USN ☐☐☐☐☐☐☐☐☐☐ 10ME/IP/IM/MA/AU/PM/TL/AE32A

Third Semester B.E. Degree Examination, December 2011
Materials Science and Metallurgy

Time: 3 hrs.   Max. Marks:100

Note: *Answer any FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. Sketch the unit cell of a HCP crystal structure. Calculate the number of atoms per unit cell. Derive an expression for the density of atomic packing. (Given C = 1.633a).   **(06 Marks)**

    b. Copper has an atomic radius of 1.28×10^{-8} cm, a FCC crystal structure and an atomic weight of 63.5. Calculate its density (Avogadro number = 6.023×10^{23}).   **(05 Marks)**

    c. Explain the different types of surface imperfections, with neat sketches.   **(06 Marks)**

    d. State and explain the Fick's second law of diffusion.   **(03 Marks)**

2 a. Draw the stress-strain diagram of mild steel and describe how the following properties can be obtained from the diagram:
      i) Elastic modulus   ii) Ductility   iii) Toughness.   **(07 Marks)**

    b. A cylindrical specimen of steel having an original diameter of 12.8mm is tensile tested to fracture and found to have an engineering fracture strength σ_f of 460 MPa. If its cross-sectional diameter at the fracture is 10.7mm, determine
      i) The ductility in terms of percent area reduction   ii) The true stress at fracture.   **(06 Marks)**

    c. Differentiate between the slip and twinning, with neat sketches.   **(07 Marks)**

3 a. Explain with a sketch, the ductile to brittle transition in the materials.   **(04 Marks)**

    b. If the specific surface energy for Al_2O_3 is 0.9 J/m^2, calculate the critical stress required for propagation of an internal crack of length 0.4mm. (E = 393 GPa for Al_2O_3).   **(05 Marks)**

    c. Draw and explain the S-N curve for steel and aluminium alloy.   **(05 Marks)**

    d. Define stress relaxation. Derive the corresponding expression.   **(06 Marks)**

4 a. Explain the homogeneous nucleation. Discuss the significance of critical radius of the nuclei.   **(08 Marks)**

    b. Describe the different types of solid solution.   **(06 Marks)**

    c. State the Gibb's phase rule and explain with a simple example.   **(06 Marks)**

PART – B

5 a. Construct a phase diagram for two metals completely soluble in the liquid state but partially soluble in solid state.   **(04 Marks)**

    b. Draw the iron-carbon equilibrium diagram and label all the parts.   **(08 Marks)**

    c. With the help of the diagram in 5(b), explain the cooling of steel with 0.6% carbon, showing the microstructure at different stages.   **(08 Marks)**

6 a. Draw the TTT diagram for plain carbon eutectoid steel and explain the critical cooling rate.   **(07 Marks)**

    b. Explain any one type of surface hardening, with sketches.   **(06 Marks)**

    c. Differentiate between the normalizing and annealing, with sketches.   **(07 Marks)**

7 a. Explain the different types of cast iron, with microstructures.   **(08 Marks)**

    b. Write a short note on the copper alloys.   **(08 Marks)**

    c. Explain the modification of Al - Si alloy.   **(04 Marks)**

8 a. What is a composite material? How is it classified?   **(08 Marks)**

    b. With a neat sketch, explain any one method for production of fiber reinforced plastic.   **(06 Marks)**

    c. Briefly discuss the advantages & applications of metal matrix composites(MMCs).   **(06 Marks)**

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