GUJARAT TECHNOLOGICAL UNIVERSITY
B. E. FIRST YEAR

Subject Name: **Mechanics of Solids**
Subject Code: **110010**

Sr. No.	Topic	Total Hrs
1	**Introduction:** Scalar and vector quantities, Composition and resolution of vectors, System of units, Definition of space, time, particle, rigid body, force.	1
2	**Fundamentals of Statics:** **Force:** Types of Forces, Characteristics of a force, System of forces. **Coplanar concurrent forces:** Resultant of coplanar concurrent force system by analytical method only- Law of parallelogram of forces, Law of triangle of forces, Law of polygon of forces, Composition and resolution of forces, Equilibrium conditions for coplanar concurrent forces, Equilibrant, Free body diagrams, Lami's theorem. **Coplanar non-concurrent forces:** Moments & couples, Characteristics of moment and couple, Equivalent couples, Force couple system, Varignon's theorem, Parallel forces, Resultant of non-concurrent forces by analytical method only, Equilibrium conditions of coplanar non-concurrent force system, Equilibrant, Free body diagrams.	9
3	**Truss** Analysis of plane truss, Static determinacy of plane truss, Methods of analysis of truss, Zero force members, Analysis of simple determinate plane trusses using method of joints and method of sections.	4
4	**Center of gravity and moment of inertia** **Center of gravity and centroid:** Centroid of lines, plane areas and volumes, Pappus – Guldinus first and second theorems. **Moment of inertia of planar cross-sections:** Parallel & perpendicular axes theorems, polar moment of inertia, radius of gyration of areas.	6
5	**Friction** Theory of friction, Types of friction, Static and kinetic friction, Cone of friction, Angle of repose, Coefficient of friction, Laws of friction, Friction on inclined plane, ladder friction, wedge friction, belt and rope friction.	6

6	**Simple stresses & strains** **Normal/axial stresses:** Tensile & compressive, Shear and complementary shear. **Strains:** Linear, shear, lateral, thermal and volumetric. Elastic Constants: Modulus of elasticity, Poisson's ratio, Modulus of rigidity and bulk modulus (Definitions only) **Analysis of normal stress & strains:** Homogeneous and composite bars having uniform & stepped sections axial loads and thermal loads, hoop stresses, analysis of homogeneous prismatic bars under multidirectional stresses.	9
7	**Statically determinate beams** **Beams:** Types of loads, Types of supports, Types of beams; Determination of support reactions. **Bending moment and shear force:** 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 contraflexure.	4
8	**Stresses in homogeneous beams** **Bending stress in beams:** Pure bending, Theory of pure bending, Neutral axis, Moment of resistance, Relationship between moment of resistance, Bending stress, moment of inertia, Radius of curvature and modulus of elasticity; Section modulus. **Shear stress in beams:** Horizontal shear stress, Relationship between shear force, shear stress and moment of inertia; Horizontal shear stress distribution diagrams across beam section; average shear stress	4
9	**Principal stresses** Analytical solution for elements under axial and shear stress: Normal, tangential and resultant stress on inclined plane, angle of obliquity of resultant stress, maximum shear stress, principal planes and principal stresses, principal stresses in beams under bending and shear.	5

Laboratory Instructions:

The students shall be studying of following in laboratory hours; the same shall be examined during **practical examinations only**.

(a) Simple Machines: Velocity ratio, mechanical advantage, efficiency, reversibility of machines, simple machines such as levers, pulley and pulley blocks, wheel and differential axle, Single purchase/double purchase crab, compound screw jacks.

(b) Physical & Mechanical properties of structural materials: Elastic, homogeneous, isotropic 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, and torsional & shear loading, Toughness, hardness

Experiments:

Students will have to perform following experiments (Five from each group) in laboratory and shall prepare the laboratory manual.

Group-I

1. Equilibrium of coplanar concurrent forces
2. Equilibrium of coplanar concurrent forces
3. Equilibrium of coplanar parallel forces: Determination of reactions of simply supported beam
4. Verification of principle of moment: Bell crank lever
5. Determination of member force in a triangular truss
6. Determination of coefficient of static friction using inclined plane
7. Determination of parameters of machines (Any two)
   (a) Wheel and differential axles
   (b) Single purchase crab
   (c) Double purchase crab
   (d) System of pulleys

Group-II

1. Determination of hardness of metals: Brinell /Vicker/Rockwell hardness test
2. Determination of impact of metals: Izod/Charpy impact test
3. Determination of compression test on
   (a) Metals –mild steel and cast iron
   (b) Timber –along and parallel to the grains
4. Determination of tensile strength of metals
5. Determination of shear strength of metals
6. Determination of transverse strength of beam
7. Determination of flexural strength of tiles

BOOKS:

1. Engineering Mechanics (Statics) Beer and Johnston
2. Applied Mechanics S. B. Junnarkar & H. J. Shah
3. Mechanics of Structure Vol. I S. B. Junnarkar & H. J. Shah
4. Mechanics of Materials Beer and Johnston