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

II B.Tech I Semester Examinations,MAY 2011
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) Define and explain the terms: Intermediate phase and intermetallic compounds. Give few examples for each of them.
   (b) Explain how x- ray method is used in constructions of a phase diagram. [6+9]
2. Differentiate between unit cell and crystal lattice. How Bravais lattices are classified? Explain with examples and properties. [15]
3. (a) Define solid solution. Distinguish between substitutional and interstitial solid solutions.
   (b) Explain the role of grains and grain boundaries in the failure of a metal or an alloy. [7+8]
4. Draw a schematic TTT diagram for a plain carbon steel of carbon content 1.2% and label all regions and superimpose on it the continuous cooling curves and briefly explain the formation of pearlite and martensite. [15]
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) Classify the different defects in the crystals. Explain each one of them.
   (b) How ductility is measured? Explain the units for ductility. [8+7]
7. (a) Write equations for the invariant reactions
      i. Eutectiod and
      ii. Peritectic.

      How many degrees of freedom exist at invariant reaction points in a binary phase diagrams?
   (b) Can coring and surrounding occur in a peritectic-type alloy that is rapidly solidified? Explain. [6+9]
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,MAY 2011
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) How is a the phase diagram constructed by thermal analysis method? Explain.
   (b) What is Lever rule? Explain its significance. [8+7]
2. (a) Explain the effects of grain size on the failure of a metal.
   (b) What properties are required of steels for cold- forming applications? [8+7]
3. A mixture of A and B forms an isomorphous phase diagram. A sample of 150 g of solid with an initial composition of 40 wt % B is heated to a temperature in the two phase region. A liquid with a composition of 25 wt % B and solid with composition 60 wt % B form.
   (a) What is the relative amount of solid that forms?
   (b) What is the mass of B (in g) in the solid?
   (c) What is the mass of B (in g) in the liquid? $3 \times 5 = 15$
4. Distinguish between the following:
   (a) natural aging and artificial aging
   (b) Coherent precipitate and incoherent precipitate. [7+8]
5. (a) Write down the possible Burgers vectors for glide dislocations in an Ice crystal. In what planes can be a dislocation with Burgers vector $\frac{1}{2}$ [111] glide in a BCC crystal?
   (b) What is the angle between the Burgers vectors $\frac{a}{6}[11\bar{1}]$ and $\frac{a}{3}[11\bar{2}]$ (in a cubic crystal), and what is the pole of the plane containing their two directions? [7+8]
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) What is martensite? Why it is very hard?

(b) Describe the martensitic transformation using isothermal transformation curves? [15]

8. (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]

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

II B.Tech I Semester Examinations,MAY 2011
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. Describe the structural changes takes place when a plain carbon eutectoid steel is slowly cooled from austenitic region to room temperature? [15]

2. (a) What is solid solution? Explain their classification with examples.
   (b) Compare and contrast between a compound and a pure metal. [7+8]

3. (a) What is a phase diagram? Explain its role in the design of alloys.
   (b) What parameters are useful in the construction of phase diagram? Explain the Gibbs phase rule. [8+7]

4. (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]

5. (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]

6. (a) Discuss on point defects concentration and annealing.
   (b) What are line defects? Explain their classification. [8+7]

7. (a) What are M_S and M_f temperatures? What is the significance of these temperatures? Explain in detail.
   (b) If martensite formation takes place, expansion occurs. Explain why?
   (c) Martensite is not always hard and brittle-Comment on the statement. [3×5 = 15]

8. (a) What are Miller Indices? How does the crystal planes and directions in a unit cell are indicated? Explain the procedure and its significance.
   (b) Define coordination number? Determine the coordination number for FCC unit cell.
   (c) Draw the unit cell for simple cubic structure and indicate [111] planes and [111] directions. [6+5+4]

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

II B.Tech I Semester Examinations,MAY 2011
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 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]
2. (a) Define slip. Explain the mechanism of slip process.
   (b) Explain the role of defects in crystals. [8+7]
3. (a) Define the terms: Unit cell, space lattice, lattice point, coordination number.
   (b) Draw the diagrams of simple cubic, face centered cubic and body centered cubic unit cells. Explain the relation between atomic size and lattice parameter for these three unit cells. [6+9]
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. Define an Fe-C martensite? Describe the following types of Fe-C martensites that occur in a plain carbon steels
   (a) lath Martensite
   (b) Plate martensite. [15]
6. A 1.10 wt% C steel is cooled slowly from about 950^0C to a temperature slightly
   (a) Above 723^0C.
      i. Calculate the weight percent Austenite present in steel.
      ii. Calculate the weight percent proeutectoid ferrite present in the steel.
   (b) Below 723^0C
      i. Calculate the weight percent of proeutectoid ferrite present in the steel.
      ii. Calculate the weight percent eutectoid ferrite and eutectoid cementite present in steel. [4+4+4+3]
7. (a) Draw and explain the equilibrium diagram formed between two elements which are partially soluble in each other in solid state and form a eutectic?
   (b) What are the conditions which must be satisfied for the formation of an isomorphous system? [8+7]

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

8. (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]

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