Code No: A109211802 **R09** **Set No. 2**

II B.Tech I Semester Examinations,November 2010
PHYSICAL METALLURGY
Metallurgy And Material Technology

Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

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1. Write short notes on the following:
   (a) Upper bainite and lower bainite
   (b) Lath martensite and plate martensite
   (c) A thermal martensite and isothermal martensite. [3×5 = 15]
2. (a) Distinguish between peritectoid and Eutectoid reaction.
   (b) What is the practical importance of the alloys undergoing peritectoid and Eutectoid transformations? [8+7]
3. (a) Explain Hume- Rothery rules which governs the formation of substitutional solid solutions.
   (b) Explain the mechanism of solid solution strengthening. [8+7]
4. (a) What is age or precipitation hardening? Give some applications of precipitation/age hardened alloys?
   (b) What is the effect of aging temperature and time on the yield strength of an Al-4% Cu alloy? [7+8]
5. (a) Discuss on point defects concentration and annealing.
   (b) What are line defects? Explain their classification. [8+7]
6. (a) What are the different methods adopted for construction of a phase diagram? Explain any one method.
   (b) What is triple point? Explain its significance. [8+7]
7. (a) Define packing density of a unit cell. Calculate the packing density of BCC unit cell.
   (b) Calculate the linear atomic density in atoms per metre in the direction [110] for aluminum (FCC). Given: Lattice parameter of aluminum is 4.049 A^0. [8+7]
8. Suppose a nickel melt can be super cooled 300^0C below its melting point of 1452^0C. If the liquid-solid surface energy is $2.55 \times 10^5 J/cm^2$, and the latent heat of fusion is $301 J/g$, using the following expression find, $\Delta G_v = \Delta H_f \frac{\Delta T}{T_m}$
   (a) What is the size of the nucleus of critical size if the density of Ni is $8.9/g/cm^3$ and

(b) What is the ratio of the nucleation rate expected with 250^0C super cooling relative to 300^0C super cooling? Assume the contribution due to diffusion in the liquid can be neglected. [7+8]

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Code No: A109211802 **R09** **Set No. 4**

II B.Tech I Semester Examinations,November 2010
PHYSICAL METALLURGY
Metallurgy And Material Technology

Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Given that the anti - phase boundary energy of Ni_3 Al is 75mJ m^{-2}, calculate the width of the super dislocation in atom spacing. [Shear modulus = 7.5 × 10^{10} Nm^{-12}, a = 3.5 × 10^{-10}m.
   (b) Define slip system? What are the slip systems in BCC and FCC crystal systems? Explain its role? [7+8]
2. (a) Describe the TTT curve for a eutectoid steels?
   (b) Define critical cooling rate of a steel with respect to its S curves? [8+7]
3. (a) What is grain? Differentiate between grain and grain boundary.
   (b) What are the important properties of a pure metal? [7+8]
4. (a) Distinguish between extended and limited solid solubility.
   (b) How does the compositions of the phases of an alloy at a temperature determined? Explain.
   (c) Distinguish between intermetallic compounds and interstitial compounds. [4+6+5]
5. Explain the following.
   (a) What are GP zones?
   (b) What types of precipitates are developed in an alloy that is considerably underaged at low temperatures? What types are developed upon overaging? [5+10]
6. (a) A 0.80%C eutectoid plain carbon steel is slowly cooled from 750^0C to a temperature just slightly below 723^0C. Assuming that the austenite is completely transformed to α- ferrite and cementite:
      i. Calculate the weight percent eutectoid ferrite formed.
      ii. Calculate the weight percent eutectoid cementite formed.
   (b) Why is the Fe-Fe_3C phase diagram a metastable phase diagram instead of true equilibrium phase diagram? [10+5]
7. (a) List and explain the various parameters affecting the nucleation kinetics.
   (b) Define the term "critical nucleus size".
   (c) Explain a method for the determination of size of nucleus. [3×5 = 15]

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8. (a) Distinguish between grains and grain boundaries. How they are related to strengthening of a metal?

   (b) What do you mean by structure refinement? Explain the advantages and disadvantages with structure refinement. [8+7]

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Code No: A109211802 **R09** **Set No. 1**

II B.Tech I Semester Examinations,November 2010
PHYSICAL METALLURGY
Metallurgy And Material Technology

Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Discuss the effect of grain size and grain boundary on mechanical properties of the metals and alloys.
   (b) Explain the grain boundary contribution to creep. [7+8]
2. (a) What is the principle of dispersion strengthening and give some examples of dispersion strengthening?
   (b) Explain how the characteristics of the matrix and dispersed phase affect the overall properties of an alloy? [5+10]
3. (a) Draw the diagram of FCC unit cell and show the closed packed planes and directions in the diagram.
   (b) Find the number of atoms/cm^2 on (100) planes of lead (FCC). (Given: Inter-atomic distance is 3.499 A^0) [8+7]
4. Write short notes on the following:
   (a) Expression of interlamellar spacing interms of growth rate
   (b) Difference between proeutectic and eutectic
   (c) Miscibility gap. [3×5 = 15]
5. (a) Draw the Iron-Iron carbide diagram and label it completely. Explain the three invariant reaction in iron-iron carbide diagram?
   (b) Calculate the percentage by weight of ferrite and cementite in pearlite at room temperature? [10+5]
6. (a) What do you understand by critical points and critical range and how are they related to heating and cooling of steel. Explain their importance in phase transformations?
   (b) Describe the process of austenite decomposition of alloyed steels with TTT diagrams. [8+7]
7. (a) What is Gibbs phase rule? Explain about the parameters used in that.
   (b) What are the advantages and limitations of phase diagrams? [8+7]
8. (a) On what planes can a dislocation with Burgers vector $\frac{1}{2}[101]$ glide in FCC metal? What are the magnitudes of the following Burgers vectors?
      i. $\frac{a}{2}$ [111]

ii. $\frac{a}{6}$ [112]

(b) State and explain the Read- Shockley formula for the energy of a tilt boundary. How does this energy vary with the angle of misorientation? Estimate the energy for a large - angle boundary. [7+8]

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Code No: A109211802 **R09** **Set No. 3**

II B.Tech I Semester Examinations,November 2010
PHYSICAL METALLURGY
Metallurgy And Material Technology

Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What are S curves or TTT curves? How these curves are determined for a given steel?
   (b) What is the advantage of S curves in heat treatment and what are its limitations? [9+6]
2. (a) Draw the Cu- Al phase diagram and Explain about the points, lines and area in the diagram.
   (b) What is solvus curve? Explain its significance. [9+6]
3. Define the following terms:
   (a) Primitive cell
   (b) Co-ordination number
   (c) Planar atomic density
   (d) Atomic packing factor
   (e) Space lattice. [15]
4. (a) Differentiate between an interstitial solid solution and a compound. How do the cooling behaviour of these two vary?
   (b) Explain the solidification behavior of a solid solution and a pure metal. [8+7]
5. Distinguish between the following:
   (a) natural aging and artificial aging
   (b) Coherent precipitate and incoherent precipitate. [7+8]
6. (a) Draw and explain a phase diagram exhibiting eutectic reaction?
   (b) What are the conditions which must be satisfied for the formation of a completely solid solubility? [9+6]
7. (a) What is allotropy? Discuss various allotropic forms of iron and their properties.
   (b) Explain why increase of pressure may give allotropic transformation to close packed structure? [9+6]
8. (a) What are annealing twins? Discuss about their formation and their effect.
   (b) Explain the role of annealing on material properties. [8+7]

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