Ref. No. Ex/PRN/BS/B/T/216/2024

B.E. PRINTING ENGINEERING EXAMINATION 2024

(SECOND YEAR FIRST SEMESTER 2024)

SUBJECT: MATERIAL SCIENCE

Time: Three Hours **Full Marks: 100**

Answer any five (5) questions.

Q1. Answer any 4 (four). 4x5=20

(a) Draw a BCC crystal structure and compute its Atomic Packing Factor [5]

(b) What is doping in a semiconductor? Explain p-type and n-type semiconductor. [5]

(c) What is surface hardening? Explain briefly Carburizing with a sketch. [5]

(d) What are the differences between colloids and suspensions? [5]

(e) What is composite material? What are differences between Cast Iron and Steel [5]

(f) What is the difference between Dyes and Pigments? [5]

Q2.(a) Explain Bragg's Law with a simple sketch. [6]

(b) For FCC Nickel (Ni) compute [6]

(i) the interplanar spacing and

(ii) the diffraction angle

for the (220) set of planes. The lattice parameter for Ni is 0.35295 nm. Assume, that monochromatic radiation having a wavelength of 0.1790 nm is used. The order of reflection is 1.

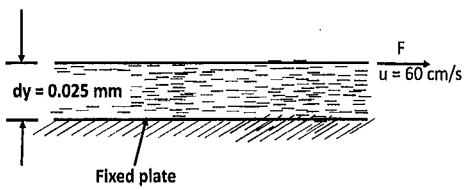
(c) Nickel (Ni) has an atomic radius of 0.1248 nm, an FCC crystal structure. Atomic weight of Nickel is 58.69 g/mol. Compute its theoretical density. Consider Avogadro's number as 6.023×10^{23} atoms/mol. [8]

Q3.(a) Explain briefly Fick's First law of Diffusion with a sketch. [6]

(b) The diffusion coefficients for copper in aluminium at 500°C and 600°C are 4.8×10^{-14} and 5.3×10^{-13} m2/s, respectively. Determine the approximate time at 500°C that will produce the same diffusion result (in terms of concentration of Cu at some specific point in Al) as a 15-hour heat treatment at 600°C. [6]

(c) (i) Explain Newton's law of viscosity. [8]

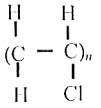
(ii) A plate of 0.025 mm distant from a fixed plate, moves at 60 cm/s and requires a force of 2 N per unit area i.e., 2 N/m^2 to maintain this speed. Determine the fluid viscosity between the plates.

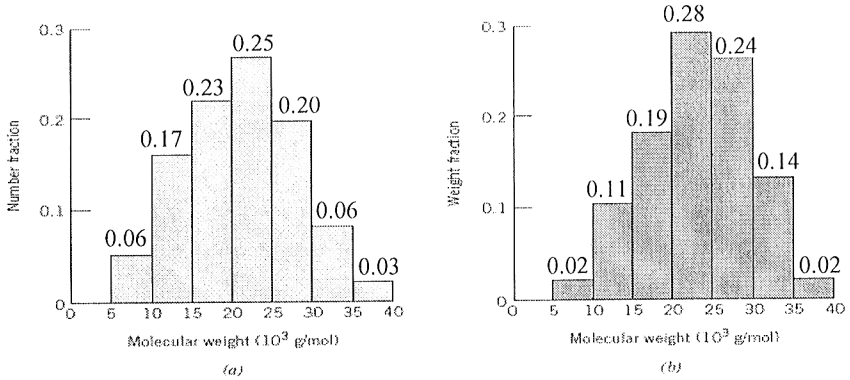


Q4.(a) Why additives are included in polymer products? Discuss various types of additives for polymer products. [10]

(b) Assume that the molecular weight distribution shown in the figure below are for a hypothetical polymer molecule size distributions of number and weight fractions of molecule poly(vinyl chloride). Atomic weights of Carbon, Hydrogen and Chlorine are 12.01, 1.01 and 35.45 g/mol respectively. [10]

Molecular structure of PVC is





For this material, compute

(a) the number-average molecular weight

(b) the weight-average molecular weight

(c) the degree of polymerisation

Q5.(a) Discuss briefly synthetic adhesives. [6]

(b) Discuss briefly primary, secondary and tertiary alcohols. [6]

(c) Calculate the capillary rise in a glass tube of 3 mm diameter when immersed vertically in (i) water and (ii) mercury. Take surface tensions $\sigma = 0.0725$ N/m for water and $\sigma = 0.52$ N/m for mercury in contact with air. The specific gravity for mercury is given as 13.6 and angle of contact for mercury is 130^{o}. [8]

Q6.(a) Discuss Amines [6]

(b) Discuss various applications of oils. [6]

(c) What are various forms of corrosion? Explain cathodic protection with a sketch. [8]

Q7. Write short notes on any four 4x5=20

(a) Amino Resins [5]

(b) Thermoplastic and Thermosetting Plastics [5]

(c) Surfactants [5]

(d) Copper and its alloys [5]

(e) Degradation of polymers [5]