

M.Sc., Final Examinations,**December 2017***(Directorate of Distance Education)***PHYSICS****Paper– VII: DPB – 530: SOLID STATE PHYSICS – I**

Time: 3 hrs]

[Max. Marks: 75/85

Note:

Answer any FIVE questions from parts A, B and C without omitting any part (Common to All) Part – D is for the students whose max. marks is 85.

PART – A

1. a) Discuss the theory of dynamics of identical atoms in three dimensions. Discuss the modes of vibrations.
b) Explain the experimental measurement of dispersion relation. (9 + 6)
2. a) Discuss the relevant theory of electrical conductivity of a metal and obtain the expression for electrical conductivity to show that not all the free electrons contribute to electrical conductivity.
b) Explain the specific heat due to free electrons in metals. (9 + 6)
3. a) What is thermal conductivity? Explain. Obtain equations for thermal conductivity due to electrons and phonons in metals.
b) With neat diagrams, explain the normal and umklapp process of phonon-phonon interaction. (9 + 6)

PART – B

4. a) Explain a simple experimental setup that can measure the dielectric constant of a material.
b) Discuss the necessary theory to arrive an equation for dipole polarization of a medium in terms of local electric field. (5 + 10)
5. a) With suitable examples, explain the different class of ferroelectric materials.
b) Describe the microscopic theory of ferroelectric phenomenon and show that the local field enhances the dielectric constant of a medium. (7 + 8)
6. a) With a neat diagram, explain the Franck – Condon principle.
b) What are Gudden – Pohl and Destrain effects? Explain them with diagrams. (7 + 8)

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PART – C

7. a) Mention different lattice defects in an ionic crystal. Obtain an expression for equilibrium concentration of Schottky defects.
b) Explain the measurement of activation energy in an ionic crystal. (9 + 6)
8. a) State and explain the first and second Fick's laws of diffusion.
b) Explain the theory random walk of atomic diffusion and obtain an expression for diffusion coefficient. (7 + 8)
9. a) Briefly explain theory the experimental setup for the photoelectric effect.
b) Give an account of color centers in alkali halide crystals. Explain the technique that produce color centers in alkali halides. (6 + 9)

PART – D

10. *Write a note on any TWO of the following:* $2 \times 5 = 10$
a) Explain Mattiessen's rule and its significance.
b) The formation of ferroelectric domains.
c) Write a note on applications of diffusion.

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