GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Plastics Engineering

Subject Code: ME03084021

Subject Name: Engineering Mechanics of Polymers and Composites

w.e.f.Academic Year:	2025-26
Semester:	3
Categoryof theCourse:	MOPEC

Pre requisite:	NIL
Rationale:	NIL

CourseOutcome:

After Completion of the Course, Student will be able to:

No	Course Outcomes
01	Understand the fundamental behavior of polymers and composites under mechanical loading.
02	Analyze the viscoelastic behavior using standard mathematical models.
03	Apply stress analysis principles to polymer-based structures.
04	Evaluate mechanical properties using characterization techniques.
05	Design and analyze composite materials for engineering applications.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial/ Practical		
L	T	PR	C	ESE (E)	PA/ CA (M)	PA/CA(I)	ESE (V)	
02	0	02	03	70	30	20	30	150

Course Content:

Unit No.	Content	No.of Hours	%of Weightage
1.	**Introduction to Polymers** • **Overview of Polymers:** Definition, classification, and applications • **Polymerization:** Mechanisms of polymerization (addition and condensation) • **Types of Polymers:** Thermoplastics, thermosets, elastomers, and natural polymers	05	15

	• **Molecular Structure:** Bonding, molecular weight, and its influence on mechanical properties • **Applications:** Common polymers and their applications in various industries		
2.	**Mechanical Behavior of Polymers** • **Molecular Packing:** Crystalline and amorphous structures • **Thermal Transitions:** Glass transition temperature (Tg) and its significance • **Mechanical Properties:** Viscoelasticity, rubbery behavior, and plastic deformation • **Material Responses:** Cold drawing, crazing, creep, stress relaxation, and impact behavior • **Testing Methods:** Creep and relaxation tests, tensile and impact tests	8	20
3.	**Viscoelastic Models and Stress Analysis** • **Viscoelastic Models:** Kelvin, Maxwell, 3-parameter and 4-parameter models • **Generalized Models:** Generalized Kelvin and Maxwell models for complex behaviors • **Stress Analysis Principles:** Boltzmann superposition principle and Alfred's correspondence principle • **Structural Analysis:** Stress analysis in bars and beams with viscoelastic materials	6	20
4.	**Polymer Characterization and Design** • **Time-Temperature Superposition:** Principles and applications • **WLF Equation:** Williams-Landel-Ferry equation and its relevance • **Dynamic Mechanical Analysis (DMA):** Measurement of storage and loss modulus • **Design Considerations:** Plastic design practices, stress relaxation, and long-term performance	6	25

5.	**Introduction to Composites and Their Mechanics** • **Composite Materials:** Definition, advantages, and classification • **Material Behavior:** 3D stress-strain relationships, generalized Hooke's law • **Lamina Mechanics:** Stress-strain relations, hygrothermal stress, and lamina property estimation • **Laminate Mechanics:** Classical lamination theory, stiffness of stacking sequences, and failure criteria • **Design Aspects:** Composite sandwich structures, testing, joining, and repair techniques	5	20
	Total	**30**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15	15	20	10	5	5

Where R:Remember; U:Understanding; A:Application, N:Analyze and E:Evaluate C:Create (asper Revised Bloom's Taxonomy)

References/Suggested Learning Resources: Books:

1. Callister, W.D., "Materials Science and Engineering: An Introduction"
2. Nielsen, L.E., "Mechanical Properties of Polymers and Composites"
3. Ranganathan, N., "Polymer Science and Technology"
4. Mallick, P.K., "Fiber-Reinforced Composites: Materials, Manufacturing, and Design"
5. Billmeyer, F.W., "Textbook of Polymer Science"
6. Strong, A.B., "Plastics: Materials and Processing"

(b) Open source software and website:

https://nptel.ac.in/

Suggested Course Practical List: As per the above syllabus topics

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