**ST.JOSEPH’S COLLEGE (AUTONOMOUS), BANGALORE-27**

B.Sc. PHYSICS - VI SEMESTER

**Special Supplementary Examination, JUNE 2019**

**PH 6115 : Solid State And Statistical Physics**

**Time: 2½ hrs Max. Marks: 70**

*This question paper has* ***two*** *printed pages and* ***three*** *parts*

Supplementary candidates only.

**PART - A**

Answer any **FOUR** of the following (4 x 10 = 40)

1. a) Distinguish between crystalline material and non-crystalline material.

b) Give the theory of Compton Effect. (2+8)

2. a) Deduce an expression for the Einstein’s theory of specific heat of solids.

b) Discuss the results at T=0 and at T = Infinite temperature. (7+3)

3. a) Obtain an expression for electron concentration in an intrinsic semiconductor.

  b) Write the applications of Hall Effect. (7+3)

4. a) What are Miller Indices? Determine the Miller indices of a plane whose intercepts

are 4a, 2b, 1c along the three crystallographic axes.

b) Explain Persistent current, Meissner effect in superconductors. (5+5)

5. a) State Fermi-Dirac distribution function and obtain an expression for Fermi energy

at zero Kelvin.

b) What is Fermi level? Discuss how does it vary with temperatures? (6+4)

6. a) Compare the classical and quantum statistics.

b) Derive Bose - Einstein distribution law. (3+7)

**PART - B**

Solve any **FOUR** of the following: (4 x 5 = 20)

7. Calculate the interplanar spacing between (111), (200), (220) planes in FCC

Crystal. Given the atomic radius is 1.246Å.

8. A sample of P-type germanium block with donor density 1022/m3 is used in Hall

effect experiment in which a magnetic field of 0.5T is used and a current of density

4 A/m2 is passed. If the thickness of the sample is 4 mm, find the Hall coefficient

and Hall voltage developed.

9. Find the relaxation time of conduction electrons in a metal of resistivity 1.54 x 10-8 Ώm,

If the metal has 5.8 x 1028 electrons / m3. Using the above result, calculate the drift

velocity for an electric field of 1 volt/cm.

10. The wavelength of Kα X- ray line for tungsten target is 0.21Å. What would be the       wavelength for a copper target? Atomic no. of tungsten = 74 and that of copper = 29.

11. Calculate the Fermi energy and Fermi velocity of free electron in rubidium at

Zero Kelvin. Given the value of n = 10.74 x 1027 / m3.

12 A system consists of 6 particles arranged in two compartments. The first compartment is

divided into 5 cells and the second into 8 cells. The cells are of equal size. Calculate the

number of microstate in the macro state (4,2) if the particles obey (a) Maxwell-Boltzmann

statistics (b) Bose - Einstein statistics (c) Fermi Dirac statistics.

**PART – C**

13. Answer any **FIVE** of the following: (5x 2 = 10)

1. Is it possible to observe crystal diffraction when an ordinary light of

wavelength is incident on a crystal? Explain.

1. Differentiate between Unit cell and Primitive cell.
2. How does the occupation number vary with temperature in M-B statistics?
3. What is the main condition with regard to the number of quantum states

and number of particles according to Fermi-Dirac statistics?

1. Is the DC Josephson Effect is same as that of AC Josephson Effect.Give reason.
2. Where does the Fermi level lie in case of p-type and n-type semi-conductor?