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

**Date: 12/04/2019**

B.Sc. PHYSICS - VI SEMESTER

SEMESTER EXAMINATION - APRIL 2019

**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) Explain in detail the Coolidge tube method of producing X-rays.

b) Derive the expression for the interplanar spacing of the crystal planes. (5+5)

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) Distinguish between continuous and characteristic X-rays. (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) Distinguish between Type I and Type II superconductor.

b) Write a note on Light Emitting Diode. (6+4)

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

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

b) Explain Maxwell distribution law of molecular velocities using graph.

6. a) Derive Maxwell -Boltzmann distribution law.

b) Compare the Bose-Einstein and Fermi – Dirac. Statistics. (7+3)

**PART - B**

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

7. Calculate the glancing angle on the plane (212) of a cube of a rock salt

(a =2.81Å) Corresponding to second order diffraction maximum for the

X-rays of wavelength 0.81Å.

8.  A current of 3A flows along the length of a metal bar with rectangular cross

section of 6 mm 2 . When a static magnetic field of 2T is applied along one

side of its cross sectional face a Hall voltage of 10µV develop between a

pair of parallel surfaces that are separated by 2mm.Calculate the Hall

coefficient and the current carrier concentration.

9. Calculate the mobility of electrons in copper assuming that each atom

contributes one electron for conduction. Resistivity of copper =1.7 x 10-8 Ω m

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

10. Calculate the atomic radius of Fe which has BCC structure. Given the density

of iron 7.86 gm/cm3 and atomic weight 55.85.

11 Eight distinguishable particles are distributed among 3 compartments. Find the total

number of ways of arrangement. Also find the probability of a microstate under the         macro state (4, 3, 1) and (3, 3, 2).

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

     and Fermi velocity.

**PART – C**

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

a) Determine the intercepts made by the crystal plane (1 2 3) on the

Crystallography axis.

    b) How does the frequency of a characteristic X-ray vary with the atomic

number of the target?

c) What are bosons? Which statistics is used to study them?

d) For a given number of particles and cells, which statistics has highest

Thermodynamic probability?

e) What is the basic principle behind magnetic levitation?

f) Hall coefficient for metals is negative. Justify.

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