BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH **SEMESTER : IV**
BRANCH: MECHANICAL **SESSION : SP/2025**

SUBJECT: ME215 COMPOSITE MATERIALS

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Define composite materials and explain their classification based on the matrix phase. Also, give one example for each type.	[5]	1	L, M
Q.1(b)	Explain the classification of fibers and define the following terms used in fiber science: Aspect ratio; Critical fiber length; Orientation; Volume fraction	[5]	1	M, L
Q.2(a)	A unidirectional 30^0 oriented carbon fiber-reinforced epoxy composite has a fiber volume fraction of 60%. The modulus of elasticity of the carbon fiber is 230 GPa and that of the epoxy matrix is 3.5 GPa. Using the Rule of Mixtures, calculate the longitudinal modulus of the composite.	[5]	2	M, H
Q.2(b)	Compare thermosetting and thermoplastic resins used in PMCs in terms of structure, processing, and applications. Also, explain the concept of A-stage, B-stage, and C-stage in the curing of thermosetting resins.	[5]	2	H, M
Q.3(a)	Explain the key design considerations for Polymer Matrix Composites (PMC) used in structural components of advanced aerospace systems. Discuss the importance of weight savings, thermal resistance, and anisotropic behavior in the design process.	[5]	3	M, H
Q.3(b)	Describe Carbon-Carbon Composites with respect to their matrix precursors and manufacturing processes. Also, explain why multi-directional reinforcement is preferred in high-performance applications like nose cones or brake discs.	[5]	3	
Q.4(a)	Explain the importance of nanoparticle dispersion in polymer nanocomposites. Compare polymer-nanoclay composites and polymer-carbon nanotube (CNT) composites in terms of structure, properties, and typical applications.	[5]	4	M, H
Q.4(b)	Define Functionally Graded Composites (FGCs). Classify them based on property gradients i.e. orientation and origin i.e. natural or artificial and discuss their industrial applications with at least one example.	[5]	4	M, H
Q.5(a)	Compare the manufacturing techniques of Hand Lay-up, Filament Winding, and Pultrusion. Discuss their process steps, typical applications, and limitations with a focus on selecting suitable tooling and equipment.	[5]	5	H, H
Q.5(b)	Explain the role of micro-mechanics and macro-mechanics in the testing and analysis of composite laminates. Also, briefly describe how Finite Element (FE) analysis is used to evaluate composite structures.	[5]	5	M, M

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