Subject Code: 01ME1305
Subject Name: Fundamental of Machine Design
B. Tech. Year - II (Semester - 3)

Type of course : Under Graduate

Prerequisite : Engineering Graphics and Physics

Rationale : Understanding the fundamental principles, concepts and techniques, both theoretical and experimental, with emphasis on the application of these to the solution of mechanics based suitable problems in all engineering.

Course Outcome :
After learning the course, the students will be competent

1. To understand the laws of mechanics and their application to engineering problem.
2. To evaluate the frictional forces for static friction problems
3. To apply the fundamentals of stress/strain for analysis of simple structure.
4. Apply shear force and bending moment diagrams to analyze the resistance offered By the beam and evaluate the stresses induced in beam.
5. To understand the fundamental concept of torsion in circular shafts.

Teaching and Examination Scheme :

Teaching Scheme			Credits	Examination Marks					
				Theory Marks			Practical Marks		Total Marks
THEORY	TUTORIAL	PRACTICAL	C	ESE(E)	IA	CSE	Viva (V)	Term Work (TW)	
3	0	2	4	50	30	20	25	25	150

Content :

Sr. No.	Content	Total Hrs.
1	**Introduction** **Terminologies s**: 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.	**02**
2	**Fundamentals of Statics** **Force and Force system:** System of Forces its definition and application in Engineering.	**08**

	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.	
3	**Shear force and Bending moment in beams** **Classification of loads and supports** **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.	**08**
4	**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.	**03**
5	**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 - Guldinas 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.	**06**
6	**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.	**10**

	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.	
7	**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.	**03**
8	**Torsion :** **Equation of Pure Torsion:** Definition of Torsion, Assumption and derivation of equation for pure torsion in circular shafts, Torsional rigidity and its application.	**02**

Distribution of Theory Marks

R Level	**U** Level	**A** Level	**N** Level	**E`** Level	**C** Level
20	**30**	**25**	**15**	**10**	--

Legends: R: Remember**; U:** Understand**; A:** Apply**; N:** Analyze**; E:** Evaluate**; C**: Create

List of Experiments :

1. Law of Parallelogram of Forces
2. Coplanar Non-Concurrent Forces
3. Coplanar Non-Concurrent Forces
4. Co-efficient of Static Friction
5. Compressive Strength
6. Tensile Strength
7. Hardness Number
8. Izod Impact Test
9. Centroid and Centre of Gravity
10. Differential Wheel & Axle
11. Double Purchase Crab
12. Beam deflection test

List of Assignment :

1. Theory and Examples on Coplanar Concurrent & Non-concurrent Forces
2. Theory and Examples on Support reaction and Shear Force and Bending moment diagram
3. Theory and Examples on Centre of Gravity & Moment of Inertia
4. Theory and Examples on Simple Stresses and Strain

Major Equipment :

1. Universal Testing Machine
2. Impact Tester machine
3. Hardness Tester Machine

Design based Examples (DE)/Open Ended Example :

1. Design a stable object
2. Centroid, centre of gravity and moment of inertia

Text Books :

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

Reference books :

1. Engineering Mechanics, 3rd Edition by G. S. Sawhney; PHI New Delhi.
2. Mechanics of Materials, 8th Edition by Beer and Johnston, TMH,
3. Mechanics of Materials, 2nd Edition, by Gere & Timoshenko; CBS Publishers & Distributors, Delhi
4. Strength of materials, 20th Edition by Ramamrutham
5. Engineering Mechanics of Solids, 2nd edition by Popov E.P; Prentice Hall of India, New Delhi

List of Open Base Software / learning website :

1. https://nptel.ac.in/courses/112/102/112102284/
2. https://web.mit.edu/emech/dontindex-build/