



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.

**15**

- 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.

**15**

**P.T.O.**



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

OR

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

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PART – C

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

- a) 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.
  - b) 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.
  - c) 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  $m_h^* = 0.28 m_0$ .
  - d) The magnetic field in a material is  $10^6$  A/m. If its susceptibility is  $-0.6 \times 10^{-5}$ , calculate the flux density, magnetization and relative permeability of the material.
  - e) A paramagnetic substance has  $10^{28}$  atoms/m<sup>2</sup>. The magnetic moment of each atom is  $2.2 \times 10^{-23}$  Am<sup>2</sup>. Calculate its susceptibility and magnetization in a magnetic field at  $10^5$  A/m at 300 K.
  - f) Calculate the London penetration depth  $\lambda_0$  at 0 K for a superconductor if  $n = 3.29 \times 10^{28}$ /m<sup>3</sup>. What is its value at 3.61 K if its  $T_c$  is 7.22 K. **(3×5=15 Marks)**
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