B.E. PRINTING ENGINEERING
(SECOND YEAR FIRST SEMESTERSUPPLEMENTARY EXAM 2024)
SUBJECT: MATERIAL SCIENCE

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

Answer any **five(5)** questions.

Q1.	**Answer any 4 (four) questions.**	4x5=20
(a)	Draw a BCC crystal structure. Show that Atomic Packing Factor of BCC Cystal is 0.68	[5]
(b)	How do you make an intrinsic semiconductor into extrinsic conductor. Explain p-type and n-type semiconductor.	[5]
(c)	Explain briefly Carburizing and Nitriding with a sketch.	[5]
(d)	What do you understand by non-Newtonian fluid? Explain Newtons law of Viscosity.	[5]
(e)	What do you understand by Resin? Explain briefly Amino resins with example.	[5]
(f)	What are the properties of Suspension?	[5]

Q2.(a) Explain Bragg's Law with a simple sketch.   [8]

(b) Pure Iron (Fe) at room temperature has BCC crystal structure. It has an atomic radius of 0.126 nm. Atomic weight ofIron is 55.85g/mol. Compute its theoretical density. Consider Avogadro's number as 6.023 X 10^{23} atoms/mol.   [6]

(c) For FCC Nickel (Ni) compute   [6]
    (i)   the interplanar spacing and
    (ii)   the diffraction angle
for the (222) 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.

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 X 10^{-14} and 5.3 X 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 20-hour heat treatment at 600°C.   [6]

(c) (i) Explain Newton's law of viscosity.   [4]
(ii) If the velocity distribution over a plate is given by $u = \frac{1}{3}y - y^2$ in which u is the velocity in m/s at a distance y meter above the plate. Determine the shear stress at y = 0 m and y = 0.12 m. take dynamic viscosity of fluid as 8.63 poises.   [4]

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). Molecular structure of PVC is [10]

$$
\begin{array}{cc}
H & H \\
| & | \\
(C & - & C)_n \\
| & | \\
H & Cl
\end{array}
$$
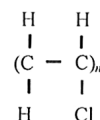
Atomic weights of Carbon, Hydrogen and Chlorine are 12.01, 1.01 and 35.45 g/mol respectively.
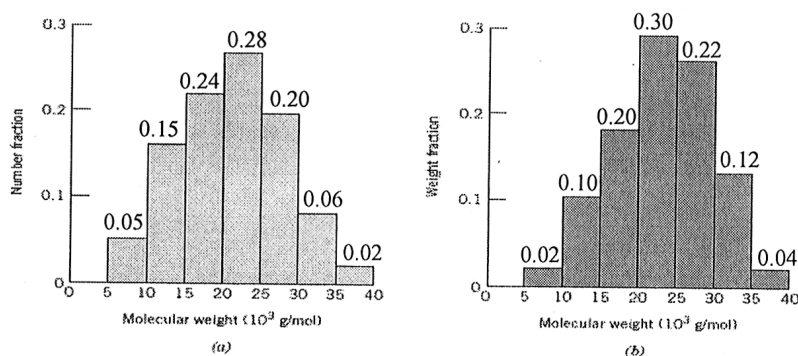
For this material, compute
(a) the number-average molecular weight
(b) the weight-average molecular weight
(c) the degree of polymerization

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 1.5 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°. [8]

Q6.(a) Discuss Amines [6]
(b) Discuss Surfactants [6]
(c) What are various forms of corrosion? Explain cathodic protection with a sketch. [8]

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

(a) Copper and its alloys [5]

(b) Applications of oils [5]

(c) Injection moulding [5]

(d) Degradation of polymers [5]

(e) Composites [5]