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Register Number:

DATE: **13** **-04-2018 (1PM)**

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

B.Sc. PHYSICS - VI SEMESTER

SEMESTER EXAMINATION - APRIL 2018

**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) What is Compton effect? Give the theory of Compton Effect.

b) Differentiate between Primitive and Unit cell. (8+2)

2. a) Obtain an expression for the electrical conductivity of metals based

on the free electron theory and hence arrive at Ohm’s law.

b) State and explain Widemann – Franz law. (7+3)

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

b) Explain the concept of effective mass. (8+2)

4. a) Explain critical field, Meissner effect and persistent currents in superconductor.

b) Write a note on Solar cell (7+3)

5. a) Write the expression for Fermi-Dirac distribution function and arrive at

an expression for Fermi energy at zero Kelvin.

b) Represent Maxwell distribution law of molecular velocities graphically

and mark r.m.s., mean and most probable velocity. (7+3)

6. a) Derive Bose - Einstein distribution law.

b) Give the differences between Classical and Quantum Statistics. (7+3)

**PART - B**

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

7. In a simple cubic crystal, a crystal plane has intercepts at 2a and 3b

along the crystallographic axes. If edge of the unit cell is 2.45 Å,

calculate the interplanar distance.

8.  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.

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9. Find the drift velocity of the free electrons in a copper wire if its cross-sectional

area is 2.4 mm2 when the wire carries a current of 1.2 A. Assume that each

copper atom contributes one electron to the electron gas.

Given: density of copper = 8.94x103 kg/m3 and atomic weight = 63.5 gm wt.

10. If the potential difference applied across an X-ray tube is 20 kV and the current

through it is 24 mA, 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?

11. A system consists of 6 particles arranged in 2 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 (i) M- B, and (ii) B –E, statistics.

12. There are 3x1028 electrons per cubic meter in sodium. Calculate Fermi

energy and Fermi velocity of electrons in sodium.

**PART – C**

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

a) Can we use any source of light to analyse crystal structure? Explain.

    b) The mobility of conduction electrons is more than that of holes.

Give reason.

c) Do protons and neutrons obey all the statistics? Why?

d) Is there a current flowing through a metal when a thermal gradient is

applied to it? Explain.

e) What is the basic principle behind magnetic levitation?

f) Mention the limitations of Bragg’s condition.