

MASTER OF BIO-MEDICAL ENGINEERING FIRST YEAR FIRST SEMESTER EXAM 2025

FUNDAMENTALS OF BIOMATERIALS AND IMPLANTS

Time: 3h

Full Marks: 100

1. Answer total of ten marks from the followings 1X10=10
 - i. Write biomedical application of following polymers: 1X4=4
 - a. Polypropylene
 - b. Polymethylmethacrylate
 - c. Polytetrafluoroethylene (PTFE)
 - d. Ultrahighmolecularweight Polyethylene (UHMWPE)
 - ii. Write application of the following polymer 1X4=4
 - a. Polyethylmethacrylate
 - b. Polypropylene
 - c. Polyisoprene
 - d. Polyacrylonitrile (PAN)
 - iii. Answer the followings 1X4=4
 - a. By which characterization technique mechanical property of ceramic material could be recorded.
 - b. Find the temperature range in which a material (T_m : 350°C) can be used without any danger of creep deformation.
 - c. Name a technique used to determine the molecular weight of materials.
 - d. Provide one example of nonpolar and polar solvent.
2. Answer Any ten Questions: 1 X 10 = 10

Write True (T) / False (F)

 - i. Polymer has less surface energy compare to metals.
 - ii. Vulcanised rubber is Thermoplastic polymer.
 - iii. Electrical double layer potential decreases exponentially beyond Debye length.
 - iv. Bone is an isotropic material.
 - v. Ceramic materials are prone to impact cracking compare to metal & polymer.
 - vi. Contact Angle is an indication of hydrophilic nature of surface.
 - vii. Polymers are always crystalline in nature.
 - viii. Swelling phenomena is observed in Polymers.
 - ix. Calendaring is used to fabricate hollow objects.
 - x. Frenkel defect indicate a lattice vacancy.
 - xi. AFM measures contact angle.
 - xii. Grain boundary exists in polycrystalline material.

[Turn over

3. Answer Any Nine Questions :

10 X 9 = 90

- i. Explain BCC, FCC, HCP crystal structure with diagram. Indicate Co-ordination number of each type and write the effective total number of atoms present in each unit cell. C03
- ii. Differentiate between step growth and chain growth polymerization. Explain chain growth polymerization with example. C02
- iii. Write the applications of TGA. Name the other thermal analysis present for polymer characterization. C04
- iv. Name different materials used for different parts of hip joint. Draw $[1\ 2\ 0]$ and $(1\ \bar{1}\ 0)$ within a rhombohedral unit cell. C05, C03
- v. Write the electronic transition of C-C, C=C, C=O, C=C-C=C on absorption of UV light with comparative position of their wavelengths in UV spectra. What is ATR? C04
- vi. If $K=500\text{Nm}^{-1}$, then find out wave number for XC-H str. considering Hooke's law. Arrange the following in increasing order of vibrational frequencies with proper explanation:
-C=C-, -C $\equiv$ C-, -C-C- C04
- vii. What are the different types of polymer processing operations present? Write a short note on injection molding. C02
- viii. Provide one example of each of the following: 1. Accelerator, 2. Curing agent, 3. Accelerator activator, 4. Antidegradent, 5. Flame retardant, 6. Plasticizer, 7. Filler. Describe the polymer processing through which hollow objects could be made. C02
- ix. What are the major difference between Optical microscopy and electron microscopy? Write a short note on TEM. What are the applications of SEM? C04
- x. Below, molecular weight data for a polypropylene material are tabulated. Find (a) the number-average molecular weight, (b) the weight-average molecular weight, (c) Polydispersity index, (d) the number average degree of polymerization, (e) the weight average degree of polymerization. C02

Molecular Weight Range (g/mol)	n_i	w_i
8,000-16,000	0.05	0.02
16,000-24,000	0.16	0.10
24,000-32,000	0.24	0.20
32,000-40,000	0.28	0.30
40,000-48,000	0.20	0.27
48,000-56,000	0.07	0.11

xi. Answer a total of ten marks from the following

C01

- Define
- a. Single Crystal, 2
 - b. Schottky defect, 2
 - c. Toughness, 2
 - d. Twin boundary, 2
 - e. Critical surface tension and its application in biomedical engineering? (2+1)
 - f. Zeta potential and its application in biomedical engineering? (2+1)
 - g. Curtain Coating. 2