Question Paper

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
THIRD SEMESTER B.Sc. Applied Sciences in Engg.
END-SEMESTER THEORY EXAMINATIONS NOVEMBER - 2018
MATERIAL SCIENCE AND ENGINEERING [IMET 233 - S2]

Marks: 100   **Duration: 180 mins.**

Answer 5 out of 8 questions.

1)

A) Compute the coordination number, effective number of atoms for a Face Centred Cubic Structure (FCC) crystal structure. Show that the atomic packing factor of an HCP crystal structure is 0.74.   (10)

B) Define polymerization. Explain the addition polymerization reaction.   (10)

2)

A) Draw Iron - Iron Carbide equilibrium diagram and explain the reaction taking place at 727°C.   (10)

B) Explain flame hardening and induction hardening processes with a neat sketch.   (10)

3)

A) I. Explain the phenomena of reflection and transmission with one application for each.   [6M]   (10)

II. Explain the phenomena of Luminescence. Name the type of luminescence that occurs in the following materials: [4M]

   1. Fluorescent Lamps
   2. Cathode Ray Oscilloscope
   3. LEDs.

B) I. Calculate the equilibrium number of vacancies per cubic meter for copper at C. The energy for vacancy formation 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.   [6M]   (10)

II. Describe the sandwich and laminar

composites.
[4M]

4)

A)

I. Explain the Dielectric Behaviour of materials. Also, define (10)
the following terms: [6M]

  1. Relaxation time and Relaxation frequency
  2. Dielectric loss and Dielectric strength

II.What are the indices for the two planes (Figure 4A.1) and
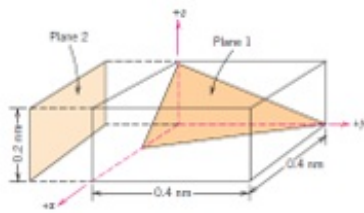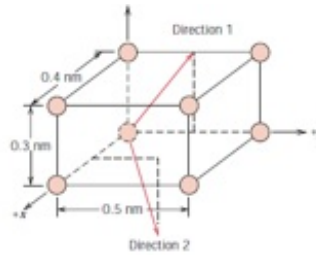two vectors (Figure 4A.2) drawn in the sketch below? [4M]

Figure 4A.1   Figure 4A.2

B)

I. Draw and explain annealing and normalizing heat   (10)
treatment process.   [6M]
II. Explain Linear and Branched Chain
Polymers.   [4M]

5)

A)

I. List the steps involved in chemical vapor deposition   (10)
process. What are the parameters that significantly
influence the rate of chemical vapor deposition?
[6M]

II. Derive planar density expressions for FCC (100) and
(111) planes in terms of the atomic radius R. Compute and
compare planar density values for these same two planes
for aluminium.   [4M]

Table 3.1   Atomic Radii and Crystal Structures for 16 Metals

Metal	Crystal Structure[a]	Atomic Radius[b] (nm)	Metal	Crystal Structure	Atomic Radius (nm)
Aluminum	FCC	0.1431	Molybdenum	BCC	0.1363
Cadmium	HCP	0.1490	Nickel	FCC	0.1246
Chromium	BCC	0.1249	Platinum	FCC	0.1387
Cobalt	HCP	0.1253	Silver	FCC	0.1445
Copper	FCC	0.1278	Tantalum	BCC	0.1430
Gold	FCC	0.1442	Titanium (α)	HCP	0.1445
Iron (α)	BCC	0.1241	Tungsten	BCC	0.1371
Lead	FCC	0.1750	Zinc	HCP	0.1332

[a] FCC = face-centered cubic; HCP = hexagonal close-packed; BCC = body-centered cubic.
[b] A nanometer (nm) equals 10^{-9} m; to convert from nanometers to angstrom units (Å), multiply the nanometer value by 10.

B)

I. Define semi conductivity. Explain intrinsic and extrinsic   (10)

semiconductor. Draw the band structure for the same. [6M]

II. List the issues related with Thin Film Deposition. [4M]

6) A) Draw and explain the TTT diagram for eutectoid steel with the phases (10)

B) I. In Fe - FeC diagram, determine the packing factor, coordination number and effective number of atoms for ? - ferrite. [5M] (10)

II. With the help of a diagram, explain physical vapor deposition process. [5M]

7) A) I. Titanium has an HCP crystal structure and a density of 4.51 g/cmÂ³. [5M] (10)

1. What is the volume of its unit cell in cubic meters?
2. If the c/a ratio is 1.58, compute the values of c and a. [Atomic Weight of Ti = 47.9 g/mol]

II. Explain Diamagnetism and Para magnetism. [5M]

B) Explain domain and hysteresis theory in magnetic materials. (10)

8) A) Explain edge dislocation. (10)

B) Discuss the formation of embryo, Nuclei and grains in the solidification process of pure metal with the help of appropriate sketches. (10)

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