


Name:			
Enrolment No:			
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES End Semester Examination, April/May 2024			
Course: Solid State Physics Program: B.Sc. (H) Physics Course Code: PHYS 3021		Semester : VI Time : 03 hrs. Max. Marks: 100	
Instructions: 1) Mention your Roll No. at the top of the question paper. 2) Attempt all the parts of a question at one place only.			
SECTION A (All questions are compulsory)			
S. No.		Marks	CO
Q 1	What is piezoelectric effect? Mention a few applications of piezoelectric effect.	2+2	CO1
Q 2	A magnetic field of induction $\mathbf{B} = 2.0 \text{ Wb/m}^2$ is applied perpendicularly to the plane of the electron's path of radius $5.1 \times 10^{-11} \text{ m}$. Calculate the change in magnetic moment of a circulating electron.	4	CO3
Q 3	Draw the fermi-energy diagram for intrinsic and extrinsic semiconductors.	4	CO3
Q 4	Write a short note on Meissner's effect.	4	CO1
Q 5	Differentiate between Type I and Type II superconductors.	4	CO2
SECTION B (All questions are compulsory)			
Q 6	A beam of X-rays of wavelength 1.54 \AA is incident on a cubic crystal at $13^\circ 40'$ when the first order Bragg's reflection occurs from (112) planes. Calculate the interatomic spacing.	10	CO4
Q 7	What is pyroelectricity? Explain with the help of an example.	10	CO2
Q 8	A current of 50 A is established in a rectangular slab of copper of width 2 cm and 0.5 cm thickness. A magnetic field of induction 1.5 T is applied perpendicular to both current and the plane of the slab. The Hall voltage developed across the slab is measured to be 3.29×10^{-7} volt. Calculate the concentration of the free electrons in copper.	10	CO3
Q 9	What do you mean by the London penetration depth? Show that the London penetration depth is given by the expression $\lambda = \left(\frac{m}{\mu_0 e^2 n_s} \right)^{1/2}$ where, the symbols have their usual meanings.	2+8	CO3

SECTION-C (Q10 is compulsory while Q 11 has internal choice)			
Q 10	Deduce an expression for the maximum angular frequency during the motion of atoms of monoatomic 1D crystal.	20	CO1
Q 11	Prove that the local field for structures possessing cubic symmetry is given by $E_L = E + \frac{P}{3\epsilon_0}$ where, the symbols have their usual meanings. OR Derive the Clausius-Mossotti equation in dielectrics.	20	CO2
Values of some physical constants: Planck's constant, $h = 6.6 \times 10^{-34}$ J.s Boltzmann's constant, $k = 1.38 \times 10^{-23}$ J/K Mass of electron, $m_e = 9.1 \times 10^{-31}$ Kg Mass of proton, $m_p = 1.67 \times 10^{-27}$ Kg Velocity of light, $c = 3 \times 10^8$ m/s Rydberg Constant, $R = 1.097 \times 10^7$ m ⁻¹ Avogadro's number = 6.023×10^{23} Permittivity of free space, $\epsilon_0 = 8.85 \times 10^{-12}$ F/m Permeability of free space, $\mu_0 = 4\pi \times 10^{-7}$ H/m			