Major Core Courses (MCC)										
Course Code	**Course Name**	**Level**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**	**Pre-requisite**
2501MA01	Linear Algebra & Calculus	FC	2	1		3	50	50	100	-
2501MA02	Differential Equations & Vector Calculus	FC	2	1		3	50	50	100	-
2501PH01	Solid State Physics	FC	2		1	3	50	50	100	-
2501CH01	Engineering Chemistry	FC	2		1	3	50	50	100	-
2501ME01	Engineering Graphics	FC	1		2	3	50	50	100	-
2501ME03	Engineering Workshop	FC			1	1	100	-	100	-
2501ME02	Engineering Mechanics	FC	2	1	1	4	50	50	100	-
2501ME04	Engineering Thermodynamics	IC	2	1		3	50	50	100	SSP/ MP
2501MA03	Integral Transforms & Applications of Partial Differential Equations	IC	2	1		3	50	50	100	LAC
2501MA04	Numerical Methods & Statistical Techniques	IC	2	1		3	50	50	100	ITAPDE
2501ME05	Fluid Mechanics & Hydraulic Machines	IC	2	1	1	4	50	50	100	SSP
2501ME06	Material Science and Deformation	IC	2		2	4	50	50	100	EC
2501ME07	Manufacturing Process-I	IC	2		2	4	50	50	100	EW
2501ME08	Automobile Engineering	IC	3		1	4	50	50	100	SSP
2501ME09	Kinematics of Machinery	IC	2	1	1	4	50	50	100	EM
2501ME10	Internal Combustion Engine	IC	2		2	4	50	50	100	ETD
2501ME11	Manufacturing Process-II	IC	2		2	4	50	50	100	MP – I
2501ME12	Heat Power Engineering	IC	2	1		3	50	50	100	ETD
2501ME13	Machine Design	IC	2	1		3	50	50	100	EG
2501ME14	Computer Aided Machine Drawing (CAMD)	IC			3	3	50	50	100	MD
2501MB01	Engineering Economics & Management	IC	2			2	50	50	100	-
2501ME15	Mechatronics	IC	3		1	4	50	50	100	MP-I

2501ME16	Heat Transfer	AC	2	1	1	4	50	50	100	HPE
2501ME17	Dynamics of Machinery	AC	2	1	1	4	50	50	100	KOM
Total			**45**	**12**	**23**	**80**				

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

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/

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

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

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

Additional Practice:

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 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 Thermodynamics

Course Code: 2501ME04	L	T	P	C
	2	1	0	3

Course Outcomes:

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

- **CO1:** Apply thermodynamic concepts to analysis of energy system.
- **CO2:** Apply the first law of thermodynamics for closed and open systems.
- **CO3:** Apply the second law of thermodynamics and principle of entropy for the engineering system.
- **CO4:** Anlayse the properties of pure substances.
- **CO5:** Explain the working of various refrigeration system and psychrometric process

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	-	-	-	-	-	-	-	-	-

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: System, boundary, Surrounding, control volume, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi static Process, Irreversible Process, Causes of Irreversibility, Forms of energy, presure, work and heat transfer, temperature and the Zeroth Law of thermodynamics.

UNIT - II

First Law of Thermodynamics: Energy analysis of closed and open system, energy analysis of steady flow devices – Nozzle, Diffusers, Turbine, Compressor, and Throttle. Limitation of first law of thermodynamics.

UNIT – III

Second Law of Thermodynamics: Heat engine and reversed heat engine, Statements of second law (Kelvin-Planck and Clausius Statement) and their equivalence, PMM-II, Carnot's principle, Carnot cycle and its specialties, Thermodynamic Temperature Scale, Thermodynamic scale of Temperature, Entropy, Clausius Inequality, The increase in entropy principles – Energy Equation, Reversibility and Irreversibility – Thermodynamic Potentials,

Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

UNIT – IV

Properties of Pure Substances: Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy transfer.

UNIT – V

Introduction to Refrigeration: Properties of the regrigerents Working of Air Refrigeration System, Vapour Compression Refrigeration System, Coefficient of performance (COP), Refrigerants.

Introduction to Air Conditioning: Psychrometric properties & Psychrometric process - adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing.

Text Books:

1. Engineering Thermodynamics, P.K. Nag, Tata McGraw Hill Publishers, 6th Edition, ISBN: 9789352606429.
2. Thermodynamics: An Engineering Approach, Cengal, Y.A and Boles, M.A, McGraw Hill, 5th Edition, ISBN: 0073107689.

Reference Books:

1. Treatises on Heat Engineering, V.P.Vasandhani & D.S Kumar, Metropolitan Book Depot, 4th Edition, ISBN: 9788120003507.
2. Engineering Thermodynamics, Mayhew and Rogers, Longman Green & Co Ltd., 4th Edition, ISBN: 0582045665.

Web Links:

1. https://archive.nptel.ac.in/courses/112/106/112106310/
2. https://archive.nptel.ac.in/courses/112/104/112104113/
3. https://ocw.mit.edu/courses/3-00-thermodynamics-of-materials-fall-2002/download/

Integral Transforms & Applications of Partial Differential Equations
(Common to CE & ME)

Course Code: 2501MA03	**L**	**T**	**P**	**C**
	2	**1**	**0**	**3**

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

CO1: Compute Laplace transform of a function.
CO2: Apply Laplace transform to solve initial value problems.
CO3: Compute the Fourier series of a function.
CO4: Compute the Fourier transform of a function.
CO5: Apply method of separation of variables for solving Heat and Wave equations.

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
Laplace Transforms: Laplace transforms of standard functions, Properties of Laplace Transformations, laplace transform of Unit step function, Dirac delta function, Periodic function (without proof), Evaluating improper integrals of the type $\int_0^\infty f(t)\,dt$ using Laplace Transform.
Practice (Using any computational tool): Find Laplace transform of elementary functions.

UNIT – II
Inverse Laplace Transforms: Inverse Laplace transforms of functions, First shifting theorem, Convolution theorem (without proof), Second shifting theorem. Solving initial value problems and integro-differential equations using Laplace transforms.

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
Applications of PDE: Classification of second order P.D.E - Method of separation of Variables- Solution of One dimensional Wave equation, Heat equation and two-dimensional Laplace equation.

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. Higher Engineering Mathematics, H. K. Dass, Er. R. Verma, S-Chand publishers, 3rd edition 2023.ISBN 9788121938907.
2. Advanced Engineering Mathematics, E. Kreyszig, John Willey & Sons,10th Ed., 2018. ISBN 978-0470458365

Web Links:

1. https://nptel.ac.in/courses/111105123/
2. https://nptel.ac.in/courses/111105093/
3. https://www.khanacademy.org

Numerical Methods & Statistical Techniques

(Common to CE & ME)

Course Code: 2501MA04	L	T	P	C
	2	1	0	3

Course Outcomes:

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

- **CO1:** Apply numerical methods to solve the equations and interpolate the polynomials.
- **CO2:** Apply numerical methods to solve problems involving differentiation, integration and initial value problems.
- **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	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

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

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

Sampling Theory: 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. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 5th Edition (9th reprint), 2021· ISBN 978-8184875607
2. Miller and Freund's, Probability and Statistics for Engineers, 9/e, Pearson, 2020. ISBN 978-9353945237.

Reference Books:

1. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K.Kapoor, 12th edition, Sultan Chand & Sons Publications, 2020.ISBN 978-9351611738.
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/noc21_ma74/preview
4. http://mathworld.wolfram.com/topics/ProbabilityandStatistics.html
5. https://www.khanacademy.org/math/statistics-probability

Fluid Mechanics & Hydraulic Machines

Course Code: 2501ME05	L	T	P	C
	2	1	1	4

Course Outcomes:

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

- **CO1:** Explain the fluid properties and calculate buoyancy forces
- **CO2:** Explain different types of fluid flow.
- **CO3:** Apply Bernoulli's equation in fluid flow.
- **CO4:** Demonstrate boundary layer theory for fluid flow.
- **CO5:** Explain the working principle of turbines and pumps.

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
CO2	2	3	-	-	-	-	-	-	-	-	-
CO3	2	3	-	-	-	-	1	1	1	-	-
CO4	2	3	-	-	-	-	1	1	1	-	-
CO5	3	2	-	-	-	-	1	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

Fluid Statics: Introduction: Fluids and continuum, Importance of fluid mechanics in various engineering fields, Properties of fluids – Mass, Density, Specific weight, Specific volume, Specific gravity, Surface tension, Viscosity, Newton's law of viscosity, Newtonian and non - Newtonian fluids, Vapor pressure and their influence on fluid motion, Methods of pressure measurement. Buoyancy and Flotation: Meta center, Stability of floating body, Submerged bodies, Calculation of metacentric height, Stability analysis and applications.

UNIT – II

Fluid Kinematics: Preliminaries of Eulerian and Lagrangian description of fluid flow, Streamline, Path line, Streak lines and Stream tubes, stream function and velocity potential function. Types of fluid, Classification of fluid flows - Steady and unsteady, Uniform and non-uniform, Laminar and turbulent, Rotational and irrotational, Principle of conservation of mass – equation of continuity for a one-dimensional flows, stream tube for unsteady three dimensional flow, Deformation of a fluid particle – linear and angular deformation and rotation.

UNIT – III

Fluid Dynamics: Principle of conservation of linear momentum, Various forces acting on a fluid element, Euler's and Bernoulli's equation for flow along a stream line, Practical applications of Bernoulli's equation, Momentum equation and its applications for pipe bend

problem, Fundamental dimensions, Dimensional homogeneity, Rayleigh's method and Buckingham Pi theorem, Dimensionless numbers and its physical significance.

Practice:

1. Determine the co-efficient of discharge of a Venturi meter.
2. Determine the co-efficient of discharge of an Orifice meter.
3. Determine the velocity of flow at any point in a pipe using Pitot tube.

UNIT – IV

Closed Conduit Flow: Reynolds number, Reynolds experiment, Darcy–Weisbach equation, Minor losses in pipes, Pipes in series and pipes in parallel, Total energy line, Hydraulic gradient line. Concept of Boundary Layer Theory: Growth of boundary layer over a flat plate and definition of boundary layer thickness, displacement thickness, momentum thickness and energy thickness, laminar and turbulent boundary layers, laminar sub layer, velocity profile, calculation of drag, boundary layer separation.

Practice:

1. Determine the major losses in pipes.
2. Determine the minor losses in pipes.

UNIT – V

Introduction to Hydraulic Machine: Turbines: Classification of turbines–Impulse and reaction turbines, Working principle of Pelton wheel, Francis turbine and Kaplan turbine, Draft tube theory and its function, Pump: Types of pump, Working principle of centrifugal pump and reciprocating pump, Characteristics of pumps, Comparison between centrifugal and reciprocating pump.

Practice:

1. Determine the performance of centrifugal pump.
2. Determine the performance of reciprocating pump.
3. Determine the efficiency of pelton wheel.
4. Determine the efficiency of francis turbine
5. Determine the efficiency of kaplan turbine

Text Books:

1. Fluid Mechanics and Hydraulic Machines, R. K. Bansal, Laxmi Publications (P) Ltd., 10th Edition, ISBN 978-8131808153
2. Hydraulics and Fluid mechanics including Hydraulics machines by P. N. Modi & S. M. Seth, Rajsons publications Pvt. Ltd, Standard Book House, 22nd Edition, 2019, ISBN 9788189401269

Reference Books:

1. Fluid Mechanics and Hydraulic Machines: In SI units, R. K. Rajput, S. Chand & Company Ltd, 6th Edition, ISBN 978-9385401374
2. Fluid Mechanics and Hydraulic Machines, Mahesh Kumar, Pearson, 1st Edition, 2019, ISBN 9789353433697

Web Links:

1. https://archive.nptel.ac.in/courses/112/105/112105182/.
2. https://nptel.ac.in/courses/112/105/112105183/.
3. https://ocw.mit.edu/courses/16-01-unified-engineering-i-ii-iii-iv-fall-2005-spring-2006/resources/learningobjectives/.

Material Science and Deformation

Course Code: 2501ME06	L	T	P	C
	2	0	2	4

Course Outcomes:

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

- **CO1:** Explain the concepts of structure of metals and mechanical behavior under different loading conditions.
- **CO2:** Apply the concept of basic knowledge for failure of material due to Fatigue, Failure and Creep.
- **CO3:** Determine the shear force and bending moment diagrams for beams of various loads.
- **CO4:** Analyze the phases of iron- iron carbide equilibrium diagram
- **CO5:** Analyze the microstructure of heat treated steel and CI

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	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	1	1	1	-	-
CO4	2	2	-	-	-	-	1	1	1	-	-
CO5	2	2	-	-	-	-	1	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	3	-
CO4	2	-
CO5	2	-

UNIT – I

Mechanical Properties of Materials: Elastic and plastic behaviour, Isotropic and anisotropic properties dislocation mechanics, slip system, hardening, Strain-rate and temperature dependence of flow stress, super-plasticity, Mechanical Twining, Types of stresses & strains, Hooke's law, Stress & Strain relationship and diagrams for different materials, Working stress, Factor of safety, Lateral strain, Poisson's ratio & volumetric strain, Elastic moduli and their relationship

Practice:

1. To conduct tension test on Mild steel bar.
2. To determine the compression strength on a cube.

UNIT – II

Fracture, Fatigue, Creep: Modes of fractures, Evolution of fracture models, ultimate failure, Microstructural mechanisms of fracture strengthening.

Significance of fatigue test, stress cycles, S-N curve, mechanism of fatigue failure, Creep - dependent plasticity, Creep testing: The creep curve, creep properties of metals. Stress-rupture test, deformation and fracture at elevated temperature, theories of creep.

UNIT – III

Shear Force and Bending Moment: Definition of beam, Types of beams, Concept of shear force and bending moment. S.F and B.M diagrams for cantilever, simply supported subjected to point load, uniformly distributed load & uniformly varying load, Point of contra flexure, Theory of simple bending, Torsion equation.

Practice:

1. To conduct bending test on Simple supported beam & Cantilever beam.
2. To determine Modulus of rigidity of given specimen by conducting Torsion test on circular shafts.

UNIT – IV

Phase Diagrams: Phase rule, Isomorphous alloy systems, Equilibrium cooling and heating of alloys. Lever rule, Nucleation and Crystal growth, Study of important binary phase diagrams of Cu-Ni, Al-Cu, Iron-carbon phase diagram.

Practice:

1. To study the Microstructures of Al.
2. To study the Microstructures of Cu.

UNIT – V

Heat Treatment: Types of steels, low, medium and high carbon steels, stainless steels, alloy steels and their applications. Annealing, normalizing, hardening, tempering, surface hardening; Cast irons, types- white, grey, malleable and nodular, Properties and applications of cast irons.

Ceramic:

Ceramics, Glasses, Cermets - Definition, Properties and Applications.

Practice:

1. To study the Microstructures of Heat-treated steels.
2. To study the Microstructure of Mild steels.
3. To study the Microstructures of Cast Irons.

Text Books:

1. Materials Science and Metallurgy, V.D. Kodgire, Everest Publishing House, 39th Edition, ISBN 978-8176314008.
2. Strength of Materials, Sadhu Singh, Khanna Publication, 11th Edition, ISBN 978-81-7409-048-5.

Reference Books:

1. Materials Science and Engineering-An Introduction, W. D. Callister, Wiley India, 6th Edition, ISBN 978-0471135760
2. Mechanics of Solids, E.P. Popov, Pearson, 2nd Edition, ISBN 978-9332550216

Web Links:

1. https://archive.nptel.ac.in/courses/113/106/113106101/
2. https://onlinecourses.nptel.ac.in/noc22_mm25/preview
3. https://ocw.mit.edu/courses/3-35-fracture-and-fatigue-fall-2003/download/

Manufacturing Process - I

Course Code: 2501ME07	L	T	P	C
	2	0	2	4

Course Outcomes:

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

- **CO1:** Elaborate the fundamental principles of casting process.
- **CO2:** Classify the various joining process with applications
- **CO3:** Discuss the basic concepts of metal forming techniques
- **CO4:** Explain the basic concepts of forging techniques.
- **CO5:** Explain the basic concepts of plastic processing techniques and powder metallurgy

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	-	2	1	-	-
CO2	2	1	2	-	-	1	-	2	1	-	-
CO3	2	2	1	-	1	1	-	2	1	-	-
CO4	2	2	1	-	1	1	-	2	1	-	-
CO5	2	2	1	-	1	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: Introduction to manufacturing process, Classification and Overview of Manufacturing Processes. Introduction to Metal Casting, Casting design considerations, Sand casting process- Casting Terminology, Types of Patterns, Pattern Materials and Pattern Allowances, Classifications of Moulds, moulding materials and their properties, Core, Gating system and its Design, Riser and its design, Foundry furnaces, Solidification of pure metals and alloys, Casting defects and remedies, Advanced casting processes, advantages and applications.

Practice:

1. To design and manufacture a Wooden Pattern for a given Casting.
2. To prepare a Casting for the given Solid Pattern & Split Pattern using Green Sand Moulding Processes.

UNIT – II

Metal Joining: Introduction, Classification of Welding Processes, Gas Welding & Cutting , Arc Welding-Theory of heat generation, ISI classification of coated electrodes, SMAW,GTAW,GMAW- SAW,LBW,EBW,UW, Resistance welding, Solid state welding processes, Hybrid Welding Processes, Brazing, Soldering and their applications, HAZ, characteristics of weldment, Welding Defects and Remedies.

Practice:

1. To prepare Lap Joint, V Butt, corner Joint, T Joint using Gas Welding, Arc Welding, GMAW, Resistance Spot Welding machine.
2. To prepare a Single Strap Butt Joint on the given work pieces using spot welding equipment.

UNIT – III

Sheet Metal Work: Sheet Metal Operations, Yield criteria, Plastic deformation of metals, Tools and Equipment in SMW, Deep drawing.

Forming : Hot working and Cold working, Rolling and its types, Embossing, Thread rolling, Tube Piercing, Hot spinning, Defects in metal working, Wire Drawing, Tube drawing. High Energy rate Forming (HERF) processes

Practice:

1. To perform the punching, blanking and deep drawing operation on hydraulic press.

UNIT – IV

Forging: Introduction Forging, Forging dies, Forging operations, Forging Process, Hand Forging, Power Forging, Impression Die Forging, Press Forging, Upset forging, Forging Defects and Remedies.

UNIT – V

Plastic Processing: Types of Plastics, Properties, Applications, and their processing methods, Blow molding and Injection molding.

Powder Metallurgy: Powder production methods, compaction, and sintering. Applications of powder metallurgy. Advantage and Disadvantage of Powder Metallurgy in comparison to Conventional Shaping process.

Practice:

1. To prepare a plastic bottle and its cap by using Blow Molding.
2. To prepare a plastic bottle cap, Jewellery box by using Injection Moulding

Text Books:

1. Manufacturing Engineering and Technology, Kalpakjain S, Schmid S.R., Pearson Education, Delhi, 7th Edition 2018, ISBN 978-9332587908.
2. Fundamentals of Modern Manufacturing, Groover Mikell P, John Wiley and Sons Inc,7th Edition,2018, ISBN 978-1119722014.

Reference Books:

1. Manufacturing Science, A. Ghosh & A.K. Mallik, East West Press Pvt. Ltd Publication, 3rd Edition, ISBN 978-8176710633.
2. Manufacturing Processes, H.S. Shan, Cambridge University Publication, 2nd Edition, ISBN 978-1316638583.
3. Process and materials of manufacture, Lindberg, PHI Publications, 4thEdition, ISBN 978-8120306639.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc25_me16/preview
2. https://onlinecourses.nptel.ac.in/noc25_me51/preview
3. https://archive.nptel.ac.in/courses/113/106/113106098/

Automobile Engineering

Course Code: 2501ME08	L	T	P	C
	3	0	1	4

Course Outcomes:

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

- **CO1:** Summarize the Vehicle Chassis Layouts of 4-wheelers
- **CO2:** Identify the different constructional features and working principles of Un-Sprung components of the given vehicle
- **CO3:** Identify the different constructional features and working principles Sprung components of the given vehicle.
- **CO4:** Summarize the functionalities of various Electrical systems of typical Automobile
- **CO5:** Explain the different Active and Passive Vehicle Safety Systems.

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	2	1	-	1
CO2	3	-	-	3	-	-	1	2	1	-	1
CO3	2	-	-	-	-	-	1	2	1	-	1
CO4	3	1	1	-	-	-	1	2	1	-	1
CO5	3	1	1	-	-	1	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	-

UNIT – I

Introduction: History of Automobile and introduction to Autombile Industry, Chassis Layouts : Components of four wheeler automobile – chassis and body - power transmission modes, Front Axle & its types and Homologation of Vehicles.

UNIT – II

Transmission: Clutches, Gear Box, Propeller shaft, Rear Axles and its Types, Differential and its applications. Steering System: Steering geometry – Types of of steering mechanism steering linkages of Independent and Conventional Suspension.

Practice:

1. Demonstration of Clutch working Principle and types of Clutches
2. Demonstration of Conventional and Power Steering and types of Steering systems

UNIT – III

Suspension System: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system, Air Suspension, Rubber Suspension, Hydrolastic suspension system, Hydragas suspension system.

Braking System:

Mechanical braking system, hydraulic braking system requirement of brake fluid.

Practice:

1. Demonstration of Conventional and Independent Suspension System
2. Demonstration of Shock absorber
3. Demonstration of Mechanical Braking system
4. Demonstration of Hydraulic Braking system

UNIT – IV

Wheels and Tyres: Basic Requirements of Wheels and Tyres, Construction of Wheel Assembly, Tyre Construction, Types, Tyre Sizes and Designation, Aspect Ratio, Tyre Tread Pattern, Selection of Tyre under Different Applications.

Practice:

1. Demonstration of constructional features and its importance of different tyres
2. Demonstration of constructional features and its importance of different wheels

UNIT – V

Electrical System: Charging circuit, generator, starting system, lighting, horn, wiper, fuel gauge, oil pressure gauge, engine temperature indicator.

Safety Systems: Introduction, safety systems - seat belt, air bags, bumper, anti-lock brake system (ABS), Electronic Brake force Distribution (EBD), mirrors, central locking, speed control, Retractable Steering system, Head restraints, seats with anti-submarine effects and fuel cut off switch.

Practice:

1. Demonstration of wiring harness of typical Automotive Vehicle
2. Demonstration of Active and Passive Safety systems of an Automotive vehicle

Text Books:

1. Automobile Engineering, Kirpal Singh, Vol- I, Standard Publisher, New Delhi, 2020, ISBN: 9788180142520.
2. Motor Vehicles, Newton Steeds and Garret, Butterworth, 13th Edition, ISBN : 0750637633.

Reference Books:

1. Modern Vehicle Technology, Heinz Hazler, Butterworth, London, 2nd edition, ISBN : 0750651318.
2. Automotive Chassis, Heldt P.M., Chilton Co., New York, 2012, ISBN: 1258386380.

Web Links:

1. https://archive.nptel.ac.in/courses/107/106/107106088/
2. https://www.udemy.com/course/automotive-engineering-automobile-fundamentals-and-advanced/?couponCode=LEADERSALE25A

Kinematics of Machinery

Course Code: 2501ME09	L	T	P	C
	2	1	1	4

Course Outcomes:

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

- **CO1:** Apply the knowledge of mechanisms in real time applications
- **CO2:** Construct the velocity and acceleration diagrams using relative velocity method and instantaneous centre method.
- **CO3:** Calculate the velocity and acceleration of follower motions and construct the cam profile.
- **CO4:** Calculate the velocities of different components of a compound and epicyclic gear trains.
- **CO5:** Construct the turning moment diagram of engine and flywheel.

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	2	-	-	-	-	-	2	1	-	-
CO2	2	2	-	-	-	-	-	2	1	-	-
CO3	2	2	-	-	-	-	-	2	1	-	-
CO4	3	2	-	-	-	-	-	2	1	-	-
CO5	3	2	-	-	-	-	-	2	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

Elements of Kinematics: Classification of Mechanisms-Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain -Limit positions- Mechanical advantage- Description of common mechanisms- Inversions of 4-bar chain: Crank and Slotted Lever mechanism, Quick Return Motion mechanism, Davis and Ackermann Steering gear mechanisms, Hooke's joint.

Practice:

1. Study of Four bar Chain mechanism

UNIT – II

Velocity and Acceleration Analysis: Plane motion of a rigid body: Instantaneous centre of rotation, centrode and axode - Relative motion between two bodies – Kennedy's Theorem – Graphical determination of instantaneous centre for Four bar and Single Slider Crank chain mechanisms, Determination of Angular Velocity of points and links. Motion of a Link in Machine - Determination of Displacement, Velocity and Acceleration for a Four Bar Mechanism, Single Slider Crank chain mechanism, Double Slider Crank chain mechanism.

Practice:

1. Plot slider displacement, velocity, and acceleration against crank rotation for single slider crank mechanism/Four bar mechanism.

UNIT – IV

Power Transmission: Introduction –Modes of Power Transmission applications. Gears and Gear Trains- Classification, Terminology, Law of Gearing, Path of contact, Arc of contact. Interference, Methods of avoiding interferences. Simple gear train, Compound gear train, reverted gear train, epicyclic gear train and Differential. Table method to find velocity of components of a gear train

Practice:

1. Measurement of Gear parameters using Gear tooth vernier.

UNIT – V

Turning Moment Diagrams: Static and dynamic force analysis of planar mechanisms, Dynamic force analysis of slider crank mechanism, Inertia Torque, Angular Velocity and Acceleration of connecting rod, Crank Effort and Turning Moment Diagrams – Fluctuation of energy – Fly Wheel design.

Practice:

1. Find the moment of inertia of a flywheel.

Text Books:

1. Theory of machines, S.S.Rattan, Tata Mc Graw Hill, 5th Edition, 2019, ISBN: 9789351343479.
2. Theory of machines, Thomas Bevan, CBS Publishers, 3rd Edition, ISBN: 9788123908748.

Reference Books:

1. Theory of machines: Kinematics and Dynamics , Sadhu Singh, 3rd Edition, Pearson Publisher, 2011, ISBN: 9788131760697.
2. Theory of machines, R.K.Bansal, J.S.Brar, Laxmi Publications, 6th Edition, ISBN: 9788131808054.

Web Links:

1. https://archive.nptel.ac.in/courses/112/104/112104121/

Internal Combustion Engine

Course Code: 2501ME10

L	T	P	C
2	0	2	4

Course Outcomes:

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

- **CO1:** Differentiate the ideal, air standard cycles and actual thermodynamic cycles
- **CO2:** Evaluate the Engine performance based on the experimental data.
- **CO3:** Analyze the fueling system and combustion behavior of SI engine
- **CO4:** Analyze the fueling system and combustion behaviour of CI engine
- **CO5:** Explain the formation of emissions and its control strategies of both SI & CI Engines

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	2	1	-	1
CO2	3	3	-	3	-	-	1	2	1	-	1
CO3	3	3	-	-	-	-	1	2	1	-	1
CO4	3	3	-	-	-	-	1	2	1	-	1
CO5	3	2	3	-	-	2	1	2	1	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	3
CO2	1	3
CO3	1	3
CO4	1	3
CO5	-	3

UNIT – I

Actual Cycles & their Analysis: Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blow down-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines; Basics of Lubrication and Cooling systems, Introduction to Supercharging and turbocharging.

Practice:

1. Draw & Study the Valve Timing Diagrams for Four Stroke Diesel Engine. (Cut Section Model).
2. Draw & Study the Port Timing Diagrams for Two Stroke Petrol Engine. (Cut Section Model).

UNIT – II

Engine Performance: Brake Power, Indicated Power, Frictional Power, Fuel consumption, BSFC, BSEC, different efficiencies, Mean Effective Pressure, and Methods to calculate the frictional power in diesel engines, Stoichiometric analysis of different fuels.

Practice:

1. Evaluate the Performance of 4 -Stroke Petrol & Diesel Engine
2. Evaluate the frictional Power using Wilian's Line Method and Morse test
3. Draw the Heat Balance Sheet for a Diesel Engine

4. Evaluate influence of varying the compression ratio on performance of a diesel engine

UNIT – III

Gasoline Fuel injection and Combustion Characteristics: Multi-point Injection system-Gasoline Direct Injection – GDI Pumps and Fuel Injectors Flexi fuel engines- Pre-mixed charge combustion, abnormal combustion - Detonation/ Knocking, factors influencing the abnormal combustion and its control.

Practice:

1. Demonstration of MPFI and GUI Pump of a Petrol Engine
2. Evaluate the Combustion Characteristics (P- ɵ, Heat Release Rate, Ignition delay, MassFraction burned of a Petrol Engine)

UNIT – IV

Diesel Fuel injection, Combustion Characteristics & Low Temperature Combustion modes: Fuel Atomization and Droplet size distribution, Sauter Mean Diameter calculations, Spray Penetration. Fuel Injection Pumps, Injector. Types of Combustion Chambers, Diesel Combustion Process Characterization: Effect of Engine and Operational Parameters on Delay, Pre-mixed Combustion, Mixing Controlled Combustion. Multi Pulse Injections, Dual fuel technologies - Introduction to Low Temperature Combustion - Homogeneous Charge Compression Ignition (HCCI), Fuel Stratified Charge combustion/ Reactivity Controlled Compression Ignition (RCCI) Technologies, Pre-mixed Charge Compression (PCCI).

Practice:

1. Demonstration of Fuel Spray Pattern using different Fuel Injectors
2. Evaluate the Combustion Characteristics (P- ɵ, Heat Release Rate, Ignition delay, Mass Fraction burned of a Diesel Engine
3. Evaluate the different Low Temperature Combustion Strategies (at least Two)

UNIT – V

Engine Emission Formation & Control Strategies(SI & CI): Sources of Engine emissions: Formation of CO, NO, UBHC, Soot and Particulate Matter. Diesel NOx-Particulate Trade off: Effect of SI Design and operating variables: Effect of Diesel Engine Design and operating Variables. SI Engine Emission Control Technology: CI Engine Emission Control Technology: Exhaust Gas Recirculation, Diesel Particulate Filter, Selective Catalyst Reduction and Diesel Oxidation Converter, Lean NOx Trap (LNT).

Practice:

1. Measuring and Analysis of Petrol Engine Emissions using 4Gas/5- Gas Analyser with and without Catalytic Converter
2. Demonstration of cut- Sectional Models of Exhaust Gas Recirculation, Selective Catalyst Reduction, Diesel Particulate Filter and Diesel Oxidation Converter.
3. Measuring and Analysis of Diesel Engine Emissions using Smoke Meter with and without Exhaust Gas Recirculation, Selective Catalyst Reduction, Diesel Particulate Filter and Diesel Oxidation Converter.

Text Books:

1. Internal Combustion Engine, M.L. Mathur & R.P. Sharma, Dhanpat Rai Publications, 4th Edition, ISBN 978-9383182528

2. IC Engine Combustion & Emissions by B.P. Pundir, Narosa Publications, 4th Edition, 2020, ISBN 978-8184870879

Reference Books:

1. Internal Combustion Engines Fundamentals, John B. Heywood, , Mc Graw Hill Publications, 2nd Edition, 2018, ISBN 9781260116106
2. Engineering Fundamentals of I C Engines, Wiliard W. Pulkrabek, Prentice Hall Publications, ISBN 9780131405707

Web Links:

1. https://nptel.ac.in/courses/112104033
2. https://ocw.mit.edu/courses/2-61-internal-combustion-engines-spring-2017/
3. https://teaching.eng.cam.ac.uk/content/engineering-tripos-part-iib-4a13-combustion-ic-engines-2018-19

Manufacturing Process - II

Course Code: 2501ME11	L	T	P	C
	2	0	2	4

Course Outcomes:

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

- **CO1:** Explain the principles of metal cutting.
- **CO2:** Demonstrate the conventional machining processes such as turning, milling, shaping, slotting and planning.
- **CO3:** Demonstrate the principles and applications of milling, drilling and boring operations.
- **CO4:** Demonstrate the principles of abrasive machining process using grinding machine.
- **CO5:** Demonstrate the principles of modern machining processes such as CNC and advanced machining processes.

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	3	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	2	2	-	-
CO3	2	2	-	-	-	-	-	2	2	-	-
CO4	2	1	-	-	-	-	-	2	2	-	-
CO5	2	2	-	-	2	-	-	2	2	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Theory of Metal Cutting: Introduction to machine tool, Geometry of Single Point Cutting tool, Mechanics of metal cutting, Tool angles, Chip formation, Types of chips, Cutting fluids, Tool Material Property. Tool nomenclature-ASA, ORS & NRS systems, Orthogonal and Oblique cutting, Feed, Depth of Cut, Tool Life Equation, Tool Wear, Machinability, Merchant circle diagram, Coolants.

UNIT – II

Lathe Machine: Introduction, Principle, Specifications, Accessories, Workholders, Tool holders, Thread turning, Attachments, Constructional features of speed and feed gear box. Turret and capstan lathes, Features of automatic lathes, Classification, Single spindle and multi-spindle automatic lathes, Applications

Shaping, Slotting and Planning Machine: Principles, Parts, Specifications, Operations performed, applications, Machining time calculations.

Practice:

1. Step turning, Taper turning, Thread cutting and Knurling using lathe machine.
2. Shaping of Vgroove using shaping machine.
3. Slotting of a keyway using slotting machine.

4. Eccentric Turning using lathe machine.

UNIT – III

Milling Machine: Principle, Classification, Features of Horizontal,Vertical and Universal milling machine, Up & Down Milling, Types of milling cutters & geometry, Indexing: Simple and compound, Accessories of milling machines, Gear manufacturing processes-hobbing, Applications.

Drilling Machine: Principles,Types, Operations performed, Tool holding devices, Twist drill, Drilling related operations: Reaming, Boring and Tapping.

Practice:

1. Cutting Spur gear using milling machine.
2. Drilling and Tapping operations using drilling machine.

UNIT – IV

Abrasive Machining Process: Grinding Machine: Principle, Classification, Cylindrical and surface grinding, tool and cutter grinding machine, Types of abrasives, Bonds, Specification and selection of a grinding wheel, Applications

Practice:

1. Grinding of Flat surfaces using Surface Grinding Machine.
2. Grinding of HSS Tool using Tool and Cutter grinder.
3. Finishing the component using hand grinder.

UNIT – V

Modern Machining Processes: CNC Machines: Principle, Classification, Features of CNC machines, 3-axis and 5-axis CNC machines, CNC controller, CNC programming, Applications of CNC machines.

Advanced Machining Processes: Introduction, Principle, Applications, Advantages and Disadvantages, Types, Electron Beam Machining (EBM), Electrical Discharge Machining (EDM) & Abrasive Jet Machining (AJM). Introduction to industry 4.0 & 5.0

Practice:

1. CNC programming for turned components using FANUC Controller.
2. CNC programming for milled components using FANUC Controller.
3. Automated CNC Tool path & G-Code generation using Pro-E/Master CAM.

Augmented Experiments:

1. Drilling, Boring and Internal threading on Lathe machine and Gang Milling on Milling machine
2. Gear tooth thickness measurement using gear tooth vernier calipers

Text Books:

1. Production Technology (Manufacturing Process, Technology & Automation), R.K. Jain, Khanna Publishers, 17th Edition, ISBN 9788174090997

2. Elements Of Workshop Technology Vol 2 Machine Tools, S. K. Hajra Choudhury, Indian Book Distributing Co. Calcutta, ISBN 978-8185099156

Reference Books:

1. Fundamentals of Metal Machining and Machine Tools, Geoffrey Boothroyd, CRC Press Inc, 3rd Edition, ISBN 978-1574446593

2. Metal Cutting Principles, Milton C. Shaw, Oxford University Press, 2nd Edition, ISBN 978-0198086116

Web Links:

1. https://archive.nptel.ac.in/courses/112/105/112105126/
2. https://ocw.mit.edu/courses/2-670-mechanical-engineering-tools-january-iap-2004/pages/tutorials/

Heat Power Engineering

Course Code: 2501ME12	L	T	P	C
	2	1	0	3

Course Outcomes:

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

- **CO1:** Apply the various techniques to improve the performance of Rankine Cycle
- **CO2:** Explain the working principle and performance of boiler and draught system
- **CO3:** Analyse the performance of Steam nozzles
- **CO4:** Analyse the performance of Impulse and Reaction Turbines
- **CO5:** Analyse the performance of Steam Condensers and Gas Turbines.

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	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Steam Power Cycles: Steam Power plant - Layout, Rankine cycle - Schematic layout, Thermodynamic analysis - Simple Cycle. Methods to improve cycle performance - Regeneration & Reheating cycle.

UNIT – II

Boiler: Classification, Working principles of low-pressure (LP) & high-pressure (HP) boilers with sketches, Boiler mountings and accessories. Performance of boiler - Equivalent evaporation - Efficiency.

Draught System: Classification – Natural and Artificial draught – Induced, Forced & Balanced draught - height of chimney for given draught and discharge - condition for maximum discharge and chimney efficiency

UNIT – III

Steam Nozzles: Function of a nozzle – applications – types, Flow through nozzles and thermodynamic analysis, assumptions, Velocity coefficient and condition for maximum discharge, Critical pressure ratio, Supersaturated flow and its effects, Degree of super saturation and Degree of undercooling, Wilson line.

UNIT – IV

Steam Turbines: Impulse turbine: Mechanical details - Velocity diagram - Effect of friction power developed, Axial thrust, Blade or diagram efficiency - condition for maximum efficiency.

Reaction Turbine: Mechanical details, principle of operation, Thermodynamic analysis of a stage, Degree of reaction velocity diagram, Parson's reaction turbine, Condition for maximum efficiency, Calculation of blade height. Compounding – Velocity, Pressure and Velocity Pressure compounding

UNIT – V

Steam Condensers: Classification - working principle, vacuum efficiency and condenser efficiency, air leakage, sources and their effects, air pump, cooling water requirement.

Gas Turbines: Simple gas turbine plant - Ideal cycle - Essential components - Actual cycle. Regeneration, Inter cooling and Reheating cycle, Merits and demerits.

Text Books:

1. Heat Engineering, V.P Vasandani and D.S Kumar, Metropolitan Book Company, 4th Edition, ISBN 978-8120003507
2. Thermodynamics and Heat Engines, R. Yadav, Central publishing house, 6th Edition, ISBN 978818544403

Reference Books:

1. Thermodynamics: An Engineering Approach, Cengel, Y. A. and Boles, M. A., Tata McGraw-Hill, 7th Edition, ISBN 978-0-07-352932-5.
2. Thermal Engineering, P.L.Ballaney, Khanna publishers, 25th Edition, ISBN 978-81-7409-031-7

Web Links:

1. https://nptel.ac.in/courses/112/106/112106303/
2. https://nptel.ac.in/courses/112103262.

Machine Design

Course Code: 2501ME13

L	T	P	C
2	1	0	3

Course Outcomes:

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

- **CO1:** Explain the steps involved in the design process and fatigue strength.
- **CO2:** Design shafts, keys and couplings as per the international standards.
- **CO3:** Design the temporary, permanent joints and curved beams.
- **CO4:** Select mechanical springs for various applications and design the engine components
- **CO5:** Calculate the design parameters of bearing and gears.

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	-	-	-	-	-	-	-	-	-	-
CO2	2	2	3	-	-	-	-	-	-	-	-
CO3	2	2	3	-	-	-	-	-	-	-	-
CO4	2	2	3	-	-	-	-	-	-	-	-
CO5	2	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 to Design: Factors influencing machine design, Selection of Materials, Direct, Bending and Torsional Stresses in Machine Elements, Factor of Safety, Design Stress, Theories of Failures.

Fatigue Strength: Fatigue Stress Concentration Factor, Size Factor, Surface Limits Factor, Variable and Cyclic Loads, S-N Curve, Gerber, Soderberg and Goodman Equations.

UNIT – II

Design of Shafts, Key & Couplings: Design of solid and hollow shafts based on strength, rigidity and critical speed, Design of Keys-Stresses in Keys, Design of Rigid and Flexible couplings.

UNIT – III

Design of Temporary and Permanent Joints: Bolted Joints, Simple and eccentrically loaded bolted joints- Welded joints – Butt, Fillet and parallel transverse fillet welds.

Design of Knuckle Joints & Curved Beam: Introduction to Knuckle Joints, Design of Knuckle Joint - Eccentric loading – curved beams – crane hook and frame only rectangular.

UNIT – IV

Design of Mechanical Springs: Stresses and Deflections of Helical Springs, Design of helical and concentric springs, Compression Springs, Helical Torsion Springs

Design of Engine Components: Introduction to IC engine components, Design of Cylinder, Design of Piston

UNIT – V

Design of Bearing: Sliding contact bearings, Design of Bearing, Selection of Bearing, Sommerfeld Number.

Design of Gear: Types of Gear, Spur Gears, Load Concentration Factor Dynamic load Factor, Surface Compressive Strength Bending Strength (Lewis equation).

Note: Design Data Book is Mandatory.

Text Books:

1. Design of Machine Elements, V.B.Bhandari, TMH Publishers, 5th Edition, 2020, ISBN: 9781259006364.
2. Machine Design, N.C.Pandya & C.S.Shaw, Charotar publishers, 21st Edition, 2022

Reference Books:

1. Shigley's Mechanical Engineering Design , McGraw-Hill Series,11th Edition, 2020, ISBN978-9390219636 : .
2. Machine Design , Robert L. Norton , Pearson Publishers, 5th Edition, 2018, ISBN :9789353062508.

Web Links:

1. https://nptel.ac.in/courses/112105125
2. https://www.me.iitb.ac.in/~ramesh/courses/ME423/me423.html

Computer Aided Machine Drawing (CAMD)

Course Code: 2501ME14	L	T	P	C
	0	0	3	3

Course Outcomes:

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

- **CO1:** Discuss the conventional representation of materials and machine components.
- **CO2:** Sketch various types of temporary fasteners.
- **CO3:** Sketch various types of permanent fasteners.
- **CO4:** Construct assembly drawings of Engine and Machine tool parts.
- **CO5:** Construct assembly drawings Valves and other machine parts.

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	-	-	-	2	-	-	2	2	-	2
CO2	2	2	-	-	2	-	-	2	2	-	2
CO3	2	2	-	-	2	-	-	2	2	-	2
CO4	2	2	-	-	2	-	-	2	2	-	2
CO5	2	2	-	-	2	-	-	2	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

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

Practice

Introduction to Machine Drawing

1. Introduction, Representation of Engineering Materials., Surface finishes tolerances
2. Standard forms of screw threads, Pins, Washers.

Part Drawing of Detachable Fasteners

1. Sketch the part Drawings of Bolts, Nuts, Stud bolts, Tap bolts, Set screws and Keys.
2. Cottered joints and Knuckle joint. Shaft coupling, spigot and socket pipe joint.

Part Drawing of Permanent Fasteners and Bearings

1. Sketch the part Drawings of Journal and pivot bearings
2. Sketch the part Drawings of Collar and foot step bearings.
3. Sketch the part Drawings of Rivetted joints, Types of welds and welded joints.

Assembly of Engine and Machine tool parts

1. Construct assembly drawings of Connecting Rod and stuffing box
2. Construct assembly drawings of Cross Head and Eccentric
3. Construct assembly drawings of Tail stock and Tool Post.

4. Construct assembly drawings of Machine Vices

Additional Practice:
Assembly of Valves and other machine parts
1. Construct assembly drawings of steam stop valve and spring-loaded safety valve
2. Construct assembly drawings of feed check valve and Air cock

Reference Books:

1. Machine Drawing, Bhatt, N.D., Charotar Publishing House, 51st Edition 2022, ISBN : 9789385039560.
2. Machine Drawing, Narayana K.L., Kannaiah. Pand Venkata Reddy K, New Age International Publishers, India, 2016, ISBN: 9788122540546.
3. Machine Drawing, Sidheswar, N., Kannaiah, P. and Sastry, V.V.S., Tata McGraw Hill Book Company, New Delhi, ISBN: 9780074603376.

Web Links:
1. https://archive.nptel.ac.in/courses/112/105/112105294/
2. https://www.coursera.org/learn/3d-cad-fundamental

Engineering Economics & Management
(Common to CE, EEE, ME, CSE, IT, AIML & CSDS)

Course Code: 2501MB01

L	T	P	C
2	0	0	2

Course Outcomes:

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

- **CO1:** Explain the Business Economic concepts, law of demand and forecasting methods.
- **CO2:** Identify the production, cost behavior for managerial decision making with Break-Even Point (BEP).
- **CO3:** Make use of financial accounting and capital budgeting techniques for decision making.
- **CO4:** Summarize management and motivational theories to renovate the practice of Management.
- **CO5:** Illustrate the functional management and project management using PERT and CPM.

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	2	-	-
CO2	1	-	-	-	-	-	-	-	-	2	-
CO3	-	-	-	-	-	-	-	-	-	3	-
CO4	1	-	-	-	-	-	-	1	1	2	-
CO5	-	-	-	-	-	-	-	-	-	3	-

UNIT – I

Introduction to Managerial Economics and Demand Analysis: Definition of Managerial Economics –Scope of Managerial Economics- Concept of Demand, Types of Demand, Determinants of Demand- Law of Demand and its limitations- Elasticity of Demand, Types- Demand forecasting and its Methods.

UNIT – II

Production and Cost Analyses: Concept of Production function Law of Variable Proportions-Isoquants and Isocosts -Producer Equillibrium, Cost concepts: opportunity costs, explicit and implicit costs- Fixed costs, Variable Costs – Cost –Volume-Profit Analysis-Determination of Breakeven point (simple problems).

UNIT – III

Introduction to Markets and Financial Accounting: Market Structures-Classification of markets,.Introduction to Financial Accounting, Concepts and conventions, Accounting cycle, Journal entries and Ledger (Simple Problems), Methods of capital budgeting (Simple Problems).

UNIT – IV

Operations Management : Concept nature and importance of Management, Generic Functions of Management, Theories of Motivation, Plant location and layout, Principles of organization, SWOT analysis.

Material Management: Need for Inventory control, EOQ, ABC analysis

UNIT – V

Functional Management and Project Management: Concept of HRM, HRD and PMIR, Functions of HR Manager, Job Evaluation and Merit Rating, Marketing Management, Functions of Marketing, Channels of distributions - Development of Network, Difference between PERT and CPM, Finding Critical Path (Simple Problems)

Text Books:

1. Managerial Economics and Financial Analysis, Dr. A. R. Aryasri, TMH, ISBN 978-0070078031
2. Managerial Economics and Financial Analysis, Dr. N. Appa Rao, Dr. P. Vijay Kumar, Cengage Publications, New Delhi, ISBN 978-8131515952
3. Management Science, Aryasri, Tata McGraw Hill, ISBN 978-0070090279
4. Management, James Arthur, Finch Stoner, R. Edward Freeman, and Daniel R. Gilbert Pearson Education/Prentice Hall, 6th Edition, ISBN 978-0131087477

Reference Books:

1. Principles of Marketing: A South Asian Perspective by Kotler Philip, Gary Armstrong, Prafulla Y. Agnihotri, and Eshan ul Haque, Pearson Education/Prentice Hall of India, 13th Edition, ISBN 9788131731017
2. A Handbook of Human Resource Management Practice, Michael Armstrong Kogan, Page Publishers, ISBN 978-1789661033

Web Links:

1. www.managementstudyguide.com
2. www.citehr.com
3. www.nptel.ac.in/courses/122106032
4. www.btechguru.com/courses--nptel--basic-course

Mechatronics

Course Code: 2501ME15

L	T	P	C
3	0	1	4

Course Outcomes:

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

- **CO1:** Explain the importance of mechatronics in the engineering field
- **CO2:** Identify the appropriate sensor and Transducers, for a given application
- **CO3:** Identify the appropriate actuation system for a given application
- **CO4:** Explain the concepts of different controllers in mechatronics
- **CO5:** Suggest a Mechatronic product design for a given application and evaluate its performance

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	-	-	-	-	-	2
CO2	2	-	-	-	1	-	-	2	2	-	-
CO3	2	-	1	-	1	-	-	2	2	-	-
CO4	2	-	-	-	1	-	-	2	2	-	-
CO5	2	-	-	-	1	-	-	2	2	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Basics of Mechatronics: Definition of mechatronics, Key elements of mechatronics system, measurement system, concepts in mechatronics, need for mechatronics systems, mechatronics systems design approach, classification of mechatronics systems, control systems, microprocessor-based controllers and emerging application areas of mechatronics.

UNIT – II

Sensors and transducers: Definition of sensor, Transducer- characteristics, Classification. Tactile sensor, displacement sensor, torque sensor, strain gauge sensor, force sensor. **Proximity sensors:** Magnetic, optical, ultrasonic, inductive, capacitive and eddy current methods.

Digital Logic: Logic gates, Boolean algebra, Karnaugh maps.

Practice:

1. Measurement of speed using Magnetic speed pick-up Sensor.
2. Draw a ladder program for logic gates
3. Characteristics of Reflective Opto Transducer.

UNIT – III

Actuators: Actuation systems, pneumatic and hydraulic systems, process control valves, rotary actuators, mechanical actuation systems, and electrical actuation systems-servo motors, dc motors, ac motors, stepper motors.

Practice:

1. Draw a series and parallel cylinders hydraulic circuit using automation studio software.
2. Draw meter-in and meter-out Hydraulic circuits using automation studio software.

UNIT – IV

Controllers: Basics of micro-processors, micro-controllers and programmable logic controllers – architecture. Basic programming and input-output devices interfacing with micro-controllers (serial, parallel, A/D and D/A). Operational Amplifiers ideal amplifiers, characteristics, integrators and differentiators, filters, and analogue computers.

Practice:

1. Characteristics of Summing Amplifier

UNIT – V

Case Studies: Robotics and automation in manufacturing and process industries. Mechatronics control in automotive, prosthetics, artificial limbs, pick and place Robot, CNC Machine, Agriculture and energy systems, Automated car parking systems, Automated Washing Machine System, and Automated Traffic signal Method.

Practice:

1. Draw a ladder program for a traffic light control system.
2. Draw a Ladder program for Conveyor control system.

Text Books:

1. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Bolton, Pearson education, 4rd Edition, ISBN 978-8131732533
2. Introduction to mechatronics and measurement systems, David G. Alciatore, Michael B. HI stand, McGraw-Hill Professional, 2nd Edition, ISBN 978-0071195577

Reference Books:

1. A course in Electrical and Electronic Measurement and Instrumentation, A.K.Sawhney, Dhanpat Rai & Sons, ISBN 978-8177001006
2. Mechatronics, Nitaigour Premchand Mahalik, Tata McGraw-Hill, ISBN 978-0070483743

Web Links:

1. https://onlinecourses.nptel.ac.in/noc25_me13/preview
2. https://www.spiceworks.com/tech/it-careers-skills/articles/what-is-mechatronics-engineering/

Heat Transfer

Course Code: 2501ME16	L	T	P	C
	2	1	1	4

Course Outcomes:

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

- **CO1:** Analyze heat transfer, conduction in different geomentries and transient conduction.
- **CO2:** Apply dimentsional analysis to convective heat transfer.
- **CO3:** Apply free and foreced convection principles for heat transfer in plate, cylinder and pipes.
- **CO4:** Explain heat exchangers, boiling and condensation using heat transfer methods.
- **CO5:** Explain radiative heat transfer & heat exchange between black & gray bodies.

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	-
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

Conductive heat transfer: Modes and mechanism of heat transfer, Fourier rate equation – general heat conduction equation in Cartesian and cylindrical coordinates, heat transfer through homogeneous slabs, hollow cylinders and spheres, overall heat transfer coefficient, electrical analogy, a critical radius of insulation, Extended surface (fins) heat transfer – long fin, short fin with insulated tip. Transient Conduction: Lumped parameter system, Significance of Biot and Fourier numbers, Heisler Chart.

Practice:

1. Determination of thermal conductivity of a metal.
2. Determination of overall heat transfer co-efficient of a composite material.

UNIT – II

Dimensional Analysis: Classification of convective heat transfer, Dimensional analysis for heat transfer study, Buckingham π theorem for forced and free convection, Significance of non-dimensional numbers

Free Convection: Development of hydrodynamic and thermal boundary layer along with a vertical plate, Heat transfer through constant heat flux and isothermal plate and cylinder with empirical relations in different orientations

Practice:

1. Determination of heat transfer coefficient in natural convection.
2. Study of two-phase flow.

UNIT – III

Forced Convection: External Flows: Concepts of the hydrodynamic and thermal boundary layer, using empirical correlations for convective heat transfer through flat plates and cylinders.

Internal Flows: Concepts about hydrodynamic and thermal entry lengths, division of internal flow based on this, use of empirical relations for horizontal pipe flow and annulus flow.

Practice:

1. Determination of heat transfer coefficient in forced convection

UNIT – IV

Heat Exchangers: Classification of heat exchangers, overall heat transfer coefficient and fouling factor, LMTD and NTU methods concepts.

Boiling: Pool boiling regimes, calculations on nucleate boiling, critical heat flux and film boiling.

Condensation: Film-wise and dropwise condensation, Nusselt's theory of condensation on a vertical plate - film condensation on vertical and horizontal cylinders using empirical correlations.

Practice:

1. Determination of effectiveness of parallel and counter flow heat exchangers.

UNIT – V

Radiative Heat transfer: Emission characteristics and laws of black body radiation, Irradiation, total and monochromatic quantities, Planck law, Wien displacement law, Kirchhoff, Lambert law, Stefan and Boltzmann law, heat exchange between two black bodies, concepts of shape factor, Emissivity, heat exchange between grey bodies, radiation shields.

Practice:

1. Determination of emissivity of a given surface
2. Determination of Stefan- Boltzmann constant.

Note: Heat Transfer Data book is to be allowed in the Examinations

Text Books:

1. Fundamentals of Engineering Heat and Mass Transfer, R. C. Sachdeva, New Age International Publications, 5thEdition, ISBN: 9789386070968.
2. Heat and Mass Transfer - Fundamentals and Applications, Yunus A. Cengel and Afshin J. Ghajar, McGraw Hill Publications, 5thEdition, 2014, ISBN :978-0073398181.

Reference Books:

1. Heat Transfer, P.K.Nag, TMH Publications, 3d Edition, 2011, ISBN: 978-0070702530.
2. Principles of Heat and Mass Transfer, Frank P. Incropera, David P. Dewitt, Theodore L, AdrienneS. Lavine, Wiley Publications, 7th E0dition, 2018, ISBN: 978-8126542734.
3. Heat Transfer, J.P. Holman, McGraw Hill Education; 10th Edition, 2017. ISBN: 978-0071069670.

Web Links:

1. https://nptel.ac.in/courses/112108149
2. https://nptel.ac.in/courses/112105271

Dynamics of Machinery

Course Code: 2501ME17	L	T	P	C
	2	1	1	4

Course Outcomes:

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

- **CO1:** Analyse stabilization of ships, aircrafts, and automobile vehicles
- **CO2:** Analyse frictional losses, torque transmission capacity of clutches, brakes, and dynamometers
- **CO3:** Analyse and plot the characteristics of a governor
- **CO4:** Apply the analytical and graphical methods for balancing of rotating and reciprocating masses.
- **CO5:** Determine the natural frequency for free and forced vibrations

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	2	-	-	-	-	-	2	1	-
CO2	3	2	2	-	-	-	-	-	2	1	-
CO3	3	2	2	-	-	-	-	-	2	1	-
CO4	3	2	2	-	-	-	-	-	2	1	-
CO5	3	2	2	-	-	-	-	-	2	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

Precession: Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motorcycle, aero planes, and ships

Practice:

1. Analyse the motion of a motorized gyroscope when the couple is applied along its spin axis.

UNIT – II

Clutches & Brakes: Clutches: Working principle of clutch, classification-Friction clutches-uniform pressure, uniform wear, single disc or plate clutch, multiple disc clutch, cone clutch, centrifugal clutch.

Brakes and Dynamometers: Working principle of brake, simple block brakes, internal expanding brake, band brake of vehicle. General description and operation of dynamometers: Prony, Rope brake, Epicyclic, Bevis Gibson and belt transmission.

Practice:

1. Determine the position of sleeve against controlling force and speed of a Hartnell governor and plot the characteristic curve of radius of rotation.

UNIT – III

Governors: Watt, porter and proell governors, spring loaded governors– Hartnell and Hartung with auxiliary springs-Lift of the governor- Sensitiveness, isochronism and hunting.

Practice:

1. Determine the position of sleeve against controlling force and speed of a porter governor and to plot the characteristic curve of radius of rotation.

UNIT – IV

Balancing: Balancing of rotating masses single and multiple – single and different planes, use analytical and graphical methods. Primary, secondary, and higher Balancing of reciprocating masses: Graphical methods, unbalanced forces and couples locomotive balancing, hammer blow, swaying couple, variation of tractive effort.

Practice:

1. Study the static and dynamic balancing using rigid blocks.

UNIT – V

Vibrations: Free and forced vibration of single degree of freedom systems, effect of damping- Dunkerley's method- vibration isolation and transmissibility; resonance; critical speeds of shafts.

Practice:

1. Determine the frequency of un-damped free vibration of an equivalent spring mass system.

Text Books:

1. Theory of machines, S.S.Rattan, Tata Mc Graw Hill, 5th Edition, 2019, ISBN: 9789353166281.
2. Theory of machines, Thomas Bevan, CBS Publishers, 3rd Edition, ISBN: 9788123908748.

Reference Books:

1. Theory of machines: Kinematics and Dynamics , Sadhu Singh, Pearson Publishers 3rd Edition, 2011, ISBN: 9788131760697.
2. Theory of machines, R.K.Bansal, J.S.Brar, Laxmi Publications, 6th Edition, 2016, ISBN : 978-8131808054.

Web Links:

1. https://archive.nptel.ac.in/courses/112/104/112104114/
2. https://archive.nptel.ac.in/noc/courses/noc21/SEM1/noc21-me08/