



## GIET UNIVERSITY, GUNUPUR - 765022

### B. Tech (Third Semester Regular) Examinations, December - 2023 21BMEPC23003 / 22BMEPC23003 - Material Science (Mechanical)

Time: 3 hrs

Maximum: 70 Marks

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**(The figures in the right hand margin indicate marks)**
**PART - A****(2 x 5 = 10 Marks)**Q.1. Answer *ALL* questions

|  | CO # | Blooms Level |
|--|------|--------------|
| a. What is atomic packing efficiency, and how does it relate to the arrangement of atoms in a crystal lattice? | CO1  | K2           |
| b. Differentiate between homogeneous and heterogeneous nucleation during the solidification process.           | CO1  | K2           |
| c. Why are alloys commonly used in engineering applications?   | CO2  | K2           |
| d. Write the process involved in Stress Relief Annealing.  | CO3  | K2           |
| e. What are the factors that control the strength of ceramics?   | CO4  | K1           |

**PART - B****(15 x 4 = 60 Marks)**Answer *ALL* questions

|  | Marks | CO # | Blooms Level |
|--|-------|------|--------------|
| 2. a. Explain the various types of crystal system with a neat sketch and example.  | 7     | CO1  | K2           |
| b. Draw the following plane and direction in FCC structure.  | 8     | CO1  | K3           |
| i) (2 1 2) (-2 1 0) (1 ½ 1)  |       |      |              |
| ii) [1 2 1] [1 -2 1] [1 ½ 1]   |       |      |              |
| (OR)   |       |      |              |
| c. Define packing factor and obtain the packing factor for the   | 7     | CO1  | K2           |
| (i) SC (ii) BCC (iii) FCC.   |       |      |              |
| d. Find the number of atoms associated in each BCC, FCC and HCP unit cells. Calculate the equilibrium number of vacancies per cubic meter for copper at 100° C. The energy for vacancy formation is 0.9 eV/atom; the atomic weight and density for copper are 63.5 g/mol and 8.45 g/cm <sup>3</sup> , respectively. Take Avogadro's number as 6.023 x 10 <sup>23</sup> atoms/mol. K = 8.62*10 <sup>-5</sup> eV/atom. | 8     | CO1  | K3           |
| 3.a. Explain the factors affecting solid solubility of a solution (or) Explain Hume Rothery rules.   | 7     | CO2  | K2           |
| b. For a 0.35 wt% C plain carbon steel at a temperature just below the eutectoid temperature determine:  | 8     | CO2  | K3           |

- i) Fraction of total ferrite and cementite phase.
- ii) Fraction of the pro-eutectoid ferrite and pearlite.

Fraction of eutectoid ferrite.

(OR)

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|--|---|-----|----|
| c. Explain Phase transformation with a suitable example.   | 7 | CO2 | K2 |
| d. A binary alloy having 28 wt% of Cu and balance Ag solidifies at 779 <sup>0</sup> C. The solid consists of two phases $\alpha$ & $\beta$ . Phase $\alpha$ has 8% Cu whereas phase $\beta$ has 8% Ag at 779 <sup>0</sup> C. At room temperature these are pure Ag and Cu respectively. Sketch the phase diagram. Label all fields & lines. Melting points of Cu and Ag are 1083 <sup>0</sup> C and 960 <sup>0</sup> C respectively. Estimate the amount of $\alpha$ & $\beta$ in the above alloy at 779 <sup>0</sup> C & at room temperature. | 8 | CO2 | K3 |
| 4.a. Draw the T – T – T diagram for eutectoid steel & explain the phase transformations in brief.  | 7 | CO3 | K3 |
| b. Explain the concept of plastic deformation by slip and twinning mechanism with neat diagrams. Also write the difference between the two mechanisms.   | 8 | CO3 | K2 |

(OR)

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|---|---|-----|----|
| c. Sketch and explain any two types of cast iron, with microstructure, composition and properties.  | 7 | CO3 | K3 |
| d. How does the presence of alloying elements affect the equilibrium cooling behaviour, microstructure, and properties of steel?          | 8 | CO3 | K2 |
| 5.a. Write short notes on: <ul style="list-style-type: none"> <li>i) Cermets</li> <li>ii) Theory of refraction and absorption,</li> </ul> | 7 | CO4 | K2 |
| b. Define composite material. Give the classification based on matrix and Reinforcement.  | 8 | CO4 | K2 |

(OR)

- |   |   |     |    |
|---|---|-----|----|
| c. Write short notes on: <ul style="list-style-type: none"> <li>i) Metal matrix composites</li> <li>ii) Fibre reinforced plastic</li> </ul> | 7 | CO4 | K2 |
| d. Write the difference between thermoplastics and thermo setting plastics.   | 8 | CO4 | K2 |

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