

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

**CLASS: BTECH
BRANCH: MECHANICAL**

**SEMESTER : IV
SESSION : SP/2023**

SUBJECT: ME215 COMPOSITE MATERIAL

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 material. What is the need for composite material? Mention important characteristics of composite material. | [5] | 01 | L |
| Q.1(b) Discuss the roles of matrix and reinforcements in composite materials with suitable examples and sketches. | [5] | 01 | L |
| Q.2(a) Discuss the, failure mechanism of composite materials under brittle fibre in ductile matrix and ductile fibre in brittle matrix when there is Fatigue loading and Tensile loading. | [5] | 02 | L |
| Q.2(b) A composite material consists of 40% (by volume) continuous, uniaxially aligned, glass fibres in a matrix of thermoset polyester. A tensile stress of 100 MPa is to be applied parallel to the fibres. Predict the strains which will result. Take the tensile modulus and Poisson's ratio of glass to be 76 GPa and 0.22, and of thermoset polyester to be 3 GPa and 0.38, respectively. | [5] | 02 | M |
| Q.3(a) Define ablative composites. Discuss the properties and applications with suitable example | [5] | 03 | L |
| Q.3(b) Explain Multi-directional reinforced Carbon - Carbon Composites elaborating the manufacturing considerations and applications | [5] | 03 | M |
| Q.4(a) Define nanocomposites and state any five industrial applications. The various properties of the nanocomposite differ remarkably on the sizes of the nano-reinforcement. Provide the output effects for sizes <5 nm, <20 nm, <50 nm, and <100 nm | [5] | 04 | M |
| Q.4(b) Discuss and briefly classify functionally graded composite materials with the aid of a flowchart. | [5] | 04 | L |
| Q.5(a) A designer of garden wheelbarrows is considering a new design where the frame of the wheelbarrow will be manufactured from a PMC. After considering many materials he narrows the choice to: 30% (by weight) glass-fibre reinforced polypropylene (GF-PP), or 30% (by weight) glass-fibre reinforced thermoplastic polyester (GF-PET). The designs employed for the two materials differ only in their wall thicknesses, which have been determined by stress analysis of the frame. A batch of 250000 frames is required, to be produced by injection moulding within a period of 12 months. Factory running costs are charged at Rs. 4000 per hour per injection moulding machine, and the cost of producing a mould is Rs. 15,00,000. The factory operates three 8-hour shifts per day, 7 days per week, 48 weeks per year, and a machine usage rate 90% and a scrap rate of 1% can be assumed. The following table gives other relevant data. | [5] | 05 | M |

	GF-PP	GF-PET
Cost of material (Rs. / kg)	92	178
Wall thickness (mm)	8.0	4.1
Mass of moulding (kg)	4.5	3.3
Cycle time (s)	150	55

- Q.5(b) Taking all factors into account, which material would you recommend? You are involved in the design and manufacture of a Polymer Matrix Composite based door handles for an upcoming automobile. Provide your choice for best possible combination of Matrix and Reinforcement with proper reasoning and the list of testing to be done in order to substantiate your alternative material(s).
- [5] 05 M