



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3132005
Semester – III
Subject Name: Engineering Mechanics

Type of course: Engineering

Prerequisite: Zeal to learn the subject

Rationale: The objective of this Course is to provide an introductory treatment of Engineering Mechanics to all the students of engineering, with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters. This course provides basic fundamentals of how to determine stress and deformation in a wide range of simple, practical structural problems, and an understanding of the mechanical behavior of materials under various load conditions.

Teaching and Examination Scheme:

| Teaching Scheme | | | Credits C | Examination Marks | | | | Total Marks |
|-----------------|---|---|--------------|-------------------|--------|-----------------|--------|----------------|
| L | T | P | | Theory Marks | | Practical Marks | | |
| | | | | ESE (E) | PA (M) | ESE (V) | PA (I) | |
| 3 | 0 | 2 | 4 | 70 | 30 | 30 | 20 | 150 |

Content:

| Sr. No. | Content | Total Hrs |
|---------|--|--------------|
| 1 | Introduction to Engineering Mechanics: Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy | 6 |
| 2 | Friction: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction | 4 |
| 3 | Basic Structural Analysis: Equilibrium conditions; Method of Sections; Method of Joints; How to determine if a member forces in a simple truss; Zero force members | 4 |
| 4 | Centroid and Centre of Gravity: Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia-Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook | 6 |
| 5 | 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 three types of loads: i) concentrated loads ii) uniformly distributed loads iii) couples and their combinations; Point of contraflexure, point & magnitude of maximum bending moment, maximum shear force. | 6 |



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| 6 | Stresses in Beams: Flexural stresses – Theory 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 formula, shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections | 5 |
| 7 | Principal Stresses: Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stress | 3 |
| 8 | Physical & Mechanical properties of materials: Elastic, plastic, brittle, ductile, homogeneous and isotropic materials; Behavior of material under axial and shear loads, Modulus of elasticity, limits of elasticity and proportionality, yield limit, ultimate strength, strain hardening. Basic definitions of stress: Linear, shear, bending, torsion, in-plane. Strains: Linear, shear, lateral, thermal and volumetric Poisson's ratio, Bulk Modulus, modulus of rigidity, relationship between various elastic constants, properties related to Toughness, hardness, Ductility, Brittleness, Analysis of prismatic, tapered and composite sections under axial and thermal loads. | 5 |

Suggested Specification table with Marks (Theory): (For BE only)

| Distribution of Theory Marks | | | | | |
|------------------------------|---------|---------|---------|---------|---------|
| R Level | U Level | A Level | N Level | E Level | C Level |
| 40 | 30 | 10 | 10 | 5 | 5 |

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Hibler and Gupta, Engineering Mechanics (Statics, Dynamics) by Pearson Education
2. Bansal R.K., A Text Book of Engineering Mechanics, Laxmi Publications
3. Khurmi R.S., Engineering Mechanics, S. Chand & Co.
4. Tayal A.K., Engineering Mechanics, Umesh Publications
5. S. B. Junnarkar and H. J. Shah, "Applied Mechanics", Charotar Publishing House Pvt. Ltd.
6. S. B. Junnarkar and H. J. Shah, "Mechanics of Structure Vol. I", Charotar Publishing House

Course Outcomes:

Upon successful completion of the course, student should be able to:

| Sr. No. | CO statement | Marks % weightage |
|---------|--|-------------------|
| CO-1 | Solve practical problems of engineering by applying fundamental principles of mechanics & principles of equilibrium. | 30 |



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|------|---|----|
| CO-2 | Calculate stability of systems using fundamentals of friction and its importance through simple applications. | 20 |
| CO-3 | Determine stresses and strains under axial & thermal loads. | 30 |
| CO-4 | Apply principles of statics to analyze statically determinate beams, cables and trusses. | 20 |

List of Experiments:

The students will have to solve few examples and related theory from each topic as an assignment.

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 member force in a triangular truss
5. Determination of hardness of metals: Brinell / Vicker / Rockwell hardness test
6. Determination of impact of metals: Izod / Charpy impact test
7. Determination of Transverse strength and Modulus of Elasticity for Metals
8. Determination of Transverse strength and Modulus of Elasticity for Timber
9. Determination of coefficient of static friction using inclined plane

Major Equipment:

1. Truss set up
2. Hardness testing machine
3. Impact testing machine
4. Universal testing machine / Compression Testing Machine with Flexure Testing Arrangement
5. Torsion Testing Machine

List of Open Source Software/learning website:

NPTEL