mass.

(c) State the physical significance of the Hall effect. (9, 3, 3)

6. (a) Discuss the concept of local field in a dielectric and find the expression for the Lorentz local electric field?

(b) What is dipolar polarizability? Find the expression for the dipolar polarizability and plot the variation of Langevin's function with $a = \frac{pE}{k_B T}$ where p is the dipole moment E is the Lorentz field and T is the temperature. (6, 9)

7. (a) According to Landau's theory of phase transitions classify the phase transitions between ferroelectric and paraelectric, superconducting and normal and ferromagnetic and paramagnetic state as first order or second order phase transitions.

(b) Derive the London's equations for superconductivity and find the expression for London penetration depth. (3, 12)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 3382 **K**

Unique Paper Code : 32221502

Name of the Paper : Solid State Physics

Name of the Course : B.Sc. Hons.(Physics) - CBCS-LOCF

Semester : V (Reappear Papers)

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt five questions in all.
3. Question No. 1 is compulsory. Attempt four questions from the remaining questions
4. All questions carry equal marks.

1. 1. Attempt any five questions

(a) Find the numerical value of atomic packing factor

(APF) for a simple cubic lattice. (3)

(b) Draw (100), (110) and (111) planes in a cubic crystal. (3)

(c) State the assumptions made in Einstein's theory of lattice specific heat. (3)

(d) What happens to the magnetic susceptibility of a paramagnetic substance with increase in temperature? State Curie's law. (3)

(e) What factors affect the mobility of charge carriers in a semiconductor? (3)

(f) Plot the frequency dependence of total polarizability of a dipolar substance and indicate the regions for dipolar, ionic and electronic polarizability. (3)

(g) Discuss the effect of application of a magnetic field on superconductivity of a material with the help of a diagram. (3)

2. (a) Show that the reciprocal lattice of a BCC lattice is a FCC lattice.

(b) Find the Miller Indices for a set of parallel planes, which make intercepts in the ratio of 1:12:14on the coordinate axes. (10, 5)

3. (a) Derive an expression for the frequency of vibrations in a one-dimensional monoatomic lattice. Also, show that the speed of sound in the long-wavelength limit is independent of the wavevector.

(b) Calculate the Debye frequency (in hertz) for a diamond lattice that has a Debye temperature of 2230 K. (10, 5)

4. (a) Derive Langevin's expression for diamagnetic susceptibility and prove that it is negative and temperature-independent.

(b) Draw and explain the B–H hysteresis loop for a ferromagnetic material using the domain theory of magnetism.

(c) If the number of magnetic dipoles in a ferromagnetic material is $3 \times 10^{28}/m^3$ and the spin magnetic moment is 3×10^{-23} Am^2, determine the saturation magnetization. (6, 6, 3)

5. (a) Explain the Kronig–Penney model for a one-dimensional crystal lattice. Derive the equation that determines the allowed energy bands for an electron in a periodic potential.

(b) Show that for the free electron model, the effective mass of electron is equal to the free electron