

**Course Name:** Mechanical Engineering Group

**Course Code:** ME/PG/PT/AE /MH

**Semester:** Third

**Subject Title:** Strength Of Materials

**Subject Code:** 9024

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme						
TH	TU	PR	Paper Hrs	TH	Test	PR	OR	TW	Total
03	--	02	03	80	20	--	--	25@	125

**Rationale:**

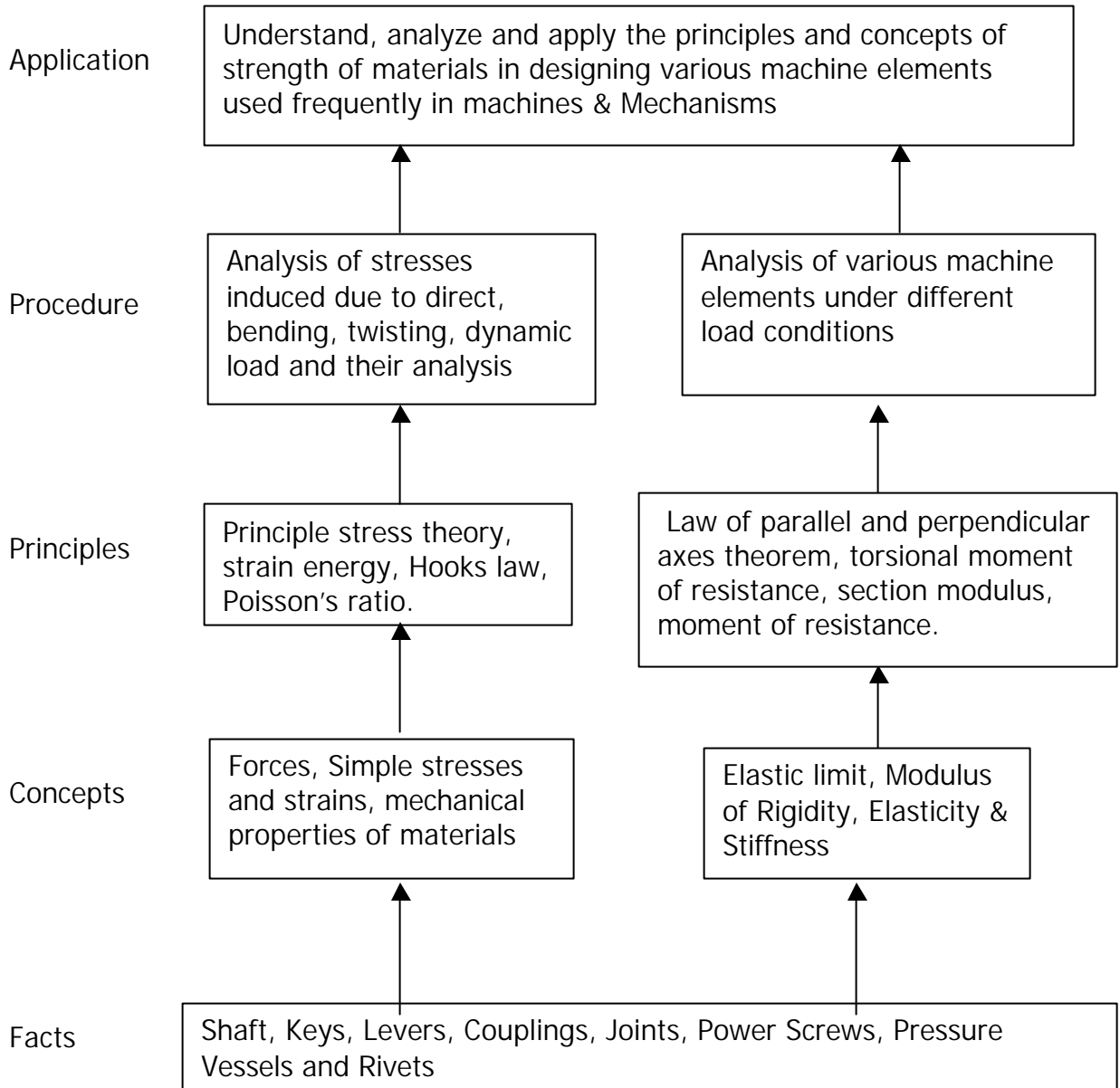
Strength of Material is a core technology subject. It aims at enabling the student to understand & analyze various types of loads, stresses & strains along with main causes of failure of machine parts. The subject is pre-requisite for understanding principles of machine design. Understanding mechanical properties of materials will help in selecting the suitable materials for various engineering applications.

**Objectives:**

The Student should be able to:

1. Understand the fundamentals of solid mechanics.
2. Acquire elementary knowledge of stresses, strains & material properties.
3. Understand & analyze the basic principles involved in the behavior of machine parts under load in the context of designing it.
4. Understand & analyze the mechanical properties of the various materials.

## Learning Structure:



## Contents: Theory

Chapter	Name of the Topic	Hours	Marks
01	<p><b>Mechanical Properties of Materials, Simple stresses &amp; Strains</b></p> <p>1.1 Types of loads, Simple stresses &amp; strains viz. tensile, compressive, Shear, Crushing, Thermal stresses, Hoop stresses &amp; corresponding strains, Volumetric Strain, Bulk modulus, Hook's law, Young's modulus, Modulus of Rigidity, stress-strain curves for ductile &amp; brittle materials, Poisson's ratio.</p> <p>1.2 Concept of stresses &amp; strains in thin cylindrical &amp; spherical shells subjected to internal pressure.</p> <p>1.3 Concepts of Buckling – Rankine's &amp; Euler's formulae for buckling load for columns / shafts under compression, concepts of equivalent length for various end conditions.</p> <p>1.4 Concepts of Deflection &amp; slope of beams – relation between bending moment &amp; slope. Deflection of simply supported beams and cantilever beams subjected to point load. (No derivation) (Problems on compressive &amp; tensile stresses, Thermal stresses, butt &amp; lap riveted joints, simple cases of buckling).</p>	10	20
02	<p><b>Strain Energy</b></p> <p>2.1 Concept, derivation &amp; use of expression for deformation of axially loaded members under gradual, sudden &amp; impact load.</p> <p>2.2 Strain energy due to self-weight.</p>	03	04
03	<p><b>Bending Moment &amp; Shear Force</b></p> <p>4.1 Shear force, bending moment &amp; relation between them.</p> <p>4.2 Shear force &amp; bending moment diagrams for simply supported beam &amp; cantilevers subjected to point loads &amp; Uniformly distribution load, concept of Uniformly varying load &amp; couples acting on beam</p>	08	12

	4.3 Location of point of contraflexure. (Problems to be based on simply supported & cantilever beams with point load & UDL only)		
04	<b>Moment of Inertia</b> 4.1 Definition of Moment of inertia, Moment of inertia of different laminae, radius of gyration. 4.2 Parallel & perpendicular axis theorem. 4.3 Moment of inertia of rectangular, circular, semicircular. Triangular, Hollow Rectangular, symmetrical I - Section, Channel section, Tee- section, angle section about centroidal axis. 4.4 Polar moment of inertia.	03	08
05	<b>Bending &amp; Shear stresses</b> 5.1 Theory of simple bending, equation of bending. 5.2 Assumptions in the theory of bending, moment of resistance, section modulus & neutral axis. 5.3 Shear stresses – concepts of direct & transverse shear stress.	06	08
06	<b>Combination of Bending &amp; Direct stresses</b> 6.1 Axial load, eccentric load, direct stresses, bending stresses maximum & minimum stresses. 6.2 Application of the above concepts for machine parts such as offset links, C-clamp, Bench vice, Drilling machine frame, stresses at base of a short column, condition for no tension at extreme fibres, total stress variation diagrams. (Simple problems on above applications)	08	12
07	<b>Principal Planes &amp; Principal Stresses</b> 7.1 Definition of principal plane & principal stresses. 7.2 Expression for normal and tangential stress, maximum shear stress. 7.3 Stresses on inclined planes. 7.4 Position of principal planes & planes of maximum shear. 7.5 Graphical solution using Mohr's circle of Stresses.	06	08

08	<b>Torsion</b> 8.1 Concept of Pure Torsion, Torsion equation for solid and hollow circular shafts. Assumptions in theory of pure Torsion. 8.2 Comparison between Solid and Hollow Shafts subjected to pure torsion (no problem on composite and non homogeneous shaft)	04	08
	Total	48	80

**Practical:**

Skills to be developed:

Intellectual Skill:

- 1 Identification of different parts of machine and their function
- 2 Interpretation failure patterns of different metal under different action
- 3 Extrapolating test result or observation during test
- 4 Testing different metals and comparison of experimental result

Motor Skill:

- 1 Sketch of standard specimen, arrangement for test on respective machines
- 2 Measurement of different parameters
- 3 Handling Instrument
- 4 Observing behavior of different metal during test.

**List of Practical:**

- 01 Study and demonstration of Universal Testing Machine & its attachments.
- 02 Study & demonstration of Extensometer.
- 03 Tension Test on mild steel, Aluminium & compression test on cast iron on Universal Testing Machine.
- 04 Direct Shear Test of mild steel on Universal Testing Machine.
- 05 Brinell Hardness Test on Mild Steel.
- 06 Rockwell hardness Test on Hardened Steel.
- 07 Izod & Charpy - Impact tests of a standard specimen.
- 08 Torsion Test on Mild steel bar.
- 09 Assignments: Drawing sheet on shear force & bending Moment diagrams for a given loading (At least four problems.).
  - a) Estimation of principal stresses and maximum shear strain for a given combined loading by analytical & Mohr's circle method. (At least two problems.).

## Learning Resources:

### Books:

SN	Author	Title	Publication
01	Andrew Pytel Fedrinand L. Singer	Strength of Material	Addison-Wesley An imprint of Addison Wesley Longman, Inc. Forth edition
02	G.H.Ruder	Strength of Material	ELBS with Macmillan third edition
03	B.K.Sarkar	Strength of Material	Tata McGraw hill New Delhi
04	Dr. R. K.Bansal	A Text Book strength of Material	Laxmi Publication New Delhi
05	S Ramamrutham	Strength of Material	Dhanpat Rai & Publication New Delhi
06	R.S.Khurmi	Strength of Material	S.Chand Company Ltd. Delhi
07	G.K.Narula K.S.Narula	Materials Science	Tata McGraw hill New Delhi