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

**B.Sc. PHYSICS - VI SEMESTER**

**SEMESTER EXAMINATION - APRIL 2020**

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

**Time: 2 ½ 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) Explain the various  point group symmetry operations.

 b) Obtain Braggs law of X –ray diffraction. Mention its limitations. (5+5)

2. a) What is Compton effect? Calculate the minimum and maximum values of the

 Compton shift.

 b) Distinguish between type I and type II superconductor. (5+5)

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

 b) Write a note on solar cell. (7+3)

4. 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 temperature? (6+4)

5. a) What are the assumptions of Einstein’s theory of specific heat of solids?

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

 Discuss the results at low and high temperatures. (2+8)

6. a) Represent Maxwell distribution of molecular velocities graphically and mark

 r.m.s., mean and most probable velocity.

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

**PART - B**

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

7. Sodium metal with a bcc structure has two atoms per unit cell. The radius of atom

 is 1.732Å.Calculate its electrical resistivity at 0°C, if the classical value of mean

 free time is 3 x 10-14 seconds.

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8. If the potential difference applied across an X-ray tube is 10kV and the current through

 It is 12mA, Calculate i) the number of electrons striking the target per second

 ii) The speed at which they strike target and iii) the wavelength of the X-rays produced.

9. The wavelength of kα X-ray line for tungsten target is 0.21 Å. What would be the

 wavelength for a copper target? Atomic number of the tungsten =74 and that of copper =29.

10.A sample of P-type germanium has donor density 1021/m3 .It is used in a Hall Effect

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

 density 24 A / m2 is passed. If the thickness of the sample is 6 mm, find the

 Hall coefficient and the Hall voltage developed.

11.Calculate the Fermi energy and Fermi temperature in a metal. Fermi velocity of electron        in the metal is 0.86 x 106m/s.

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 and F-D statistics.

**PART – C**

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

a) Why spectral lines are not sharp, but have finite width?

b) A perfect superconductor is perfectly diamagnetic.Justify.

c) In the intrinsic semiconductor n=p .Is the current due to electrons and holes same? Explain.

d) How does the frequency of characteristic X-rays varywith atomic number of anode?

e) What is the minimum size of a cell (state) in phase space according to Classical and

 Quantum statistics?

f) In metals as the temperature increases, what happens to the conductivity? Justify.

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