



Reg. No. :

Name :

Fourth Semester M.Sc. Degree Examination, July 2018
Branch : PHYSICS
PH 241 : Condensed Matter Physics
(2009 Admin.)

Time : 3 Hours

Max. Marks : 75

PART – A

I. Answer **any five** questions. **Each** question carries **three** marks.

- a) Explain the two branches of the dispersion curve of a linear diatomic lattice.
- b) What is a colour centre ?
- c) Explain the concept of fermi surface.
- d) What is photoconductivity ?
- e) What are magnons ?
- f) Distinguish between type I and type II superconductors.
- g) What is STM ?
- h) Write a note on SNOM.

(5×3=15 Marks)

PART – B

- II. A) a) Derive an expression for the lattice heat capacity using Debye model.
b) Compare Einstein and Debye models for specific heat capacity.

OR

- B) a) Distinguish between Frenkel and Schottky defects. Obtain an expression for concentration of Schottky defects.
b) Explain Bloch's theorem.

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- III. A) a) Briefly describe the action of a p-n junction diode as a rectifier and obtain an expression for current voltage relation in a rectifier.
b) Explain the term quantum hall effect.

OR

- B) a) Explain the existence of pauli paramagnetism.
b) Write notes on :
i) Ferrites
ii) Spintronics.

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P.T.O.



- IV. A) a) Write notes on :
- Polarons and mass enhancement
 - Frohlich Hamiltonian.
- b) Explain spin waves in electron gas.

OR

- B) a) Explain ac Josephson effect.
- b) Write notes on :
- STS and
 - SCM.

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PART – C

V. Answer **any three** questions. **Each** question carries **five** marks.

- The Debye temperature of a sample is 2230 K. Calculate the highest possible vibrational frequency and molar heat capacity of the sample at 10 K.
 - The average energy required to create a Frenkel defect in an ionic crystal is 1.4 eV. Calculate the ratio of Frenkel defects at 300 K and book in 1 gram of crystal.
 - Calculate the intrinsic concentration of charge carriers in a semiconductor if $E_g = 0.67$ eV at 300 K. Given that $m_e^* = 0.12 m_0$ and $m_h^* = 0.28 m_0$.
 - The magnetic field in a material is 10^6 A/m. If its susceptibility is -0.6×10^{-5} , calculate the flux density, magnetization and relative permeability of the material.
 - A paramagnetic substance has 10^{28} atoms/m². The magnetic moment of each atom is 2.2×10^{-23} Am². Calculate its susceptibility and magnetization in a magnetic field at 10^5 A/m at 300 K.
 - Calculate the London penetration depth λ_0 at 0 K for a superconductor if $n = 3.29 \times 10^{28}$ /m³. What is its value at 3.61 K if its T_c is 7.22 K. **(3×5=15 Marks)**
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