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

B.Sc. PHYSICS – VI SEMESTER

SEMESTER EXAMINATION- APRIL 2018

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

Time: 2½ hrs       Max.Marks:70

*This paper contains* ***two*** *printed pages and* ***three*** *parts*

**PART-A**

Answer any **four** of the following:                [4x10=40]

1.a) What is space lattice? Mention the seven crystal systems.

   b) Explain the various symmetry elements present in a cubic crystal.                                 [4+6]

2. a) State and explain Moseley’s law.

    b) Explain the Meissner effect, critical field and persistence of current in a superconductor.                                                                                                                                           [4+6]

3. a) Describe Hall effect in metals. Deduce an expression for Hall coefficient in metals.

    b) Write a brief note on solar cells.                                                                               [7+3]

4. a) Discuss Einstein’s theory of specific heat of solids and arrive at an expression for the   specific heat.

     b) Give the differences between Type I and Type II superconductors.                             [7+3]

5. a) Using the basic postulates of statistics, derive Maxwell-Boltzmann distribution law .

  b) Draw the graph of Maxwell–Boltzmann velocity distribution curve and indicate r.m.s      velocity, average velocity and most probable velocity on the graph.                           [8+2]

6. a) Distinguish between Bose - Einstein and Fermi-Dirac statistics.

    b) Define Fermi function. Obtain an expression for Fermi energy of electrons at 0 K.      [3+7]

**PART-B**

Solve any **four** of the following:                                                                                  [4x5=20]

7.  A monochromatic X-ray beam of wavelength 0.7Å undergoes first order Bragg’s reflection from the plane (3 0 2) of a cubic crystal at a glancing angle of 35$°. $Calculate the lattice constant and the atomic radius , if the crystal has fcc structure.

8. The thickness and area of cross section of a germanium plate are 0.4mm and 1cm2 respectively. When a potential difference of 2V is applied between its faces, the mobility of electrons and holes are 0.38 m2/ V-s and 0.2 m2/V-s respectively. Calculate the electrical conductivity and current produced, if the carrier concentration in germanium is 3x1019 m-3.

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9. X-rays of wavelength 0.1nm are scattered from a target. Find a) the wavelength of X-rays scattered through 45$°$ b) the maximum wavelength present in the scattered X-rays.

10. Find the electrical resistivity and thermal conductivity of copper at 27$℃$ from the given data. Density of copper= 8940 kgm-3, atomic weight of copper= 63.5, relaxation time= 2.48x10-14s. Lorentz number =2.26x10-8 WΩK-2

11. A system consists of five particles arranged in two compartments. The first compartment is divided in to 6 cells and second in to 8 cells. The cells are of equal size. Calculate the number of microstates in the macrostate (2, 3) if the particles obey (i) B-E statistics and (ii) F-D statistics.

12. The Fermi velocity of electrons in a metal at 0 K is 1x106 m/s. Calculate the Fermi energy  and average energy of electrons. Also find the Fermi temperature of the metal.

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**PART-C**

13.  Answer any **five** of the following:                                                                             [5x2=10]

a) Among sc, bcc and fcc crystalline structure in which one, are the atoms most densely packed?

b) What happens to λmin of X-rays, when the potential difference between the electrodes of an X- ray tube is increased?

c) Why in metals, as the temperature increases the electrical conductivity decreases?

d) Is the current due to electrons and holes same in an intrinsic semiconductor? Justify.

e) Why the choice of cell size is immaterial as far as classical statistics is concerned?

f) The width of the spectral lines of hydrogen atom is broader than silver atoms. Explain.