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

B.Sc. PHYSICS - VI SEMESTER

SEMESTER EXAMINATION - APRIL 2020

**PH 6115 – SOLID STATE AND STATISTICAL PHYSICS**

**Time: 2½ hrs Max. Marks: 70**

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

**PART - A**

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

1. a) Describe the production of x-rays using Coolidge tube. Mention how the quality and

quantity of x-ray can be controlled.

b) Derive an expression for interplaner distance between the lattice planes of a simple

cubic crystal. (5+5)

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

b) Discuss the results at low and high temperature. (7+3)

3. a) Explain the concept of effective mass of an electron.

b) Derive an expression for concentration of electrons in an intrinsic semiconductor (3+7)

4. a) Give the differences between Type I and Type II superconductors.

b) Explain different symmetry elements in crystal. (6+4)

5. a) What are the fundamental postulates of statistical mechanics.

b) Derive Maxwell Boltzmann distribution law. (2+8)

6. a) Give the differences between classical and quantum statistics.

b) Write the expression for Fermi –Dirac distribution function and arrive at an

expression for Fermi energy at zero kelvin. (3+7)

**PART - B**

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

7. X-rays of wavelength 0.5 Å are made to incident on a crystal plane which is parallel to Y-axis and cuts intercepts of 2 and respectively along x and z axes. If edge of the unit cell is 5.62 Å, calculate the glancing angle for the first order Bragg’s reflection.

8. A monochromatic X-ray beam of wavelength 0.15 Å undergoes Compton Effect from a carbon block. Calculate the wavelength scattered through i) 135° ii) 180° iii) 45°

9. When a potential difference of 5V is applied across a wire of length 1m, it carries a current of 1.2A. If the cross-sectional area is 1.2 mm2 and the electron density of copper is

8.5 x 1028/ m3, Calculate average drift velocity and relaxation time of the electrons.

10. A sample of P-type germanium has donor density 10**21**/m3. It is used in a Hall effect experiment in which a magnetic field of flux density 0.5 T is used and a current of density

24A /m2 is passed. If the thickness of the sample is 6mm, find the Hall coefficient and the Hall voltage developed. PH-6115-B

11. A system consists of 5 particles arranged in two compartments. The first compartment is divided into 4 cells and the second into 6 cells are of equal size. Calculate the number of microstates in the macro states (3, 2) if the particles obey i) M-B ii) B-E and iii) F-D statistics.

12. For a certain star the D**1** line of sodium atom with wavelength 5896 Å shows a Doppler broadening of 0.1 Å. Calculate the surface temperature of the star. The rest mass of sodium atom is 3.8 x 10**-23**g.

**PART – C**

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

a) How does resistivity varies with temperature in the case of metal? Explain.

b) How are x-rays classified based on their penetrating power?

c) Where does the Fermi level lies in the case of intrinsic semiconductor? Explain

d) What is the condition for electrons to travel as Cooper pair?

e) Find the probability of drawing 3 kings in succession from a pack of 52 cards?

f) Black body radiation is explained using B-E statistics. Justify.

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