Exam.Code:0005
Sub. Code: 0448

2021
B.A./B.Sc. (General) Fifth Semester
Physics
Paper – A: Condensed Matter Physics – I

Time allowed: 3 Hours | Max. Marks: 44

NOTE: *Attempt five questions in all, including Question No. VII (Unit-III) which is compulsory and selecting two questions each from Unit I - II. Use of log tables and non-programmable calculator is allowed.*

x-x-x

UNIT – I

I. a) Deduce an expression for the distance between two adjacent planes of a simple cubic lattice.

b) Copper has FCC structure and atomic radius is 0.1278 nm. Calculate the interplanar spacing for (111) and (321) planes. (5,4)

II. a) Explain the crystal structure of diamond. Draw it. Also find its packing fraction.

b) What do you mean by Brillouin zones? Derive expression for Brillouin zone for SC lattice. (5,4)

III. a) Derive the Lane's equations of diffraction for X-rays and obtain Bragg's diffraction condition for them.

b) What is reciprocal lattice? Show that BCC lattice is the reciprocal of the FCC lattice. (5,4)

UNIT – II

IV. a) Determine expressions for wave function and energy eigen values for electrons confined in one dimensional rectangular box of length L. Also obtain the expressions for the Fermi energy and density of states of this system.

b) Show that in one dimensional problem the average Kinetic Energy in the ground state is one third of the Fermi energy. (6,3)

V. a) Discuss Kronig-Penny model for electron energy in solids and show how it explains the forbidden bands.

b) Define effective mass of electron. What is its significance? (7,2)

P.T.O.

VI. a) Explain why at high temperatures, an extrinsic semiconductor behaves like intrinsic semiconductor?

b) Calculate the concentration of acceptor atoms that have to be added to an intrinsic semiconductor to produce a p-type semiconductor of conductivity 0.056 mho per m. Given the mobility of holes in semiconductor is $0.4 m^2/Vs$. (6,3)

UNIT – III

VII. Answer any eight of the following:-

a) What is Fermi gas?

b) Why visible light can't be used to study diffraction from crystal?

c) Define atomic scattering factor.

d) State Wiedemann-Franz relation.

e) What are direct and indirect semiconductors?

f) State Bloch theorem.

g) Give diffraction condition for reciprocal lattice.

h) Explain the phenomena of Hall Effect.

i) What are Miller indices?

j) What is the charge on p and n-type semiconductors? (8x1)

x-x-x