SEMESTER S3

MECHANICS OF SOLIDS

Course Code	**PCMRT303**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Engineering Mechanics/ (GCEST103)	**Course Type**	Theory

Course Objectives:

1. This course helps the students to understand the concept of stress and strain in different types of structure/machine under various loading conditions
2. The course also covers simple and compound stresses due to forces, stresses and deflection in beams due to bending, torsion in circular section, strain energy, different theories of failure, stress in thin cylinder and spheres

SYLLABUS

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Module No.	Syllabus Description	Contact Hours
1	Mechanical Properties of materials, stress, strain, Stress–Strain curves of Ductile and Brittle Materials, Poisson's ratio. Constitutive equations- Hooke's law, equations for linear elastic isotropic solids in terms of Young's Modulus and Poisson's ratio, Hooke's law for Plane stress and plane strain conditions. Relations between elastic constants E, G, ν and K. Calculation of stress, strain and change in length in axially loaded members with single and composite materials. Effects of thermal loading – thermal stress and thermal strain. Thermal stress on a prismatic bar held between fixed supports.	11
2	Principal planes and principal stress, Mohr's circle for 2D case. Circumferential and Longitudinal stress in a thin cylindrical vessel, stresses in a thin spherical vessel. Elastic strain energy for axial loading, transverse shear, bending and torsional loads. Expressions for strain energy in terms of load, geometry and material properties of the body for axial, shearing, bending and torsional loads.	11

3	Torsional deformation of circular shafts, assumptions for shafts subjected to torsion within elastic deformation range, derivation of torsion formula Torsional rigidity, Polar moment of inertia, basic design of transmission shafts. Simple problems to estimate the stress in solid and hollow shafts. Shear force and bending moment diagrams for cantilever and simply supported beams. Differential equations between load, shear force and bending moment. Normal and shear stress in beams.	**11**
4	Derivation of flexural formula, section modulus, flexural rigidity, numerical problems to evaluate bending stress, economic sections. Shear stress formula for beams: Derivation, shear stress distribution for a rectangular section. Deflection of beams, Simple problems to find the deflections. (using double integration method) Introduction to Theories of Failure, Rankine's theory for maximum normal stress, Guest's theory for maximum shear stress, Saint-Venant's theory for maximum normal strain, Hencky-von Mises theory for maximum distortion energy, Haigh's theory for maximum strain energy	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

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Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	**3.** Each question carries 9 marks. **4.** Two questions will be given from each module, out of which 1 question should be answered. **5.** Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (Cos)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Analyse the strength of materials using stress-strain relationships for structural and thermal loading	**K3**
CO2	Determine the stresses, strains and displacements of structures using Mohr's circle	**K3**
CO3	Perform basic design of shafts subjected to torsional loading and analyse beams subjected to bending moments	**K3**
CO4	Determine the deformation of structures subjected to various loading conditions using strain energy methods	**K3**
CO5	Estimate the strength of thin cylinders and spherical vessel, and appreciate the theories of failures and its relevance in mechanical design	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2									3
CO2	3	3	2									2
CO3	3	3	1									2
CO4	3	3	1									2
CO5	3	3	1									2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

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Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Mechanics of materials in S.I.units	R .C. Hibbeler	Pearson Higher Education	9e, 2018
2	Advanced Mechanics of Solids	L. S. Srinath	McGraw Hill	3e, 2017
3	Design of Machine Elements,	V. B Bhandari	McGraw Hill	4e, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Strength of Materials	Surendra Singh	S.K. Kataria & Sons	2011
2	Engineering Mechanics of Solids	Popov E	Pearson	2002
3	Mechanics of Materials S. I. units	Beer, Johnston, Dewolf	McGraw Hills	2017
4	Strength of Materials	Rattan	McGraw Hills	2011

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc23_me140
2	https://onlinecourses.nptel.ac.in/noc23_me140
3	https://onlinecourses.nptel.ac.in/noc23_me140
4	https://onlinecourses.nptel.ac.in/noc23_me140

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