Code No: RR220805 **Set No. 1**

II B.Tech II Semester Supplementary Examinations, November/December 2005
MATERIAL SCIENCE FOR CHEMICAL ENGINEERING
(Chemical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) State the different types of bonds and their characteristics.
   (b) Name four types of atomic bonds observed in the materials. Describe them in detail by giving examples. [8+8]

2. Sodium and chlorine weigh 22.997 and 35.457gm/atomic weight respectively. If the density is 2.165 gm/cm^3. Calculate the dimensions of unit cell of Nacl. [16]

3. (a) What is a solid solution?
   (b) Discuss the similarities and differences between substitutional and interstitial solid solution. [6+10]

4. The energy stored by strain hardening in a metal is 4*104 cal/m^3. Given that the shear modulus is 4*10^{10}N/m^2, b= 2.8*10^{-10}m and $\upsilon = \frac{1}{3}$, calculate the dislocation density. Assume that the edge and screw dislocation densities are equal. [16]

5. Explain the differences between:
   (a) Hardness and brittleness
   (b) Strength and stiffness
   (c) Ductility and malleability
   (d) Elasticity and plasticity [4x4=16]

6. Sketch time-strain curve for anelastic behavior and compare it with the time-strain curve in the Voigt-Kelvin element? What do you deduce from this? [16]

7. What is fracture? State the causes of fracture in a material? [16]

8. Define grain boundary and account for its character. [16]

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Code No: RR220805 **Set No. 2**

II B.Tech II Semester Supplementary Examinations, November/December 2005
MATERIAL SCIENCE FOR CHEMICAL ENGINEERING
(Chemical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. How many atoms are there per square millimeter on:
   (a) (100) Plane of copper
   (b) (110) Plane
   (c) (111) Pane? [5+5+6]
2. Write about closed packed structures. [16]
3. What is meant by crystal imperfections? Classify them in order of their geometry. [16]
4. Consider a hypothetical element whose crystal structure consists of atoms on the points of a simple-cubic lattice. Make a sketch of crystal structure for a left-hand screw orientation. [16]
5. Explain the differences between :
   (a) Elastic limit and proportional limit
   (b) Yield point and yield strength
   (c) Toughness and resilience
   (d) Endurance limit and fatigue strength [4x4=16]
6. Sketch time-strain curve for anelastic behavior and compare it with the time-strain curve in the Voigt-Kelvin element? What do you deduce from this? [16]
7. How would you distinguish between a ductile and a brittle fracture? Why is the fracture strength of real materials lower than ideal breaking strength? [16]
8. A liquid containing 90% Ni and 10% Cu is cooled relatively quickly the bottom of the container upward. Describe the compositional differences in the final solid casting. [16]

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Code No: RR220805 **Set No. 3**

II B.Tech II Semester Supplementary Examinations, November/December 2005
MATERIAL SCIENCE FOR CHEMICAL ENGINEERING
(Chemical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Sketch the five, two dimensional (plane) lattices.
   (b) Explain why each is a distinct distribution of points in two dimension.
   (c) Why is "entered squar" not a separate plane lattice. [10+3+3]
2. Calculate the atomic density (number of atoms for unit area) in (111),(110),(100) planes of copper (F.C.C.) with the lattice parameter of 3.61 A^0 . Can you pack atoms more closely than in (111) plane? [16]
3. State the effects of crystal imperfections in materials. [16]
4. (a) Briefly discuss about the interactions of dislocations?
   (b) Give simple rules for interaction between two edge dislocations? [8+8]
5. Relatively brittle materials can often be successfully deformed by special processes in which two or three principal stresses are applied simultaneously, one a tensile stress and the other a compressive stress of comparable magnitude. Using the following equation, show that plastic flow can occur even if each of these stresses is appreciable below the yield stress σ_0 at which plastic flow begins when only a single tensile stress is applied.
$$\overline{\sigma} = \left\{ \frac{1}{2} \left[(\sigma_I - \sigma_{II})^2 + (\sigma_{II} - \sigma_{III})^2 + (\sigma_{III} - \sigma_I)^2 \right] \right\}^{1/2}$$
[16]
6. What is understood by viscoelastic deformation? State the mechanical models to demonstrate viscoelastic behavior of materials? Name the materials which exhibit viscoelastic behavior? [16]
7. (a) Give procedure for shortening the relaxation time of a plastic.
   (b) Cite examples where long relaxation times are desirable? [10+6]
8. How much ferrite, austenite and cementite by weight are presenting 0.1 kg of an Fe-C alloy containing 0.5 wt% C at
   (a) 1000^0C
   (b) 724^0C and room temperature? [16]

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Code No: RR220805 **Set No. 4**

II B.Tech II Semester Supplementary Examinations, November/December 2005
MATERIAL SCIENCE FOR CHEMICAL ENGINEERING
(Chemical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Sketch a (110) plane in a unit cell of cubic crystal. Show all the (111) directions that lie on this plane, giving Miller indices of each one of them. [16]

2. X-rays with a wave length of $1.54A^0$ are used to calculate the spacing of (200) planes in aluminium. The Brag angle for this reflection 22.4^0 . What is the size of the unit cell of the aluminium crystal? [16]

3. Give a sketch of stacking fault in a fcc structure and describe about stacking fault. [16]

4. A two phase material has precipitate particles of radius 1.25 X 10^{-8} m and of concentration 10^{20} m^{-3}. The energy of the grain boundary between the particles and the surrounding material is $0.5Jm^{-2}$. After the heat treatment at an elevated temperature the particles were found to have coarsened to 3 X 10^{-8} m radius and their concentration decreased to 7.2 X 10^{18} m^{-3}. What is the reduction in the total grain boundary energy due to the coarsening? [16]

5. Explain the differences between :
   (a) Elastic limit and proportional limit
   (b) Yield point and yield strength
   (c) Toughness and resilience
   (d) Endurance limit and fatigue strength [4x4=16]

6. In dislocation density in a copper sample is increased by cold working from 10^9 m m^{-3} to 10^{13} m m^{-3} calculate the free energy change during recrystallization. [16]

7. What is fracture? State the causes of fracture in a material? [16]

8. Define grain boundary and account for its character. [16]

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