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

B.Sc. PHYSICS-VI SEMESTER

SEMESTER EXAMINATION – April 2022

(Examination conducted in July 2022)

**PH 6118: Solid State and Statistical Physics**

TIME:2$½$ hours Max: Marks-70

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

**PART – A**

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

1.a) Define unit cell. Mention the 7 crystal systems along with their lattice parameters.

 b) Explain Moseley’s law of X-ray spectra. Mention it’s significance. (7+3)

2. a) Distinguish between continuous and characteristic X-rays.

 b) Give the theory of Compton effect. Obtain an expression for Compton shift.

 (2+8)

3. a) Write the important assumptions of free electron theory of metals.

 b) Derive an expression for the hole concentration in an intrinsic semiconductor. (3+7)

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

 specific heat.

 b) Write a brief note on solar cell. (8+2)

5. a) How does Classical statistics differ from Quantum statistics?

 b) Based on the postulates of statistical mechanics derive an expression for Bose-Einstein

 distribution law. (3+7)

6. a) Define Fermi energy. Explain the variation of Fermi function at different temperatures.

 Represent it graphically.

 b) Draw the graph of Maxwell - Boltzmann velocity distribution and give any two features

 of the distribution curve. (7+3)

**PART-B**

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

7. The interplanar spacing of (110) plane is 2 $Å$ for a cubic crystal having FCC structure.

 Find out the atomic radius.

8. First order Bragg’s reflection occurs when a monochromatic beam of X-rays of wavelength

 0.675$ Å$ is incident on a crystal at a glancing angle of 4.85$°$. What is the glancing angle for

 the third order Bragg reflection to occur?

9. Calculate the electrical conductivity and thermal conductivity of copper at 27$°$ C from the

 following data. Density of copper = 8940kgm-3, atomic weight of copper = 63.5, relaxation

 time = 2.48x10 -14 s, and Lorentz number= 2.26x10-8 w$Ω$K-2

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10. In a Hall effect experiment, a potential difference of 4.5 μV is developed across a foil of

 Zinc of thickness 0.02mm, while carrying a current density 1.5 Am-2 in a direction

 perpendicular to the applied magnetic field of 2T. Calculate a) Hall coefficient for zinc

 b) concentration of electrons.

 11. Nine particles are arranged in three compartment system. The first compartment is

 divided into six cells and the second into five cells and third into three cells. Calculate the

 number of microstates or thermodynamic probability of the macrostate (4,3,2) if the

 system obeys M-B statistics.

12. Calculate the Fermi energy, Fermi velocity and Fermi temperature for a metal of atomic

 weight 23 and density 971kg/m3. It has one conduction electron per atom.

**PART- C**

13. Answer any **five** of the following. [2x5=10]

a. X-rays are not deflected by a magnetic field. Justify.

b. How does a superconductor differ from a normal conductor? Explain.

c. What happens to the resistivity of a metal when the mobility of the electrons increases?

d. What is the value of Debye frequency for copper if its Debye temperature is 230 K?

e. Mention the significance of the most probable macrostate in determining the behaviour of

 a system?

f. Among Hydrogen and Caesium which element will have sharper spectral lines? Explain

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