maclaurin's series and Laurent series. **Types of Singularities**:Isolated–Essential–Pole of order m–Residues–Residue theorem (without proof)

UNIT – III

Random variables and Distributions:
Random variables – Discrete and Continuous random variables – Distribution functions – Probability mass function, Probability density function and Cumulative distribution functions – Mathematical Expectation and Variance –Binomial, Poisson and Normal distributions.
Practice(Using any computational tool): Fitting Binomial and Poisson distributions

UNIT – IV

SamplingTheory:
Introduction –Population and Samples–Sampling distribution of Means and Variance – Central limit theorem (without proof) –Point and Interval estimations –Maximum error of estimate.
Practice(Using any computational tool): Plotting of confidence intervals

UNIT – V

Tests of Hypothesis:
Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors –Level of significance – One tail and two-tail tests – tests for large samples (Z - test for single mean, difference of means, single proportion, difference of proportions) – tests for small samples (t-test for single mean and difference of means)– F-test for comparison of variances-Chi Square test for attributes.
Practice(Using any computational tool): F- test and t- test.

Students are advised to use any computational / AI Tool like Wolfrum Alpha, Symbolab, Mathway, Desmos, Geogebra etc., for the practice

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 44'th Edition (2021).ISBN 978-9383214204
2. Miller and Freund's, Probability and Statistics for Engineers, 9/e, Pearson, 2020.ISBN978-9353945237

Reference Books:

1. Complex Variables and Applications, J.W.Brown and R.V.Churchill, 9th edition , Mc-Graw Hill, 2021 .ISBN 9789354600364.
2. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K.Kapoor, 12th edition, Sultan Chand & Sons Publications, 2020.ISBN 978-9351611738

Web Links:

1. https://archive.nptel.ac.in/courses/111/103/111103070/
2. https://onlinecourses.nptel.ac.in/noc20_ma50/preview
3. https://onlinecourses.nptel.ac.in/noc21_ma74/preview
4. http://mathworld.wolfram.com/topics/ProbabilityandStatistics.html
5. https://www.khanacademy.org/math/statistics-probability

Engineering Economics

(Common to ECE, Min.E, PT)

	L	T	P	C
Course Code:2501MB02	**3**	**0**	**0**	**3**

Course Outcomes:

At the end of the course, student will be able to:

- **CO1:** Explain the Managerial Economic concepts and Illustrate the law of demand forecasting methods.
- **CO2:** Identify the production , cost behavior for managerial decision making and Break Even Point (BEP) of an enterprise.
- **CO3:** Differentiate types of market structures, business organizations along with basic knowledge on business cycle.
- **CO4:** Make use of the process & principles of accounting for the preparation of basic accounts.
- **CO5:** Utilize various techniques on investment project proposals with the help of capital budgeting techniques for decision making.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	-	-	1	-	1	-	-	2	-	-	-
CO2	-	-	-	-	-	-	-	-	2	-	-
CO3	1	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	1	1	-	-
CO5	-	-	-	-	-	-	-	3	1	2	-

UNIT – I

Introduction to Managerial Economics and demand Analysis: Definition and Scope of Managerial Economics, Concept and determinants of demand, Demand curve, Law of Demand and its limitations, Elasticity of demand and its types, Demand forecasting and its Methods.

UNIT – II

Production and Cost Analyses: Concept of production function – Law of variable proportions-Isoquants and Iso costs- cost concepts: opportunity costs, explicit and implicit costs- Fixed costs, Variable costs and total costs – Cost –Volume-Profit analysisDetermination of breakeven point (simple problems)- Managerial significance and limitations of breakeven point.

UNIT – III

Introduction to Markets, Pricing Policies & Types of Business Organization and Business Cycles.

Market structures: Perfect competition, monopoly, monopolistic competition and oligopoly –Features – Methods of pricing: Average cost pricing, Limit pricing, Market skimming pricing. Features and evaluation of Sole Trader, Partnership, Joint Stock Company – Business cycles : Phases of business cycles.

UNIT – IV

Introduction to Accounting & Financing Analysis: Introduction to double entry systems – Journal entries – Ledger – Trail balance – Trading and Profit and Loss account-simple problem.

UNIT – V

Capital and Capital Budgeting:Capital Budgeting: Meaning of Capital- Methods of Capital Budgeting-Traditional Methods(pay back period, accounting rate of return) and modern methods(Discounted cash flow method, Net Present Value. method, Internal Rate of Return Method and ProfitAbility Enhancement CoursesIndex)- Simple Problems.

Text Books:

1. Managerial Economics and Financial Analysis, A.R. Aryasri , McGrawHill Education, ISBN: 978-0070078031.
2. Managerial Economics and Financial Analysis, N.Appa Rao, P.Vijay Kumar, Cengage Publications, ISBN: 978-8131515952.

Reference Books:

1. Managerial Economics , V. Maheswari , Sultan Chand Publications, ISBN: 81-8054-914-4.
2. Managerial Economics, Suma Damodaran : Oxford University Press, ISBN: 978-0198061113.

Web Links:

1. https://www.udemy.com/course/introduction-to-managerial economics/?couponCode=LETSLEARNNOWPP
2. https://archive.nptel.ac.in/courses/110/101/110101149/

Mine Surveying

	L	T	P	C
Course Code: 2501MN05	**3**	**0**	**2**	**5**

Course Outcomes:

At the end of the course, student will be able to:

CO1: Analyze different types of surveying methods.
CO2: Determine levels and Contours.
CO3: Apply modern instruments of surveying.
CO4: Evaluate the geodetic surveying GIS & GPS.
CO5: Estimate volumes of borrow pits and areas of fields

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	2	-	-	-	-	2	1	1
CO2	3	-	1	2	-	-	-	-	2	1	1
CO3	3	-	-	-	-	-	-	-	2	1	1
CO4	3	-	-	-	-	-	-	-	2	1	1
CO5	3	-	-	-	-	-	2	-	2	1	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT – I

Overview of Plane Surveying: Objectives and Principles of Surveying. Triangulation survey, Meridians, Azimuths and Bearings, declination, computation of angle.

Practice:

1. Measurement of distance using chains.
2. Measurement of bearing of sides using prismatic compass.

UNIT – II

Levelling: Types of levelling, traversing with theodolite, Stadia Tachometry. EDMs; Total station, GPS, Introduction to remote sensing.

Practice:

1. Simple leveling and differential levelling using dumpy level.
2. Measurement of horizontal and vertical angles using theodolite.

UNIT – III

Correlation Survey: Principles, Classification, Methods, Shaft Plumbing, Assumed

Bearing, Weisbach Triangle, Co-planning, Weisbach quadrilateral, Problems on correlation survey etc. Measuring depth of shaft. Magnetic and gyroscopic orientation.

Practice:

1. Triangulation survey by theodolite.
2. Measure the height and distance using Tacheometer.

UNIT – IV

Curve Setting: Types of curves, simple and compound curves by linear and angular methods on surface and in the underground, Super elevation and transition curve, Characteristics and uses of contours.

Practice:

1. Distance measurement using Total station.
2. Measurement of horizontal angles using Total station.

UNIT – V

Problems in mine surveying: Dip, fault, bore hole and cross measure drift problems, Area from field notes,computation of areas along irregular boundaries and regular boundaries and volume of pits.

Practice:

1. Measurement of area using Total station.
2. Calculation of area using GPS.

Additional Practice:

1. Measurement of vertical angles using Total station
2. Radiation survey using plane table
3. Intersection survey using plane table
4. Study of mine plans.

Text Books:

1. Surveying, B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi Publications (P) ltd.Volume 3. ISBN: 9788131809569.
2. Mine Surveying, S Ghatak, Volume 3, ISBN: 9789382332887.

Reference Books:

1. Surveying, Dr.L.O.Punmia, Dr C.M.Kole, Khuli Khan KaAyojan (Hindi), CMPDIL, Ranchi,1st edition. ISBN: 9788187566775.
2. Surveying and leveling, Kanetkar & Kulkarni, Volime I and II. ISBN: 9788189401237 & 9788189401244.

Web Links:

1. http://www.nptelvideos.in/2012/11/surveying.html
2. http://nptel.ac.in/courses/105107158/17

Surface Mining

	L	T	P	C
Course Code: 2501MN06	**3**	**0**	**0**	**3**

Course Outcomes:

At the end of the course, student will be able to:

CO1: Analyze different surface mining methods
CO2: Design the layout of a large opencast mine
CO3: Design drilling and blasting for Surface mining
CO4: Choose the better excavation and loading equipments
CO5: Organize the transportation system

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	2	-	-	-	-	-	-	-
CO2	3	1	1	-	-	-	-	-	-	-	-
CO3	3	1	1	-	-	-	-	-	-	-	-
CO4	3	1	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT – I

Introduction: Status and scope of surface mining- Applicability, Limitations and, advantages and disadvantages. Methods of opening box cut, selection of site for box cut. Surface Mining Methods: Open pit Mining, Open cast Mining,Quarrying, High-wall Mining, Modern mining Methods. Placer Mining.

UNIT – II

Open Pit Layout and Design: Planning the layout and open pit mine with special reference to large mechanized mines. Optimum dimensions of open pit mines. Removal of over burden and disposal, Bench Design/Geometry, Design and stability slopes.

UNIT – III

Blast Design in Surface Mines: Drillability, mechanics of drilling, major types of drilling machines. Blasting: Basics of mechanics of blasting, principles of fragmentation. Blast design, Adverse impacts of blasting in surface mines. Controlled blasting techniques. Novel methods of blasting.

UNIT – IV

Excavation and Loading: Shovels, Dragline, Front-end loader. Non-Cyclic Surface Mining: Bucket Wheel Excavators and Continuous surface miners.Auxiliary Equipment: Stackers, Graders, Dozers, Ripper.

UNIT – V

Transport Equipment: Selection of mode of transport. Dumpers, Aerial ropeways-monocable and bicable types and their constructional details. Conveyor systems, ICC system, Slurry Transportation.

Text Books:

1. Surface Mining Technology, S. K. Das, Lovely Prakashan, Dhanbad. ISBN: 978-0873351087.
2. Surface Mining, G. B. Mishra, Dhanbad Publishers. ISBN: 978-0873351027.

Reference Books:

1. Opencast Mining unit operations, V.V.Rzhevsky, Mir Publisher's, Mascow. ISBN: 978-0412298600.
2. Open Pit Mine Planing and Design Crawford, T.john, American Institute of Mining, Metallurgical and Petroleum Engineers. ISBN: 978-0873352224.

Web Links:

1. http://www.cienciaviva.pt/img/upload/Introduction%20to%20mining.pdf
2. http://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/safework/documents/normativeinstrument/wcms_107828.pdf
3. https://www.iitbhu.ac.in/faculty/min/rajesh-rai/NMEICT Slope/Pdf/03%20Types%20of%20slope%20failure.pdf

Underground Coal Mining Technology

	L	T	P	C
Course Code: 2501MN07	**3**	**0**	**0**	**3**

Course Outcomes:

At the end of the course, student will be able to:

- **CO1:** Illustrate the fundamentals of underground coal mining.
- **CO2:** Explain the various mine development methods.
- **CO3:** Explain the long wall mining method.
- **CO4:** Analyze the various thick and deep seam mining methods.
- **CO5:** Categorize the various modern mining methods.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	2	-	3	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-
CO5	2	-	-	3	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT – I

Introduction: Formation of coal deposits, structures associated with coal deposits, rank and grade of coal. Different coal mining methods: factors influencing choice of coal mining methods.Status of coal mining industry in India and global scenario.

UNIT – II

Bord and Pillar Mining: Applicability, limitations, advantages and disadvantages of Bord and pillar mining method. Development-Design of pillars and panel, supports. Depillaring-methods and sequence of operations, splitting and slicing of pillars, supports. Partial extraction techniques.Extraction of multi seams. Stowing Techniques. Mechanization- SDL, LHD, Continuous miners, belt conveyors, UDM etc.Case studies

UNIT – III

Longwall Mining: Applicability, limitations, merits and demerits, Longwall mining Methods- Advancing and Retreating, Thin and Thick seam. Longwall Development- Gate

roads, longwall face. Face Mechanization, Shearer, Plough, AFC,Powered Supports. Sequence of operations- Cutting and conveying of coal from face. Case studies.

UNIT – IV

Thick Seam Mining: Applicability, limitations, and problems associated with thick seam mining, selection of mining method, caving and stowing methods. Different slicing methods- inclined Slicing, Horizontal Slicing, Diagonal Slicing, Transversely Inclined Slicing, Caving methods- Sublevel Caving Working Steep and Moderately Thick Seams- Blasting Gallery method, Room and Pillar method, Descending Shield method of Mining. Design of Supports, Case studies.

UNIT – V

Modern Coal Mining Methods: Horizon Mining, Hydraulic Mining, Underground Coal Gasification.Case studies.

Text Books:

1. Principles and Practices of Modern Coal Mining, R. D. Singh, New Age International. ISBN: 978-8122429705.
2. Modern Coal Mining Technology, S. K. Das, Lovely Prakashan Publishers,2nd edition. ISBN: 978-81-7850-043-6.

Reference Books:

1. Underground Coal Mining Methods, J. G. Singh, BrajKalpa Publishers, Varnasi. ISBN: 81-7525-204-9.
2. Coal Mining, I.C.F. Statham, The Caxton Publishing Company Ltd. Inc, Vol. I, II, III and Vol. III. ISBN: 978-81-7850-043-9.
3. Winning and working coal, R. T. Deshmukh, D.J Deshmukh Vol 1 & 2. ISBN: 97-88-189904333.

Web Links:

1. https://osme.co.in/wp-content/uploads/2023/01/UCMR-BAL-1.pdf
2. https://www.digitalxplore.org/up_proc/pdf/340-151522605452-56.pdf

Underground Metal Mining Technology

	L	T	P	C
Course Code: 2501MN08	**3**	**0**	**0**	**3**

Course Outcomes:

At the end of the course, student will be able to:

- **CO1:** Illustrate the fundamentals of metal mining
- **CO2:** Analyze the various mine development methods.
- **CO3:** Analyze the basics of stoping
- **CO4:** Compare the various stoping methods.
- **CO5:** Categorize the various special stoping methods.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	3	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT – I

Introduction to Metal Mining: Terminologies in metal mining. Special Characteristics of Metalliferous deposit. Scope and limitations of underground metal mining. Access to deposits, Status of metal mining in India and World.

UNIT – II

Mine Developments: Factors affecting choice of level interval, Cross cuts, drive, shape and size of drive, shaft station, ore bin, ore pass and their position in relation to ore body and general scheme of its development. Division of mining area into working units and level pattern, dimensions of panels and blocks. Unit Operations in Metal Mining.

UNIT – III

Basics of Stoping: Stoping methods- applicability, limitations, merits and demerits. Selection of stoping methods. Stope design and production planning in various methods of stoping. Support design.

UNIT – IV

Stoping Methods: Supported and un-supported Stoping Methods, Caving methods. Description, application and design of stoping methods. Mechanisation of stopes.

UNIT – V

Novel Techniques: In-situ leaching, bio-mineral engineering, hydraulic mining, Extraction of remnant pillars, shaft pillars and contiguous reefs, their supporting system and special precautions during extraction.

Text Books:

1. Introductory Mining Engineeing, H L Hartman, John Wiley and sons. ISBN: 978-0471811778.
2. Elements of Mining Technology, D.J.Deshmukh. Vol III. ISBN: 978-8184890700.

Reference Books:

1. Deep Mining, jack Spalding, mining publications. ISBN: 978-0-903078-36-8.
2. Mineral engineers hand book, Peele, Vol. I &II, ISBN: 978-0873352205 & 978-0873352212.
3. U/G Mining Method,Hustrulid, society for mining, metallurgy &Exploration. ISBN: 978-0873352643.

Web Links:

1. https://www.911metallurgist.com/methods-mining-metals/
2. https://www.greatmining.com/metals.html

Mineral Processing Technology

	L	T	P	C
Course Code: 2501MN09	**2**	**0**	**2**	**4**

Course Outcomes:

At the end of the course, student will be able to:

- **CO1:** Illustrate the fundamentals of mineral processing technology.
- **CO2:** Categorize material by sieve analysis.
- **CO3:** Select various mineral crushers
- **CO4:** Choose the various mineral separators.
- **CO5:** Analyze the mineral processing techniques

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	1	1	1
CO2	3	2	-	-	-	-	-	-	1	1	1
CO3	3	2	-	-	-	-	-	-	1	1	1
CO4	3	2	-	-	-	-	-	-	1	1	1
CO5	3	2	-	-	-	-	-	-	1	1	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT – I

Scope and objective of mineral processing. Liberation and Communition: crushing, grinding, Laws of communition.

Practice:

1. To do Sampling by Using Conning and quartering and John Riffle and calculation of error.
2. Determination of various sized product by using different Sieve shaker.

UNIT – II

Sizing- Laboratory sizing techniques and interpretation of sizing data, Industrial screen.

Practice:

1. Determination of average size reduction by Jaw crusher and study their theoretical and actual capacity
2. Determination of average size by sieving of crushed Ore sample in roller crusher
3. To study the effect of grinding with grinding time in Ball mill

UNIT – III

Mineral Concentation Methods: tabling, zigging, floatation, magnetic and heavy media separation; ore sorting; electric separation.

Practice:

1. To study the effect of grinding with frequency (RPM) in Ball mill.
2. Determination of Washability Curve by using Float -sink analysis.
3. Determination of Proximate analysis of coal.

UNIT – IV

Forth flotation:Theories, techniques, performance, selective flocculation and agglomeration.

Practice:

1. Perform the beneficiation of an Oxide ore pulp mix using Floatation Cell.
2. Perform the beneficiation of a sulphide ore pulp mix using Floatation cell.

UNIT – V

Coal preparation for coarse and fine coal. Washability curves and washability number. Dewatering devices. Drying and tailings disposal.

Practice:

1. Study of magnetic separator, and effect of magnetic field on efficiency of the process.
2. Perform the Jigging operation to detecting the rate of stratification.

Additional Practice:

1. Crushing of Coal in the Jaw Crusher, and Determination of average size by sieving
2. Determine the theoretical capacity and actual capacity of a roller crusher.
3. Compare the reduction ratio of an ore sample and the coal sample.

Text Books:

1. Principles of Mineral Dressing, A.M.Gaudin, TataMcGraw &Hill. ISBN: 978-74604311.
2. A text Book on Ore, R.H.Richard and C.E.Locky. ISBN: 978-70438090.

Reference Books:

1. Mineral Dressing Handbook, F.Taggart. ISBN: 978-0471033484.
2. Mineral Processing Technology, B. A.Wills, Willy & Sons. ISBN: 978-0750644505.

Web Links:

1. https://www.britannica.com/technology/mineral-processing
2. http://met solvelabs.com/library/articles/mineral processing introduction
3. http://www.nmlindia.org/mnp.html
4. http://ibm.nic.in/index.php?c=pages&m=index&id=81&mid=22090

Mine Hazards & Rescue

	L	T	P	C
Course Code: 2501MN10	**3**	**0**	**1**	**4**

Course Outcomes:

At the end of the course, student will be able to:

CO1: Illustrate the fundamentals of Mine Fires
CO2: Examine the various causes of Mine Explosions.
CO3: Analyze the reasons of Inundation.
CO4: Summarize the dust and noise in mines
CO5: Explain the rescue procedures in mining.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	3	-	-	-	-	-	-	1	2	-
CO2	1	3	-	1	-	-	-	-	1	2	-
CO3	1	3	-	-	-	-	-	-	1	2	-
CO4	1	3	-	-	-	-	-	-	1	2	-
CO5	1	3	-	1	-	-	-	-	1	2	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT – I

Mine Fires: Causes of mines fires; spontaneous combustion - mechanism, factors affecting spontaneous combustion; detection, susceptibility indices and prevention of spontaneous heating; accidental fires – causes and prevention; dealing with mine fires - direct and indirect methods.

Practice:

1. Detection of Mine Gases.

UNIT – II

Mine Explosions: Firedamp and coal dust explosions – mechanisms, causes and prevention; stone-dust and water barriers; investigations after an explosion.

Practice:

1. Detection of Methane using flame safety lamp.

UNIT – III

Inundation: Causes and prevention; design of barriers; design and construction of water dams, shaft dams, emergency bulk heads; precautions and techniques of approaching old workings, safety boring apparatus, pattern of holes.

Practice:

1. Analysis of mine air by Orsat apparatus.

UNIT – IV

Rescue and Recovery: Classification of rescue equipments and their applications; rescue organization, rescue stations and rescue rooms; reopening and recovery of sealed of workings.

Practice:

1. Determination of Air pressure (Mine & Duct) by Inclined Manometer & Pitot tube.

UNIT – V

Dust and Noise in surface Mines: Airborne respirable dust – sources, sizes, effects, measurement, standards, prevention and control. Air quality Models-Box Model and Gaussian Model. Metreological aspects of Dust- Lpase Rate, Mixing Height, Atmoshpheric Stability.

Occupational noise-sources, effects, measurement- Sound Power, Sound Intensity, and Sound Pressure, Energy equivalent sound level (L_{eq}), Standards, Prevention and Control.

Practice:

1. Determination of Air quantity by Vane Anemometer.
2. Determination of Sound levels by Noise meter.

Text Books:

1. Mine Ventilation, Dr. G.B. Mishra. ISBN: 978-81-22402501.
2. Introduction to environmental Science and engineering by Gilberts and Masters. ISBN: 978-0131481930.

Reference Books:

1. Fires in coal Mines, L.C Kaku. ISBN: 978-8179561683.
2. Mine fire and spontaneous heating, S.P. Banarjee. ISBN: 978-9061915744.
3. Mine Ventilation, Penman. ISBN: 978-1-330-63568-1.

Web Links:

1. https://nptel.ac.in/courses/12310602/MODULE%20 %20I/Lecture%208.pdf
2. https://nptel.ac.in/courses/12310602/MODULE%20 %20I/Lecture%209.pdf

Mine Environment & Ventilation Engineering

	L	T	P	C
Course Code: 2501MN11	**2**	**0**	**2**	**4**

Course Outcomes:

At the end of the course, student will be able to:

CO1: Outline various gases-origins, occurrence, physiological effects.
CO2: Identify mine climatic conditions by using various devices.
CO3: Analyze the necessity of mine ventilation systems.
CO4: Analyze the operation of mine fans and related laws.
CO5: Assess the ventilation planning, design and ventilation survey.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	2	2
CO2	3	2	-	-	-	-	-	-	-	2	2
CO3	3	2	-	-	-	-	-	-	-	2	2
CO4	3	2	-	-	-	-	-	-	-	2	2
CO5	3	2	1	-	-	-	-	-	-	2	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT – I

Mine Air: Composition of Atmospheric and mine air, Mine gases-Properties, sources, physiological effects, detection, monitoring and control. Methane layering, degasification of coal seams, Mine dust: Sources, Effects, Monitoring, & Control.

Practice:

1. Detection of Mine Gases.
2. Detection of Methane using flame safety lamp.
3. Analysis of mine air by Orsat apparatus.

UNIT – II

Mine Climate: Sources of heat in mines, effects of heat and humidity in mines, testing methods and devices: psychometry, kata thermometer, methods for improving of cooling power of mine air: Refrigeration and Air Conditioning Mine Illumination, Illumination standards, Design of illumination system in underground mines, flameproof enclosures.

Practice:

1. Determination of mine fan characteristics.
2. Detection of different gases by Gas Chromatograph.

UNIT – III

Ventilation Systems: Necessity of ventilation, different ventilation systems and its related calculations, factors affecting selection of ventilation system, Mechanism of airflow through mine openings, Laws of air flow, resistance of airways, equivalent orifice, Distribution of air flow and control devices. Natural ventilation: calculation of NVP.

Practice:

1. Determination of Relative humidity& cooling power of mine air.
2. Determination of Air quantity by Vane Anemometer.

UNIT – IV

Mechanical Ventilation: Different types of mine fans: Installation, operation details, applicability, limitations, efficiencies and characteristic. Factors affecting selection of mine fans, testing and output control of fans, operation of mine fans (series and parallel). Fan laws, drives, evasees, diffusers, booster fans. Auxiliary ventilation. Reversal of air currents and controlled recirculation.

Practice:

1. Determination of Air pressure (Mine & Duct) by Inclined Manometer & Pitot tube.
2. Analysis of mine air by Haldane apparatus.

UNIT – V

Ventilation Planning and Design: Ventilation survey: both quantity and pressure and related calculations. Mine ventilation design criteria and factors, Accessional, descensional, homotropal, antitropal Ventilation planning. Central and boundary ventilation systems – layouts and comparisons. Standard of ventilation. Calculation of air quantity and total head requirement for ventilating a mine, Ventilation network analysis.

Practice:

1. Illumination survey using Lux meter.
2. Determination index of flammability of coal dust.

Additional Practice:

1. Study of different types of ventilation control devices.
2. Study of IoT based gas monitoring techniques.
3. Study and uses of self-rescuer, Gas mask, smoke helmet.

Text Books:

1. Elements of Mining Technology, D. J. Deshmukh, Central Techno Publication, 9th Edition, Vol II. ISBN: 978-81-208-2547-5.
2. Mine Environment and Ventilation, G. B. Mishra, Oxford University Press. ISBN: 978-0198087714.

Reference Books:

1. Mine ventilation and air conditioning, Howard L. Hartman. Wiley International. ISBN: 978-0471216921.

2. Environmental Engineering in Mines,Vutukuri& Lama, Cambridge University Press. ISBN: 978-0521545519.
3. Mine Ventilation, S. Ghatak, Coalfield Publishers, Vol. – II. ISBN: 978-1578086795.

Web Links:

1. https://archive.nptel.ac.in/courses/123/106/12310602/

Mine Machinery

	L	T	P	C
Course Code: 2501MN12	**3**	**0**	**0**	**3**

Course Outcomes:

At the end of the course, student will be able to:

- **CO1:** Outline different types of machinery used in mines
- **CO2:** Compare types of rope haulages and its safety appliances
- **CO3:** Predict optimist conveyor system in mines.
- **CO4:** Design winding system and its safety
- **CO5:** Design drainage and pumping system in surface and underground mines.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	3	-	-	-	-	-	1	1	1
CO2	1	1	3	-	-	-	-	-	1	1	1
CO3	1	1	3	-	-	-	-	-	1	1	1
CO4	1	1	3	-	-	-	-	-	1	1	1
CO5	1	1	3	-	-	-	-	-	1	1	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT – I

Introduction: Elements of the transport system, classification and techno economic indices of transportation systems. Wire ropes –classification, construction, fields of application, rope capping and splicing; deterioration of rope in use and its prevention; testing of ropes, selection and maintenance, rope calculations.

Practice:

1. Identify and sketch the different types of wire ropes.
2. Sketch the different types of rope capping.

UNIT – II

Rope Haulages: Types of rope haulages gravity, direct, main & tail, endless, suitability of these haulages and their limitations, merits and demerits, safety appliances and rope haulage calculations; Underground man riding system.

Practice:

1. Sketch the direct rope haulage system and observe the types of motors & braking system used.

2. Sketch the endless rope haulage system and various attaching devices like small man clip.

UNIT – III

Conveyors: Various types of conveyors, Scraper chain conveyors, AFC's, belt conveyors, cable belt conveyor, shaking and vibrating conveyors, high angle conveying, electrical layouts. Numerical problems in conveyors.

Practice:

1. Sketch the tandem drive (Tensioning arrangement) system used in conveyor haulage system.

UNIT – IV

Mine Winders: Winding systems, principles of koepe and drum winders and their applications, mechanical braking of winders, safety devices in winding, overwind and over speed protection. Head gear and their design, cages and skips, suspension gear, shaft fittings and appliances – guides, keps, etc.,

Practice:

1. Draw the circuit diagram of signalling system used in Haulages.

UNIT – V

Mine Pumps: Centrifugal, Reciprocating, Submersible pumps. Numerical problems on Mine Pumps. Characteristics curves for centrifugal pumps.

Practice:

1. Sketch and know the principles of mine pumps.

Text Books:

1. Mine Winding and Transport,Walker, S.C, Elsevier. ISBN: 978-0-444-41717-1.
2. Elements of mining technology, D. J. Deshmukh, Vol. 3. ISBN: 978-8185930914.

Reference Books:

1. Heavy Earth Moving Machinery, Amitosh Dey, Lovely Prakashan Publications, Dhanbad. ISBN: 978-. 9380386423.
2. Mine Mechanisation and Automation, Alemgren G, Kumar U, and Vagenas N A.A, Balkema Publication. ISBN: 978-0419220100.

Web Links:

1. http://mineportal.in/upload 20MACHINERY_243.pdf
2. http://gujaratmining.blogspot.com/2017/10/rope haulage notes.html

Mine System Engineering

Course Code: 2501MN13	L	T	P	C
	3	0	0	3

Course Outcomes:

At the end of the course, student will be able to:

- **CO1:** Apply mathematical modelling to formulate real-world problems involving decision making.
- **CO2:** Solve Linear programming problem, transportation and assignment problems.
- **CO3:** Solve sequencing problem, replacement problem and inventory problem.
- **CO4:** Apply game theory problems, queuing theory in decision making
- **CO5:** Apply dynamic programming &simulation techniques in real-world problems.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	2	-	-	-	-	-	-	-	-	1
CO2	1	2	-	-	-	-	-	-	-	-	1
CO3	1	2	-	-	-	-	-	-	-	-	1
CO4	1	2	-	-	-	-	-	-	-	-	1
CO5	1	2	-	-	-	-	-	-	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

UNIT – I

Introduction : Definition and Scope of Operations Research, Phases of Operations Research - Mathematical formulation of the problem, graphical solution. Linear Programming Problem Standard Form of LPP, Basic Feasible Solutions, Unrestricted Variables, Simplex Algorithm Artificial Variables, Big M Method, Two Phase Simplex Method, Degeneracy, Alternative Optimal, Unbounded Solutions, Infeasible Solutions, Primal And Dual Problems And Their Relations, Dual Simplex Method.

UNIT – II

Transportation Problem : Introduction to the problem, LP formulation of a transportation problem. Basic feasible solution by north-west corner method, Vogel's approximation method, least cost method. Finding optimal solution by MODI method, degeneracy, unbalanced transportation matrix and Maximization in transportation model. Assignment Problem Hungarian method, optimal solution, unbalanced assignment matrix. 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 – III

Inventory Control : Inventory-Factors Effecting Inventory-EOQ, ABC & VED analysis, Inventory Problems with and without Shortages, Price Breakups, Multi Item Deterministic Problems. Probabilistic Inventory Problems.

UNIT – IV

Queuing Theory : Queuing systems and their characteristics. M/M/1 : FCFS/ / M/M/2 : FCFS/, M/M/1 : FCFS/ /N queuing models, Case studies on mining. Project Management Techniques CPM, PERT Networks, Network analysis and Crashing, Case studies on mining.

UNIT – V

Production Scheduling: Simulation Techniques for Equipment selection and production scheduling Definition and applications- Monte Carlo simulation- Random numbers and random number generation, Case studies on mining.

Text Books:

1. Operations Research, S.D Sharma Kedarnath Ramnath & Co. ISBN: 978-8190701105.
2. Operations Research, KantiSwaroop, P.K. Gupta, Man Mohan, Sulthan Chand & Sons. ISBN: 978-81-8054-078-3.

Reference Books:

1. Operations Research, P.K.Gupta and D.S.Hira, S.Chand& Co., 7th Edition. ISBN: 978-9352538233.
2. Operations Research, Panneer Selvam, Prentice Hall of India. ISBN: 978-81-203-4212-0.
3. Operations Research, Richard Bronson, Schaum Series. ISBN: 978-71820825.

Web Links:

1. http://ww2.informs.org/Resources/
2. http://www.mit.edu/~orc/
3. http://www.ieor.columbia.edu/
4. http://www.universalteacherpublications.com/univ/ebooks/or/Ch1/origin.htm
5. http://www.wolfram.com/solutions/OperationsResearch/

Mine Legislation & General Safety

	L	T	P	C
Course Code: 2501MN14	**3**	**0**	**0**	**3**

Course Outcomes:

At the end of the course, student will be able to:

CO1: Illustrate the general principle of mining laws and regulations
CO2: Compare the rules and regulation framed under CMR& MMR.
CO3: Explain the various mining rules and Indian electricity rules
CO4: Explain the Mineral concession rules and mine act
CO5: Explain the training rules and DGMS circular

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	3	-	-	-	-	2	-	-	-	-
CO2	1	3	-	-	-	-	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	3	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT – I

General principles of mining laws, The Mines Act 1952, The mines & Minerals (Regulation & Development) Act 2015, Industrial dispute Act 1947.

UNIT – II

The Coal Mines Regulations 2017 and The Metalliferous Mines Regulations 2019.

UNIT – III

The Mines Rules 1955, Mine rescue rule 1985, Indian Electricity rule 1956.

UNIT – IV

The Mineral Concession Rules 2017, The Mineral Concession and Development Rules 2017.

UNIT – V

Introduction to Environmental Legislation in mines, Land Acquisition & Revenue: Concepts: Related laws and regulations, Forest Conservation Act 1980.

Text Books:

1. Mines act, Mine Rules, CMR,MMR,MVTC, Mine Rescue Rules, DGMS.
2. Legislation in Indian Mines: A critical appraisal, Rakesh and S. D. Prasad, Mrs Asha Lata Varnasi, 5th edition, Vol I & II.

Reference Books:

1. Proceeding of the National Seminar on Policies, A. K. Ghosh, S. K. Ray and A. K. Patra, Statutes & Legislation in Mines, CIMFR, Dhanbad.
2. Mineral Concession Rules 1960, V. K. Malhotra, Malhotra Bros., Patna, Supplementary Edition.

Web Links:

1. https://mines.gov.in/writereaddata/UploadFile/MMDR%20Act,1957.pdf
2. https://dgms.gov.in.