25MEMJ206: Applied Mechanics

w. e. f. Academic Year:		2025-26
Semester:		3^{rd}
Category of the Course:		PCC
Prerequisite:	Basic knowledge of Engineering Mechanics and Mathematics. Understanding of force systems, equilibrium and free body diagrams. Fundamental concepts of stress, strain and material behavior. Basic algebra and trigonometry for engineering calculations.	
Rationale:	✓ To develop understanding of behavior of materials under different loading conditions. ✓ To analyze stresses, strains, bending, torsion and friction in mechanical components. ✓ To apply concepts of shear force, bending moment and strain energy in engineering problems. ✓ To build foundation for design of safe and economical mechanical systems.	

Course Outcomes:

After Completion of the Course, Students will able to:

	Course Outcome (CO)	RBT Level (Cognitive Domain)
CO1	Define and recall fundamental concepts of stress, strain, compound stress, types of loads, friction, lifting machines, shear force, bending moment, and polar moment of inertia, along with basic terminology such as principal stress, resilience, and law of machine	Remember
CO2	Explain the behavior and relationships of stress–strain systems, principal stresses, Mohr's circle, strain energy theories, friction laws, and shear force–bending moment concepts, including their physical significance in engineering applications.	Understand
CO3	Apply engineering principles to solve numerical problems involving stress analysis, thin cylinders, torsion in shafts using polar moment of inertia, strain energy calculations, friction on inclined planes, and lifting machines.	Apply
CO4	Analyze complex mechanical systems by constructing and interpreting Mohr's stress circle, shear force and bending moment diagrams, and evaluating stress–strain conditions under combined loading and torsion.	Analyze
CO5	Evaluate the suitability and performance of engineering components using failure theories (maximum stress, shear stress, and strain energy), friction conditions, and machine efficiency, and justify design decisions in two-dimensional stress systems considering sustainability.	Evaluate

Teaching and Evaluation Scheme:

Teaching Scheme					Examination Scheme				
L	T	P	C	Hrs/Week	IE	EE	CIA	Practical/ Viva	Total Marks
3	0	2	4	5	40	60	30	20	150

IE: Internal Exam
EE: External Exam (End Semester)
CIA: Continuous Internal Assessment
Practical: Practical Exam (End Semester)

Detailed Syllabus:

Topic		Hrs.	Marks % Weightage (approx.)
UNIT: 1	**Compound Stress, Strain & Polar Moment of Inertia:** Introduction, Simple stress, strain and types of load, Stress Analysis, Principal Stresses, Mohr's Stress Circle, and Principal strain, Strain Analysis, Stresses in thin cylinders (circumferential and longitudinal stresses). Polar Moment of Inertia: Definition and relation with mass moment of inertia, Polar radius of gyration, Polar Moment of inertia, for solid and hollow circular shafts, Application in torsion of shafts.	8	18
	Strain Energy: Resilience, Proof Resilience, Shear strain Energy, Maximum principal stress theory, maximum shear stress theory, Total strain energy theory, shear strain energy theory, application to problems relating to two-dimensional stress systems only.	8	18
UNIT: 2	**Shear Force and Bending Moment:** Introduction, Types of Supports and Beams, Shear Force, Bending Moment, Shear Force and Bending Moment Diagrams.	10	22
UNIT: 3	**Basics of Friction** Friction and its characteristics, Nature of Friction, Static and Dynamic Friction, Laws of solid friction Terms of Friction, Friction on Inclined Plane. emphasizing reduction of energy losses, improved efficiency, and sustainable mechanical system performance.	10	22
UNIT: 4	**Lifting Machines** Basic Concept and Definition, Reversible and Irreversible Machines, Law of Machine, Application in levers, Pulleys, Simple and Differential wheels and axles with emphasis on energy-efficient operation, safety, and sustainable engineering applications	9	20
	TOTAL	**45**	**100**

List of Practical:

Sr.	Practical Topic	Hours
1	To determine principal stresses using Mohr's Circle for a given two–dimensional stress system.	4
2	Measurement of strain using strain gauge / extensometer and comparison with analytical results.	2
3	Verification of strain energy in an axially loaded bar and comparison with analytical value.	2
4	Torsion test on circular shaft to determine modulus of rigidity and verification of polar moment of inertia.	2
5	Plotting SFD & BMD for a Simply Supported Beam.	4
6	Plotting SFD & BMD for an Overhanging Beam.	4
7	Determination of coefficient of friction on horizontal plane for different materials.	2
8	Determination of coefficient of friction on inclined plane for different materials.	2
9	Study of Simple Machine – Lever and determination of MA, VR and Efficiency.	2
10	Performance Test on Single Purchase Crab (Lifting Machine).	2
	TOTAL	**30**

Reference Books:

1. **Strength of Materials** – S.S. Rattan, Tata McGraw Hill Education Pvt. Ltd.
2. **Engineering Mechanics** – D.S. Kumar, S.K. Kataria & Sons
3. **Strength of Materials** – Bansal R.K., Laxmi Publications
4. **Mechanics of Materials** – Dr. Kirpal Singh, Standard Publishers & Distributors
5. **Strength of Materials** – R.S. Lehri, S.K. Kataria & Sons
6. **Elements of Strength of Materials** – Timoshenko & Young, East-West Press

Teaching Learning Method:

- Classroom Teaching
- ICT Enabled Learning
- Laboratory Demonstration
- Tutorial & Problem Solving
- Activity Based Learning

Course Outcomes Mapping:

CO No.	Course Outcome (CO)	POs / PSOs Mapped	Cognitive Level (RBT)	Knowledge Category	Class Sessions
CO1	Define and recall fundamental concepts of stress, strain, compound stress, types of loads, friction, lifting machines, shear force, bending moment, and polar moment of inertia, along with basic terminology such as principal stress, resilience, and law of machine	PO1, PO2, PSO1	Remember	Procedural Conceptual	10
CO2	Explain the behavior and relationships of stress–strain systems, principal stresses, Mohr's circle, strain energy theories, friction laws, and shear force–bending moment concepts, including their physical significance in engineering applications.	PO1, PO2, PO10, PSO1, PSO2	Understand	Procedural	8
CO3	Apply engineering principles to solve numerical problems involving stress analysis, thin cylinders, torsion in shafts using polar moment of inertia, strain energy calculations, friction on inclined planes, and lifting machines.	PO1, PO2, PO3, PO4, PO5, PO10, PSO1, PSO2	Apply	Conceptual Procedural	7
CO4	Analyze complex mechanical systems by constructing and interpreting Mohr's stress circle, shear force and bending moment diagrams, and evaluating stress–strain conditions under combined loading and torsion.	PO1, PO2, PO3, PO4, PO5, PO10, PSO1, PSO2	Analyze	Procedural	7
CO5	Evaluate the suitability and performance of engineering components using failure theories (maximum stress, shear stress, and strain energy), friction conditions, and machine efficiency, and justify design decisions in two-dimensional stress systems considering sustainability.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO10,PO11, ,PSO1,PSO2	Evaluate	Metacognitive	8

Mapping of COs with POs & PSOs:

CO	PO											PSO	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	1	–	–	–	–	–	–	–	–	–	2	–
CO2	3	2	–	–	–	–	–	–	–	1	–	2	1
CO3	3	3	2	1	2	–	–	–	–	1	–	3	2
CO4	3	3	2	2	2	–	–	–	–	1	–	3	2
CO5	3	3	3	2	2	1	1	1		2	1	3	2

3: High, 2: Medium, 1: Low

Sustainable Development Goals (SDG) Integration

This course incorporates sustainability by promoting efficient material utilization, energy-efficient design, and safe structural practices. Concepts of stress, strain, friction, and machine efficiency are applied to reduce material wastage, improve durability, and enhance system performance. The course supports sustainable engineering aligned with SDG 4, SDG 9, SDG 11, and SDG 12.

SDG Mapping with Course Outcomes

CO	Course Outcome	Relevant SDGs	Justification
CO1	Define and recall fundamental concepts of stress, strain, compound stress, types of loads, friction, lifting machines, shear force, bending moment, and polar moment of inertia, along with basic terminology such as principal stress, resilience, and law of machine	SDG 4	Builds strong engineering fundamentals and technical understanding
CO2	Explain the behavior and relationships of stress–strain systems, principal stresses, Mohr's circle, strain energy theories, friction laws, and shear force–bending moment concepts, including their physical significance in engineering applications.	SDG 9	Supports efficient analysis and understanding of engineering systems
CO3	Apply engineering principles to solve numerical problems involving stress analysis, thin cylinders, torsion in shafts using polar moment of inertia, strain energy calculations, friction on inclined planes, and lifting machines.	SDG 9, SDG 12	Promotes efficient resource use and optimized engineering solutions
CO4	Analyze complex mechanical systems by constructing and interpreting Mohr's stress circle, shear force and bending moment diagrams, and evaluating stress–strain conditions under combined loading and torsion.	SDG 9, SDG 11	Ensures safe, reliable, and sustainable structural performance
CO5	Evaluate the suitability and performance of engineering	SDG 12	Enhances

	components using failure theories (maximum stress, shear stress, and strain energy), friction conditions, and machine efficiency, and justify design decisions in two-dimensional stress systems considering sustainability.		durability, reduces waste, and improves lifecycle performance