

Subject Code : 1ET1000113	Subject Title : MECHANICS OF SOLIDS
Pre-requisite Subject	Knowledge of Physics and Mathematics up to 12th science level.

Course Objective:

To acquire Basic knowledge of Rigid and Deformable body, System of units, Laws of motion, Basic idea of force, Concept of centroid, Fundamentals of stress, strain and their relationships.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture	Tutorial	Practical	Credit	Theory		Practical		Total (T+P)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
4	-	2	5	70	30	-	20	120

Subject Contents				
Sr. No	Topic	Total Hours	Weight (%)	
1	Introduction Definition of space, time, particle, rigid body, deformable body. Force, types of forces, Characteristics of a force, System of forces, Composition and resolution of forces. Fundamental Principles of mechanics : Principle of transmissibility, Principle of superposition, Law of parallelogram of forces.	04	10	
2	Fundamentals of Statics Coplanar concurrent forces: Resultant of coplanar concurrent force system by analytical and graphical method, Law of triangle of forces, Law of polygon of forces, Free body diagrams, Equilibrium conditions, Lami's theorem. Application of statically determinate pin – jointed structures. Coplanar non-concurrent forces: Moments & couples, Characteristics of moment and couple, Equivalent couples, Force couple system, Varignon's theorem, Resultant of non-concurrent forces by analytical method, Equilibrium conditions of coplanar non-concurrent force system.	10	20	
3	Statically determinate beams Types of loads, Types of supports, Types of beams; Determination of support reactions, Relationship between loading, shear force & bending moment, Bending moment and shear force diagrams for beams subjected to only three types of loads :i) concentrated loads ii) uniformly distributed loads iii) couples and their combinations; Point of contra flexure, point & magnitude of maximum bending moment, maximum shear force.	10	12	
4	Centre of Gravity and moment of inertia Centre of Gravity: Centre of gravity of lines, plane areas and volumes, Examples related to centroid of composite geometry, Pappus – Guldinus theorems I and II. Moment of inertia: Derivation of equation of moment of inertia of standard lamina using first principle, Parallel & perpendicular axes theorems, polar moment of inertia and radius of gyration of areas. Examples related to moment of inertia of composite	8	15	

	geometry.		
5	Friction Concept of friction, Types of friction, Static and kinetic friction, Cone of friction, Angle of repose, Coefficient of friction, Laws of friction, Application of theory of friction: Friction on inclined plane, ladder friction, wedge friction.	06	08
6	Simple Stresses & Strains Elastic, homogeneous, isotropic materials, Hooke's law, limit of elasticity and proportionality, yield limit, ultimate strength, section of composite materials, prismatic and non prismatic sections. Stresses: Normal stresses, axial - tensile and compressive, shear and complementary shear, thermal and hoop. Applications to composite material stepped and tapered bars. Strains: Linear, lateral, shear, thermal and volumetric. Elastic Constants: Modulus of elasticity, Poisson's ratio, Modulus of rigidity and bulk modulus and relations between them with derivation.	10	20
7	Stresses in Beams Flexural/bending stresses: Concept of simple bending, Assumptions, derivation of equation of bending, neutral axis, determination of bending stresses, section modulus of rectangular & circular (solid & hollow), I, T, Angle, channel sections. Shear stresses: Derivation of shear stresses formula, shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections.	08	15
8	Physical & Mechanical properties of materials (laboratory hours) Elastic, homogeneous, isotropic materials; Stress –Strain relationships for ductile and brittle materials, limits of elasticity and proportionality, yield limit, ultimate strength, strain hardening, proof stress, factor of safety, working stress, load factor, Properties related to axial, bending & shear loading, Toughness, hardness, Ductility, Brittleness.	05	Only for Practical (no Theory weightage)
9	Simple Machines (laboratory hours) Basics of Machines, Definitions: Velocity ratio, mechanical advantage, efficiency, reversibility of machines. Law of Machines, Application of law of machine to simple machines such as levers, pulley and pulley blocks, wheel and differential axle, Single purchase, double purchase crab, screw jacks. Relevant problems	05	

Course Outcome :

After learning the course the students should be able to :

1. Apply fundamental principles of mechanics & principles of equilibrium to real practical problems of engineering.
2. Determine reactions & internal forces in statically determinate beams by applying principles of statics.
3. Find center of gravity and moment of inertia of different geometrical shapes.
4. Know basics of friction and its importance through simple applications.
5. Understand the types of stresses and strains developed in the member subjected to axial, bending and shear.
6. To get information of behavior & properties of engineering materials.
7. Understand basics of simple machines and their working mechanism.

List of Experiments:

(a) Mechanics of rigid body

1. Equilibrium of coplanar concurrent forces
2. Equilibrium of coplanar non-concurrent forces

3. Equilibrium of coplanar parallel forces: Determination of reactions of simply supported beam
4. Determination of coefficient of static friction using inclined plane
5. Determination of parameters of machines (Any two)
 - a. Wheel and differential axles
 - b. Single purchase crab
 - c. Double purchase crab
 - d. System of pulleys

(b) Mechanics of deformable body

6. Determination of hardness of metals: Brinell /Vicker/Rockwell hardness test
7. Determination of impact of metals: Izod/Charpy impact test
8. Determination of compression test on
 - a. Metals – mild steel and cast iron
 - b. Timber – along and parallel to the grains
9. Determination of tensile strength of metals
10. Determination of shear strength of metals

Reference Books:

1. Engineering Mechanics by Beer & Johnston
2. Applied Mechanics by S.B.Junarkar & H. J. Shah
3. Mechanics of Structure Vol. I by S.B.Junarkar & H. J. Shah
4. Engineering Mechanics by P.J.Shah
5. Engineering Mechanics by Dr. R. K. Bansal
6. Strength of Materials by Dr. R. K. Bansal
7. Engineering Mechanics by S. Ramamrutham
8. Strength of Materials by S. Ramamrutham
9. Engineering Mechanics by Kumar
10. Strength of Materials by Timo Shenko