INSTITUTE	**FACULTY OF ENGINEERING AND TECHNOLOGY**
PROGRAM	**BACHELOR OF TECHNOLOGY (MECHANICAL ENGINEERING - ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)**
SEMESTER	**3**
COURSE TITLE	**FUNDAMENTAL OF MACHINE DESIGN**
COURSE CODE	**01ME1305**
COURSE CREDITS	**4**

Objective:

1 To develop the ability to apply principles of engineering mechanics and strength of materials to analyze and evaluate force systems, frictional behavior, stress–strain relationships, centroid and moment of inertia, and the structural response of members under bending and torsional loading.

Course Outcomes: After completion of this course, student will be able to:

1 Apply principles of engineering mechanics to solve force systems and equilibrium conditions in static structures.

2 Apply laws of friction to solve engineering systems involving static and dynamic friction.

3 Analyze stress–strain relationships in structural members under different loading conditions, including axial, shear, and thermal loads.

4 Analyze shear force and bending moment in beams and evaluate structural behavior based on loading conditions and support configurations.

5 Evaluate the centroid and moment of inertia of standard and composite sections to determine their significance in torsional behavior and stress distribution in structural members.

Pre-requisite of course: Engineering Graphics and Physics

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Introduction** Terminologies:space, time, particle, rigid body, deformable body. Force: Definition, categorization of forces, Characteristics of a force, System of forces and resolution of forces., Principles of mechanics: Principles of Transmissibility, superposition, Gravitational Law and Parallelogram Law of Forces	2

Contents : Unit	Topics	Contact Hours
2	**Fundamentals of Statics** Force and Force system: System of Forces its definition and application in Engineering., Coplanar concurrent force system: Derivation of resultant force and equilibrant force using analytical and graphical methods. Triangle law of forces and Polygon law of forces., Equilibrium of rigid bodies: Conditions of equilibrium, Lami's theorem and its derivation. Concept of Free body diagram in engineering. Application of Lami's theorem in various problems., Coplanar non-concurrent forces: Definition of moment, couple and its effect on rigid bodies. Properties of couple, equivalent force couple system with examples, Varignon's theorem and its derivation., Resultant of Coplanar non-concurrent Force system: Calculation of resultant force in coplanar non-concurrent force system by analytical and graphical methods.	8
3	**Shear force and Bending moment in beams** "Support Reactions: Calculation of support reactions for determinate beams subjected different loads viz. (i) Concentrated loads and moment, (ii) Uniformly distributed load, and (iii) Uniformly Varying loads.", "Internal forces in beams: Definition of shear force and bending moment. Correlation between loading, shear force & bending moment in beams", "Shear Force and Bending Moment Diagrams: Bending moment and shear force diagrams for beams subjected to; i) Concentrated loads and moment, (ii) Uniformly distributed load, and (iii) Uniformly Varying loads. Point of Contra flexure and maximum bending moment in a beam."	8
4	**Centroid and Moment of Inertia** "Centroid: Definition, concept, and evaluation of centroid for one-dimensional standard geometry viz. horizontal, vertical, inclined and circular curved lines. ", "Centroid of Standard Geometrical shapes: Determination of centroid for standard two-dimensional and three-dimensional shapes viz. rectangular, triangular, circular, semi-circular. ", Calculation of Centroid: Calculation of centroid for composite lines, areas and volumes., Pappus - Guldinus Theorem: Pappus Guldinus theorem and its application in calculating surface area and volume, "Introduction to Moment of Inertia: Definition and concept of Moment of Inertia. Perpendicular axis, Parallel axis theorem, Polar Moment of inertia, and radius of gyration.", "Moment of Inertia for Planar cross-sections: Determination of Moment of Inertia for planar sections using parallel axis theorem for standard lamina. "	6

Contents : Unit	Topics	Contact Hours
5	**Simple Stresses & Strains** "Introduction: Definition and types of simple stresses (direct and indirect) and strains (linear and lateral) in an element and its importance in engineering. ", "Relation between stress and strain: Hooke's law, Poisson's ratio, Modulus of Elasticity, Rigidity, and Bulk modulus. ", "Stresses and strains Members: Evaluation of stresses and strains in members subjected to axial and shear loading for homogenous, composite, prismatic and tapered sections.", "Thermal Stresses: Evaluation of stresses in elements subjected to temperature effects in homogeneous and composite members", Inter-relationship between various Moduli: Relationship between modulus of elasticity, rigidity, bulk modulus and Poisson's ratio with problems, Multidirectional Stresses: Volumetric strains, effect of multi-directional stresses on homogeneous members.	10
6	**Stresses in Beams** "Theory of Pure Bending – Assumption, theory and derivation of equation for pure bending. Determination of bending stresses at various sections. ", "Flexural stresses – Section modulus and determination of flexural stress distribution in beams of various cross sections. "	3
7	**Torsion:** "Equation of Pure Torsion: Definition of Torsion, Assumption and derivation of equation for pure torsion in circular shafts, Torsional rigidity and its application. "	2
8	**Concepts and Application of Static Friction** Introduction: Theory, Classification and laws of Static and Dynamic friction, Glossary of Terms: Angle of friction, Coefficient of friction, Angle of repose and Cone of friction. , Block friction: Solutions of problems involving block friction in horizontal and inclined planes.	3
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Concepts and Application of Static Friction** Introduction: Theory, Classification and laws of Static and Dynamic friction. Glossary of Terms: Angle of friction, Coefficient of friction, Angle of repose and Cone of friction. Application of Static Friction -Block friction: Solutions of problems involving block friction in horizontal and inclined planes.	4
2	**Law of Parallelogram of Forces** Law of Parallelogram of Forces	2
3	**Coplanar Concurrent Forces** Coplanar Concurrent Forces	2
4	**Coplanar Non-Concurrent Forces** Coplanar Non-Concurrent Forces	2

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
5	**Co-efficient of Static Friction** coefficient of static friction	2
6	**Compressive Strength** compressive strength	2
7	**Tensile Strength** Tensile Strength	2
8	**Hardness Number** Hardness Number	2
9	**Izod Impact Test** IZOD IMPACT TEST	2
10	**Centroid and Center of Gravity** Centroid and Center of Gravity	2
11	**Differential Wheel & Axle** Differential Wheel & Axle	2
12	**Double Purchase Crab** Double Purchase Crab	2
13	**Shear forces and bending moment Diagrams.** Shear forces and bending moment Diagrams.	2
Total Hours		**28**

Textbook :

1 Applied Mechanics, 19th Edition, S. B. Junarkar & H. J. Shah, Charotar Publication, 2015

2 A Textbook Of Strength Of Materials 6th Edition, R K Bansal, Laxmi Publications, 2018

3 Fundamentals of Machine Design, Ajeet Singh, Cambridge University Press, 2025

References:

1 Engineering Mechanics, 3rd Edition, Engineering Mechanics, 3rd Edition, G. S. Sawhney, PHI New Delhi, 2008

2 Mechanics of Materials, 3rd Edition, Mechanics of Materials, 3rd Edition, Gere & Timoshenko, CBS Publishers & Distributors, 2021

3 Strength of materials, 20th Edition , Strength of materials, 20th Edition , S. Ramamrutham &, R. Narayanan, Dhanpat Rai Publishing Company (P) Ltd., 2020

4 Mechanics of Materials 8th Edition, Mechanics of Materials 8th Edition, Beer and Johnstion, McGraw Hill, 2020

5 Engineering Mechanics of Solids 2nd Edition, Engineering Mechanics of Solids 2nd Edition, Egor P popov, Pearson Education India, 2015

6 Machine Design, 2nd Edition, Machine Design, 2nd Edition, Jindal, Pearson , 2024

Suggested Theory Distribution:

The suggested theory distribution as per Bloom’s taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
0.00	0.00	40.00	40.00	20.00	

Instructional Method:

1 Power point presentation and Lecture Handout

Supplementary Resources:

1 https://web.mit.edu/emech/dontindex-build/

2 https://nptel.ac.in/courses/112/102/112102284/