# GUJARAT TECHNOLOGICAL UNIVERSITY

STRENGTH of MATERIALS (Harmonized - PAI)
**SUBJECT CODE:** 2130608
B.E. 3RD SEMESTER (Harmonized - PAI)

**Type of course:** Applied Physics

**Prerequisite:**
System of units
Laws of motion
Basic idea of force
Concept of centroid & Moment of Inertia
Fundamentals of stress, strain and their relationships

**Rationale:** This subject is conceptual applications of principles of mechanics of rigid and deformable bodies in Engineering.

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory Marks | | | Practical Marks | | | |
| L | T | P | C | ESE (E) | PA(M) | | PA(V) | | PA (I) | |
| | | | | | PA | ALA | ESE | OEP | | |
| 4 | 0 | 2 | 6 | 70 | 20 | 10 | 20 | 10 | 20 | 150 |

| Sr. No. | Topics | Teaching Hrs. | Weightage |
|---|---|---|---|
| 1 | **Statically Determinate Structures:**<br>Analysis of support reactions, Internal forces in trusses, beams; Consideration of concentrated loads, moments/couples, Uniformly Distributed Loads (UDL), Uniformly Varying Loads (UVL); Shear Force and Bending Moment Diagrams for Beams, Point of Contraflexures, Point and magnitude of Maximum bending moment and maximum shear force, | 08 | 20 |
| 2 | **Friction:**<br>Theory 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, belt and rope friction. | 06 | 15 |
| 3 | **Stresses in Beams:**<br>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<br>Shear stresses – Derivation of formula, shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections. | 08 | 20 |
| 4 | **Torsion:** | 06 | 15 |

| | | | |
|---|---|---|---|
| | Derivation of equation of torsion, Assumptions, application of theory of torsion equation to solid & hollow circular shaft, torsional rigidity, Power Transmitted by shaft. | | |
| 5 | **Principal Stresses:**<br>Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stress | 06 | 15 |
| 6 | **Physical & Mechanical properties of materials:**<br>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, and torsional & shear loading, Toughness, hardness, Ductility, Brittleness | 06 | 15 |

**Course Outcome:**
After learning the course the students should be able to:

1. Apply fundamental principles of mechanics & principles of equilibrium to simple and practical problems of engineering.

2. Apply principles of statics to determine reactions & internal forces in statically determinate beams.

3. Determine centroid and moment of inertia of a different geometrical shape and able to understand its importance.

4. Know basics of friction and its importance through simple applications.

5. Understand the different types of stresses and strains developed in the member subjected to axial, bending, shear & torsional effects.

6. Know behaviour & properties of engineering materials.

**List of Experiments:**
The students will have to solve at least five examples and related theory from each topic as an assignment/tutorial. Students will have to perform following experiments in laboratory and prepare the laboratory manual.

1. Verification of principle of moment: Bell crank lever
2. Determination of member force in a triangular truss
3. Determination of hardness of metals: Brinell /Vicker/Rockwell hardness test
4. Determination of impact of metals: Izod/Charpy impact test
5. Determination of Transverse strength and Modulus of Elasticity for Metals/Timber
6. Determination of Torsional strength and Modulus of Rigidity for Metals

**Design based Problems (DP): (any two)**

1. For a real industrial building having roof truss arrangement, (a) take photograph & identify type of truss, (b) draw sketch of truss with all geometrical dimension, cross sections details, type of joints, type of support conditions (c) prepare a model of truss (d) identify & determine types of load acts on it (d) determine support reactions & member forces due to dead load & live load only.

2. Take a case of the Mery-Go-Round used in the fun park. Draw its sketch showing radius of wheel, no of seats, capacity of each seats and other related information. Determine the amount of resultant produced at the center of wheel during rest position, when (i) it is fully loaded (2) it is 30% loaded with symmetric arrangement. Draw support arrangement and determine support reactions. Also determine amount of torque required to start its operation.

3. Prepare working models for various types of beams with different shape of cross section, supporting conditions and study the effect of cross section on the deflection of beams.

**Major Equipment:**

1. Truss set up

2. Bell crank lever

3. Hardness testing machine

4. Impact testing machine

5. Universal testing machine / Compression Testing Machine with Flexure Testing Arrangement

6. Torsion Testing Machine

**List of Open Source Software/learning website:**
**www.nptel.iitm.ac.in/courses/**

**Active learning Assignments (AL) :** Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The Power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.