**Bachelor of Printing Engineering Examination, 2018**
(2nd Year- 2nd Semester)
Printing Material Science II

Time: Three hours   Full Marks: 100

1. (a) Briefly describe laminar composites. What is the prime reason fabricating these materials?   5
   (b) Derive the modulus of elasticity of a continuous and aligned fiber-reinforced composite in the transverse direction of the alignment.   5

2. (a) How fiber lengths influence the strength properties of fiber-reinforced composites?   5
   (b) Give an example of ceramic-ceramic, ceramic-metal and dispersion strengthened composite.   3
   (c) What is the distinction between matrix and dispersed phase in a composite material?   2

3. (a) What is polymerization? Explain condensation polymerization with an example.   5
   (b) Describe the difference between thermoplastic and thermosetting Polymers.   5

4. Write short notes on:(any two)   5 X 2
   (a) Polydispersity index
   (b) Extrusion molding.
   (c) Elastomer

5. (a) What are the criteria a material has to fulfill to act as dye? Classify dyes.   4
   (b) Write short notes on azo-dyes.   4
   (c) What is degree of polymerization? Discuss the change in state of polyethylene as the degree of polymerization increases.   2

6. (a) What are the different types of polymer additives used? Explain briefly.   7
   (b) Why must fiber materials that are melt, spun and then drawn be thermoplastic?   3'

1. Show for the body-centered cubic crystal structure that the unit cell edge length a and the atomic radius R are related through $a=4R/\sqrt{3}$.   5

2. (a) What is meant by co-ordination number in crystal structure?   2
   (b) Write down the limitations of Bragg's law used for crystal structure determination.   3

3. (a) What is polymorphism and allotropy?   1
   (b) What is the difference between crystal structure and crystal system?   4

4. Determine the Miller indices for the plane shown in the accompanying sketch.   5
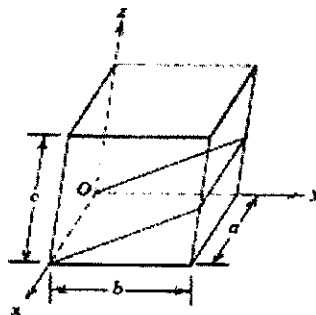
1. What is diffusion flux? What is the driving force for steady-state diffusion? 5
2. What is surface hardening? Describe the Cyaniding process used for surface hardening of material. 5
3. What do you mean by cathodic protection in electrochemical corrosion? Explain with proper example. 5
4. Describe galvanic corrosion. How this can be reduced? 5
5. (a) Cite reasons why interstitial diffusion is normally more rapid than Vacancy diffusion? 3
   (b) What is Kirkendall effect? Explain. 2
6. State the Fick's second law of diffusion. Draw the concentration profile of non steady state diffusion. 5

1. Calculate the radius of a palladium atom, given that Pd has an FCC crystal structure, a density of 12 g/cm^3, and an atomic weight of 106.4 g/mol. 5

2. A sample of poly vinyl chloride is composed according to the following fractional distribution

| Wt. fraction | 0.04 | 0.23 | 0.31 | 0.25 | 0.13 | 0.04 |
| Mean mol. Wt. X 10^3 | 7 | 11 | 16 | 23 | 31 | 39 |

   i. Compute $\overline{M}_n$, $\overline{M}_w$, $\overline{DP}_n$ and $\overline{DP}_w$.
   ii. How many molecules per gram are there in the polymer? 10

3. Copper is electroplated onto one side of a 1 cm X 1 cm cathode using a current of 10 A. Calculate (a) the weight of copper plated per hour and (b) the time required to make a copper plate 0.1cm thick.(Atomic mass of copper 63.54g/g.mole; Density of copper=8.96 g.cm^{-3}) 5

4. Calculate the distance between adjacent (111) planes in gold which has a lattice parameter of 4.0786A^0. 5

5. The diffusion coefficient for aluminum in copper is found to be 2.5 X 10^{-24}m^{2}s^{-1}at 200^{0}C and 3.1 X 10^{-17}m^{2}s^{-1}at 500^{0}C. Calculate the activation energy for the diffusion of aluminum in copper. 5

6. One gram of hydrogen peroxide is added to 10,000 gm of ethylene to serve as the initiator and terminator. Calculate the average molecular weight of the polymer if all the hydrogen peroxide is consumed? 5

7. Calculate the modulus of elasticity for a composite material consisting of 60 percent by volume of continuous E-glass fiber and 40 volume percent epoxy resin for the matrix when stressed under iso-stress condition. The modulus of elasticity of E-glass is 72 GPa and that of epoxy resin is 3 GPa. 5