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 **PRESIDENCY UNIVERSITY**

  **Bengaluru**

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| **End - Term Examinations – JANUARY 2025** |
| **Date:** 03-01-2025 **Time:** 09:30 am – 12:30 pm |

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| **School:** School of Engineering | **Program:** B. Tech - PET |
| **Course Code:** PET2031 | **Course Name:** Overview of Material Science |
| **Semester**: V | **Max Marks**: 100 | **Weightage**: 50% |

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| **CO - Levels** | **CO1** | **CO2** | **CO3** | **CO4** | **CO5** |
| **Marks** | **20** | **20** | **30** | **30** | **-** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Do not write anything on the question paper other than roll number.*

**Part A**

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| **Answer ALL the Questions. Each question carries 2marks. 10Q x 2M=20M** |
| **1** | Define the term “crystal” with a suitable example. | **2 Marks** | **L1** | **CO4** |
| **2** | Recall isomorph and polymorphism. | **2 Marks** | **L1** | **CO4** |
| **3** | Define homogeneous and heterogeneous nucleation. | **2 Marks** | **L1** | **CO4** |
| **4** | Show the eutectic cooling curve. | **2 Marks** | **L1** | **CO4** |
| **5** | Define glass transition temperature of polymer and draw the specific volume versus temperature, upon cooling from the liquid melt, for totally amorphous, semicrystalline, and crystalline polymers. | **2 Marks** | **L1** | **CO4** |
| **6** | Define homogeneous and heterogeneous phase with suitable example. | **2 Marks** | **L1** | **CO3** |
| **7** | List two benefits of phase diagram. | **2 Marks** | **L1** | **CO3** |
| **8** | In phase diagram define the Gibb’s phase rule with example. | **2 Marks** | **L1** | **CO3** |
| **9** | Show the phase diagram for one component and label it properly. | **2 Marks** | **L1** | **CO3** |
| **10** | Recall the glass transition (Tg) temperature (in °C) of Nylon 6,6 polymer. **(only mention the temperature)** | **2 Marks** | **L1** | **CO3** |

**Part B**

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| **Answer the Questions Total 80 Marks.** |
| **11.** | **a.** | Solve the equilibrium number of vacancy per cubic meter for copper at 1000°C. The energy for vacancy is 0.9 eV/atom; the atomic weight and density (at 1000°C) for copper are 63.5 g/mol and 8.4 g/cm3, respectively. [Boltzmann’s constant (K) = 8.62$×10^{-5}eV/atom$.K; Avogadro’s Number = 6.022$×10^{23} atoms/mol$]. | **20 Marks** | **L3** | **CO1** |
| **or** |
| **12.** | **a.** | Show that a Face Centered Cubic (FCC) crystal has 26% vacancy. **(Do not skip any steps)** | **20 Marks** | **L2** | **CO1** |
|  | **b.** | In material science, the crystalline material plays a good role in making of several advanced materials that have good thermal and other mechanical properties rather than materials like amorphous and semicrystalline. Explain elaborately the steps involved during the crystallization process, and develop the factors that affect the crystallization process. **(Discuss explicitly and draw any corresponding figure if required)** | **L2** | **CO1** |
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| **13.** | **a.** | Solid materials have been conveniently grouped into three basic categories like metals, ceramics, and polymers. Illustrate the definition of these three types material and explain their physical characteristics elaborately. Also construct a stress-strain behavior of these three types of material and explain accordingly. **(All explanations should be mentioned very clearly)** | **20 Marks** | **L3** | **CO2** |
| **or** |
| **14.** | **a.** |  Construct the concept of property variability in engineering materials and its impact on the design and performance of structures. Discuss how material variability is accounted for in safety factors and design codes. Describe the role of safety factors in ensuring the reliability of structures and the balance between material properties, design stress, and safety. Provide examples where safety factors play a crucial role in the engineering design process, including the factors that influence their selection. | **20 Marks** | **L3** | **CO2** |

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| **15.** | **a.** | Gibbs Triangle, also known as a **ternary phase diagram,** is a graphical representation used in materials science, metallurgy, and chemistry to illustrate the phase behavior of three-component systems. The equilateral triangle as shown below represents the ternary phase diagram of Nickle (Ni), Copper (Cu), and Zinc (Zn) at three corresponding vertex Q, F, and L. Solve the molar % or Wt.% of each component in the given alloy system at point a, b, c, d, and e, respectively. (All vertexes are having 100% molar % or Wt.% of each component) | **20 Marks** | **L3** | **CO3** |
| **Or** |
| **16.** | **a.** | Develop a binary phase diagram for a Copper (Cu)-Nickel (Ni) alloy system and clearly explain the liquidus, solidus phases, tie line, and etc. From your graph find an empirical formula by which you can find out the fraction of solid (Fs) and fraction of liquid (Fl).  | **20 Marks** | **L3** | **CO3** |
|  | **b.** | In a Cu-Ni alloy system, A 53% Ni is cooled from liquid state to 1300°C. Solve the % of liquid and solid at 1300°C. **(use graph sheet and consider, one small square = 2 units in X-axis, and one small square = 10 units in Y-axis)** | **L3** | **CO3** |

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| **17.** | **a.** | Show the Copper-Zinc phase diagram. Label all the phases and discuss accordingly from that graph only. | **20 Marks** | **L2** | **CO4** |
| **Or** |
| **18.** | **a.** | Illustrate an iron–iron carbide phase diagram. Also label and explain the following phases from that diagram only: **(Draw the diagram clearly. Take X and Y axis value arbitrarily. Graph sheet is not required)**1. Austenite
2. Ferrite
3. Pearlite
4. Eutectic
5. Eutectoid
6. Peritectic
 | **20 Marks** | **L2** | **CO4** |

**\*\*\*\*\* BEST WISHES \*\*\*\*\***