JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT
TEST -3 EXAMINATION- 2025
B.Tech-V Semester (CSE/IT)

COURSE CODE (CREDITS): 18B1WPH532 (03)

COURSE NAME: APPLIED MATERIALS SCIENCE

COURSE INSTRUCTORS: PBB, VSA, SKT, SBA, HAZ

MAX. MARKS: 35

MAX. TIME: 2 Hour

Note: (a) All questions are compulsory.
(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems. Scientific Calculators are allowed.

Q.No	Question	CO	Marks
Q1	(a) How did the London brothers using mathematical derivation justify the penetration of magnetic flux in superconducting thin films?	2	4
	(b) Determine the transition temperature and critical field at 4.2 K for a given specimen of a superconductor if the critical fields are 1.4×10^5 A/m and 4.205×10^5 A/m at 14 K and 13 K respectively.	3	3
	(c) The critical temperature for mercury with isotopic mass 202 is 4.159 K. Determine its critical temperature when its isotopic mass is 200.7.	3	1
2	(a) Derive an expression to calculate the dispersion in an optical fiber.	4	2
	(b) A ray of light enters from air to fibre. The fibre has refractive index of core 1.5 and cladding 1.48. Find the critical angle, fractional refractive index, acceptance angle and numerical aperture.	3	2
	(c) The refractive index of core and cladding of a fibre are 1.465 and 1.460 respectively and the wavelength of light used is 1.25 um. What should be the diameter of core for single mode propagation? If the core diameter is changed to 50 um, how many modes can propagate through this fibre.	5	2
	(d) Assuming that the critical magnetic field depends on T, find the critical current density for a 0.1 cm diameter of lead at 4 K. Take critical temperature for lead 7.18 K and critical field for lead 6.51×10^4 A/m.	3	2
Q3	(a) A signal of power 5 µW exist just inside the 1 km long fibre. Calculate the absorption coefficient of the fibre if the power inside the fiber is 1 µW.	4	1
	(b) Discuss the mechanisms through which polymers can be made conducting.	1	3
	(c) Crosslinked copolymers consisting of 60 wt% ethylene (C_2H_4) and 40 wt% propylene (C_3H_6) may have elastic properties similar to those for natural rubber. For a copolymer of this composition, determine the fraction of both repeat unit types.	3	2
4	(a) For 8-bit display, how many colours can be displayed? Also, define dot pitch in displays.	4	2
	(b) Analyse the ferroelectric behaviour of $PbTiO_3$ for application at low and high temperatures.	5	2
	(c) An electron revolving with angular velocity ω in an orbit of radius r around the nucleus generates magnetic moment. Justify the statement with suitable derivation.	1	2
Q5	(a) An element with FCC structure has 4 atoms per unit cell. The radius of atom is 1.85 Å. Estimate the order of diamagnetic susceptibility.	1	3
	(b) Deduce the expression for the energy loss in a dielectric and correlate this with the loss tangent.	1	3
	(c) A parallel-plate capacitor has plates of area 0.1 m² and carries a charge of 9 nC. What is the electric field between the plates?	3	1

Constants: $m_e = 9.11 \times 10^{-31}$ kg; $e = 1.6 \times 10^{-19}$ C; $N_A = 6.023 \times 10^{23}$; $k_B = 1.38 \times 10^{-23}$ J/K; $\varepsilon_o = 8.85 \times 10^{-12}$ F/m; $\mu_B = 9.27 \times 10^{-24}$ Am²;