SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

Mechanical Engineering

B. Tech. Semester III

Course Name: Strength of Material **Course Code: BTME13306**

Type of course : Professional Core Course (PCC)
Prerequisite : Basics of Engineering Mechanics
Rationale of course : This subject is useful to provide basic knowledge of simple and principle stress and strain, shear force and bending moment of shaft, bending and shear stress in beam, deflection in beam, torsion of shaft so that students can solve real engineering problems.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
3	0	2	4	60	25	15	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course.

Contents:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**Introduction:** Fundamental Principles of mechanics, System of forces of machine link, Composition and resolution of forces in mechanical systems, Free body diagrams and equilibrium of forces acting on mechanical systems, Virtual work, Moments & Couples in levers and brakes, Centroid of line, area, volume, Centre of Gravity and mass in shaft and machine body sections, Finding of Moment of Inertia of different machine elements, using Parallel and Perpendicular Axis Theorem.	**05**	**10%**
2	**Simple Stresses and Strains:** Mechanical Properties of materials, Concept of stress and strain, Types of stresses and corresponding strains, Stress-strain diagram of ductile and brittle materials, Hooke's law, Poisson's ratio, Elastic constants and its inter Relations, Thermal stresses, Elongation of simple and compound bars, Strain energy, Resilience, Stresses due to Gradual, sudden and impact loadings, Failure of different types of Columns and struts using Euler's theory.	**08**	**20%**

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Sr. No.	Topics	Teaching Hrs.	Module Weightage
3	**Shear Force and Bending Moment in Shaft:** Types of Loads, Supports and Beams, Reactions at supports, Shear force and bending moment at any section of a beam, Sign Conversion, Shear Force and Bending Moment diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads and combination of these loads, Point of contra flexure.	**08**	**20%**
4	**Bending and Shearing Stresses in Beam:** **Flexural stresses –** Theory of simple bending with Assumptions, Neutral layer, Position of Neutral axis, Moment of Resistance, Expression for Bending Stress, Section Modulus, Section modulus for Various Shapes of Beam Sections, Beam of uniform Strength. **Shear stresses –** Variations of Shear Stress in Beams, concept of shear centre, Shear stress variation in Different Sections of beam.	**07**	**15%**
5	**Deflection of Beam:** Relation between slope, deflection and radius of curvature, Determination of deflection of different beams by Energy, Conjugate beam and Double integration methods.	**05**	**10%**
6	**Torsion of Circular Shaft:** Theory of Torsion, Assumptions, Stresses and Deformations in Solid and Hollow Circular Shafts, Shaft in series and parallel, Torsional Rigidity.	**05**	**10%**
7	**Principal Stresses and Strains:** Normal and Tangential stress, State of Stress in two dimensions, Principal stresses and Principal planes, Principal Shear Stresses, Ellipse of stress, Principal Strains, Principal Shear Strain, Mohr's circle of stress and strain, Strain gauges and Rosette, Introduction to theory of failures and its applications.	**07**	**15%**

Percentage Distribution of Marks as per Revised Bloom's Taxonomy (Theory/Practical):

Percentage Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
25	**30**	**30**	**15**	**0**	**0**

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyse, **E:** Evaluate **C:** Create and above Levels

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.

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Reference/Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher	Publication year	Publication Edition
1.	Strength of Materials	S. Ramamurthan, R. Narayanan	Dhanpat Rai Publications	2014	18th
2.	Strength of Materials	Stephen TimoShenko	CBS Publisher	2002	3rd
3.	Strength of Materials	R. K. Bansal	Laxmi Publi.	2018	6th
4.	Strength of Materials	S.S. Rattan	Tata McGraw Hill	2017	3rd
5.	Mechanics of Solids	S.S. Bhavikatti	New Age Publi.	2010	--

Course Outcomes (CO's):

CO No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Identify and estimate centroid and moment of inertia of different geometrical shapes and apply it to find strength of different cross sections under different load conditions.	10
CO-2	Calculate simple stresses and strains developed in the member subjected to axial, bending, shear and thermal loads.	30
CO-3	Apply principles of statics to calculate reactions, shear force and bending moment in beams.	30
CO-4	Calculate stresses and deflection of beams and shafts and justify safe cross section of load carrying members.	20
CO-5	Calculate principal stresses and devise safe cross section of members subjected to combined loading.	10

Mapping with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO-1	3	1	1	1	0	1	1	1	0	0	0	1	1	2	0
CO-2	3	3	1	1	2	2	2	1	2	0	0	2	2	3	1
CO-3	3	3	2	2	2	2	3	1	2	0	0	2	2	3	1
CO-4	3	3	2	3	3	2	2	1	2	0	0	2	3	3	1
CO-5	3	2	2	1	2	2	1	1	2	0	0	2	2	3	1

Rationale - Mapping of CO's with PO's and CO's with PSO's:

CO-PO's: According to CO and PO mapping, this course will give basic understanding of various stresses and strains generated in mechanical components, develop the problem analysis skill in students as they are able to correlate with real life problems.

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CO-PSO's: According to CO and PSO mapping, students will able to design and analyze mechanical systems using modern computing and analysis software and their application to machine design to solve technical problems.

List of Practical:

1. Analyze the behavior of mild steel and cast iron specimen under the action of tensile loading.
2. Analyze the behavior of cast iron specimen under the action of compressive loading.
3. Calculate the impact strength of different materials using Charpy Impact Test.
4. Examine and calculate the Brinell and Vicker Hardness number of various metal specimens.
5. Calculate support reaction, shear force and bending moment of a given wooden beam and also compare it with analytical results.
6. Measure and calculate the Deflection of wooden beam and compare it with analytical approach of Maxwell theorem.
7. Find the angle of twist and modulus of rigidity of shaft under torsional loading equipment and compare it with analytical results.
8. Demonstrate and compare analytical, software simulation and experimental results of tensile, compressive, impact and deflection loading test carried out.

Major Equipment:

1. Universal testing machine.
2. Compression testing machine.
3. Torsional testing machine.
4. Charpy Impact testing machine.
5. Brinell and Vicker Hardness testing machine.
6. Computational Facilities.

List of Open Source/learning website:

https://archive.nptel.ac.in/courses/112/107/112107146/
https://archive.nptel.ac.in/courses/112/107/112107147/
https://archive.nptel.ac.in/courses/112/106/112106141/
http://elearning.vtu.ac.in/econtent/courses/video/ME/18ME32.html

List of Open Source Software:

- FreeCAD