


Name:			
Enrolment No:			
<b>UPES</b> <b>End Semester Examination, May 2023</b>			
<b>Course: Condensed Matter Physics I</b> <b>Semester: II</b> <b>Program: M.Sc. (Physics)</b> <b>Course Code: PHYS 7020</b>		<b>Time : 03 hrs.</b> <b>Max. Marks: 100</b>	
<b>Instructions:</b>			
<b>SECTION A</b> <b>(5Qx4M=20Marks)</b>			
S. No.		Marks	CO
Q 1	State the Dulong -Petit law.	4	CO 2
Q 2	Define the concept of Fermi sphere.	4	CO 3
Q 3	The conductivity of n- type germanium semiconductor is $39 (\Omega m)^{-1}$ . If the mobility of electrons in germanium is $0.39 m^2 V^{-1}s^{-1}$ , then find the concentration of the donor atoms.	4	CO 3
Q 4	Describe Meissner effect.	4	CO 5
Q 5	What is ferroelectricity? Give an example of ferroelectric crystal.	4	CO 4
<b>SECTION B</b> <b>(4Qx10M= 40 Marks)</b>			
Q 6	What is Ewald construction? How does it help to interpret x-ray diffraction?  <b>OR</b> What is atomic structure factor? Derive the general expression for atomic structure factor using spherical polar coordinate.	10	CO1
Q 7	Discuss the Debye model of lattice heat capacity. What is Debye $T^3$ law?.	10	CO 2
Q 8	What are superconductors? Give a qualitative description of the BCS theory.	10	CO 5
Q 9	Derive the Clausius –Mossotti relation expressing the relation between dielectric constant and atomic polarizability.	10	CO 4
<b>SECTION-C</b> <b>(2Qx20M=40 Marks)</b>			
Q 10	(a) Silver (fcc) has an atomic radius of $1.44 \text{ \AA}$ . Assuming silver to be monovalent metal. Calculate the value of the Fermi energy, The Fermi temperature and the Fermi velocity.	15+5	CO 3

	(b) What is Bloch theorem? <b>OR</b> Discuss the Kronig- Penney model in detail and formation of allowed and forbidden energy bands.		
Q.11	Explain the origin of diamagnetism in material. Obtain an expression for diamagnetic susceptibility using Langevin's theory. What is the significance of negative susceptibility?	<b>5+10+5</b>	<b>CO 4</b>