

(FOR THE CANDIDATES ADMITTED  
DURING THE ACADEMIC YEAR 2022-23 ONLY)

SUBJECT CODE **22 UPS 615**

REG.NO.

**N.G.M.COLLEGE (AUTONOMOUS) : POLLACHI**  
**END-OF-SEMESTER EXAMINATIONS : MAY– 2025**

**B.Sc. – PHYSICS**

**MAXIMUM MARKS: 50**

**VI SEMESTER**

**TIME : 3 HOURS**

**PART – III**

**SOLID STATE PHYSICS AND STATISTICAL MECHANICS**

**SECTION – A**

**(10 X 1 = 10 MARKS)**

**ANSWER THE FOLLOWING QUESTIONS.**

**(K1)**

- The reciprocal lattice of an FCC lattice is  
(a) an SC lattice                      (b) a BCC lattice                      (c) an FCC lattice                      (d) none of these
- The dissociation energy of NaCl molecule into Na and Cl ions is  
(a) 3.6 eV                                  (b) 1.5 eV                                  (c) 4.5 eV                                  (d) 5.1 eV
- The energy spectrum of an electron moving in a periodic potential consists of  
(a) continuous energy regions                                  (b) forbidden energy regions  
(c) allowed and forbidden energy regions                      (d) zero energy regions
- Below transition temperature ( $T_c$ ) a superconductor exhibit  
(a) only zero resistance                                  (b) only diamagnetic property  
(c) zero resistance and diamagnetic property (d) zero resistance and paramagnetic property
- Constraints imposed on a system:  
(a) increase the number of inaccessible microstates.                                  (c) have no effect  
(b) decrease the number of inaccessible microstates.                                  (d) none of these

**ANSWER THE FOLLOWING IN ONE (OR) TWO SENTENCES.**

**(K2)**

- What is packing fraction? Provide the values of SC and BCC structures
- Give any three properties of metallic bonding.
- Write a short note on the effective mass of an electron.
- What is Meissner effect?
- Provide the basic rules of probability theorem.

**SECTION – B**

**(5 X 3 = 15 MARKS)**

**ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS. (K3)**

- Write short notes on Bravais lattice and Miller Indices.

**(OR)**

  - Prove that a reciprocal lattice vector is normal to a lattice plane of the crystal lattice.

12. a) What is ionic bonding? Give the characteristics of ionic bonds.  
(OR)
- b) Derive the expression for wave motion in a one-dimensional atomic lattice.
13. a) Explain the concepts of energy spectra in atoms, molecules, and solids.  
(OR)
- b) Discuss the formation of Brillouin zones for (i) linear and (ii) two- dimensional lattice.
14. a) Briefly explain the Weiss theory of para-magnetism.  
(OR)
- b) Define the Josephson effect. Discuss the formulation of AC Josephson effects.
15. a) What is the fundamental postulate of statistical thermodynamics regarding probability?  
(OR)
- b) How do the three statistical models relate to each other, and what are the key similarities and differences between them.

**SECTION – C****(5 X 5 = 25 MARKS)****ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.****(K4 (Or) K5)**

16. a) Explain the various symmetry operations that are present in the crystal.  
(OR)
- b) Write a short note on reciprocal lattice and discuss the experimental methodology of rotating crystal method.
17. a) What is the cohesive energy of a solid? Find its expression for ionic crystals.  
(OR)
- b) Explain the classical theory of lattice heat capacity using Dulong Petit's law.
18. a) Using the Kroning-Penny model, show that the energy spectrum of an electron consists of a number of allowed energy bands separated by forbidden regions.  
(OR)
- b) What is meant by the Hall effect? Discuss the experiment with a suitable diagram for finding the Hall coefficient and Hall voltage. Mention two applications of the Hall effect.
19. a). Deduce Langevin's formula for the molar susceptibility of diamagnetic materials.  
(OR)
- b) What is a Cooper pair? Discuss the origin of superconductivity in the view of BCS theory.
20. a) Discuss the concept of microstates and macrostates in statistical thermodynamics. How do These concepts relate to the idea of entropy?  
(OR)
- b) What is Bose-Einstein statistics? Derive an expression on Bose-Einstein Distribution law.