


Name:			
Enrolment No:			
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES End Semester Examination, May 2022			
Course: Condensed Matter Physics I Program: MSc (Physics) Course Code: PHYS 7020		Semester: II Time: 03 hours Max. Marks: 100	
Instructions: <ul style="list-style-type: none"> All questions are compulsory (Q9 and Q11 have an internal choice). Scientific calculators can be used for calculations. 			
SECTION A (5Q x 4M = 20 Marks)			
S. No.		Marks	CO
Q1	What is a reciprocal lattice? Discuss some of its important properties.	4	CO1
Q2	A beam of x-rays is incident on a crystal having lattice spacing of 0.3 nm. The first order Bragg reflection is observed at an angle of 10° . What is the wavelength of x-rays? At what angle would the second reflection occur?	4	CO1
Q3	What are the ferroelectric and piezoelectric materials?	4	CO4
Q4	Superconducting critical temperature T_c of a sample with an isotopic mass of 204.87 g/mol is 19.2 K. Find T_c when isotopic mass changes to 218.87 g/mol.	4	CO5
Q5	With the help of a diagram illustrate how the density of states changes at a superconducting transition.	4	CO5
SECTION B (4Qx10M= 40 Marks)			
Q6	Find the volume of the first Brillouin zone of a simple cubic lattice.	10	CO1
Q7	Show that the kinetic energy of a three-dimensional gas of N free electrons at 0 K is $U_0 = 3NE_F/5$.	10	CO2
Q8	Calculate the Debye specific heat of copper at 10 K, given that the	10	CO2

	Debye characteristic frequency is 6.55×10^{12} Hz.		
Q9	<p>Derive the London equations for a superconductor and explain London's penetration depth.</p> <p style="text-align: center;">OR</p> <p>Derive a relation between the thermodynamic critical field and entropy difference between the superconducting and normal states.</p>	10	CO5
<p>SECTION-C</p> <p>(2Qx20M=40 Marks)</p>			
Q10	<p>Write short notes on</p> <ol style="list-style-type: none"> a) Crystal momentum b) Electron orbits and hole orbits c) Fermi surface and its importance d) Effective mass of an electron 	20	CO3
Q11	<ol style="list-style-type: none"> a) What are the characteristics of a ferromagnet. Discuss the magnetic domains and hysteresis in a ferromagnetic material. (10 M) b) Discuss Van Vleck paramagnetism and Pauli spin paramagnetism. (10 M) <p style="text-align: center;">OR</p> <p>Within the context of dielectrics discuss the local electric field in an atom. Discuss the Lorentz relation.</p>	20	CO4