5. (a) Define Origin of the energy gap and solve the wave equation of electron in a periodic potential.

Or

(b) Discuss the restatement of Block Theorem and explain the number of orbitals in a band, metals and insulators.

6. (a) Give the theory of intrinsic semiconductor and obtain an expression for the carrier density of an intrinsic semiconductor.

Or

(b) Explain what is meant by polarization in dielectrics. Arrive at the relation between the dielectric constant and atomic polarizability.

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2017

Time : 3 hours

Full Marks : 80

Answer from **both** the Sections as per directed

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words as far as practicable

(BASIC SOLID STATE PHYSICS)

SECTION—A

1. Answer any *four* questions : 4×4

(a) Briefly explain vibrations of diatomic lattice.

(b) Explain the effect of temperature on the Fermi-Dirac distribution function.

(2)

(c) State and explain Hall effect.

(d) Briefly explain the free electron model.

(e) Explain briefly the point defects.

(f) Write a note on ionic conductivity.

Or

2. Answer *all* questions :   2 × 8

(a) Define cohesive energy.

(b) What are long wavelength limits ?

(c) Define heat capacity.

(d) State Ohm's law.

(e) Define thermal conductivity.

(f) Define band gap.

(g) What is defect ? Explain.

(h) What do you mean by Lorentz field ?

(3)

SECTION—B

Answer **all** questions :   16 × 4

3. (a) What are the forces contributing to the binding of an ionic crystal ? What do you understand by Madelung constant ? Obtain an expression for the lattice energy of an ionic crystals.

Or

(b) Derive an expression for phonon dispersion in a monoatomic lattice and explain what are optical and acoustic modes.

4. (a) Obtain Debye T^3 law and explain the Einstein's theory of the specific heat.

Or

(b) Derive expressions for electrical conductivity and thermal conductivity on the basis of classical free electron theory.