

**Q.P. Code – 22631**

**Sixth Semester B.Sc. Degree Examination, September 2020**

*(Non-CBCS – Semester Scheme)*

**Physics**

**Paper VII (601) – STATISTICAL PHYSICS AND  
SOLID STATE PHYSICS**

*Time : 3 Hours]*

*[Max. Marks : 60*

*Instructions to Candidates : Answers should be written completely in English.*

**PART – A**

Answer any **FIVE** of the following questions. Each question carries **6** marks :

**(5 × 6 = 30)**

1. Obtain Maxwell-Boltzmann Distribution law. **(6)**
2. (a) What is fermi gas? **(1 + 5)**  
(b) Derive an expression for fermi energy of a metal at Zero Kelvin. **(1 + 5)**
3. (a) Write a note on properties of nano scale system. **(4 + 2)**  
(b) Mention four applications of nano structures. **(4 + 2)**
4. What are X-rays? Describe the production of X-rays by Coolidge tube method. **(1 + 5)**
5. (a) State Mosley's law. **(1 + 5)**  
(b) Obtain an expression for the spacing between lattice planes of cubic crystals. **(1 + 5)**
6. (a) Distinguish between conductors, insulators and semiconductors on the basis of Band theory of solid. **(4 + 2)**  
(b) Define intrinsic and extrinsic semiconductor. **(4 + 2)**
7. Derive an expression for carrier concentration of electrons in an intrinsic semiconductor. **(6)**
8. Explain the working of (a) light emitting diode (b) light dependent resistor. **(3 + 3)**

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### PART – B

Answer any **FOUR** of the following questions. Each question carries **5** marks :

(4 × 5 = 20)

9. Copper has a mass density  $\rho_m = 8.95 \text{ gcm}^{-3}$  and an electrical resistivity  $\rho = 1.55 \times 10^{-8} \Omega\text{m}$  at room temperature. Assuming that the effective mass  $m^* = m_0$ . Calculate the concentration of conduction electrons and mean free time.  
Given  $z_v = 1$  for Cu,  $N_A = 6.023 \times 10^{23}$ ,  $M = 63.5 \times 10^{-3} \text{ kg}$  for Cu,  $e = 1.6 \times 10^{-19} \text{ coulomb}$ ,  $m^* = m_0 = 9.1 \times 10^{-31} \text{ kg}$ .
10. Sodium has  $2.5 \times 10^{26}$  free electrons per  $\text{m}^3$ , calculate the Fermi energy and Fermi velocity. Effective mass of electron =  $1.2 m_0$ , where  $m_0$  is rest mass of electron =  $9.1 \times 10^{-31} \text{ kg}$ .
11. X-rays are scattered by carbon and observed at  $90^\circ$  to the incident beam. Calculate the Compton shift. When the shift becomes zero and maximum? Given  $h = 6.625 \times 10^{-34} \text{ js}$ .
12. Find the interplanar spacing for lattice planes of Miller indices (3 2 1), (2 1 0), (1 1 1) for a cubic lattice with  $a = 5.62 \text{ \AA}$ .
13. A conducting rod contains  $8.5 \times 10^{28}$  electrons per  $\text{m}^3$ . Calculate the resistivity at room temperature and also the mobility of electrons, if the collision time for electron scattering is  $2 \times 10^{-14} \text{ sec}$ .
14. Calculate the Hall coefficient of sodium if the number of free electrons per unit volume is  $2.55 \times 10^{28}$ .

### PART – C

Answer any **FIVE** of the following questions. Each question carries **2** marks :

(5 × 2 = 10)

15. (a) Do Bosons and Fermions have different functions? Explain.  
(b) Does the ratio of thermal to electrical conductivity of a metal depend on temperature? Explain.

- (c) X-rays are not deviated by a magnetic field. Explain.
- (d) What are smart materials?
- (e) What is a dynamic smart material? Give an example.
- (f) A substance has an angular momentum. Whether it is paramagnetic or diamagnetic?
- (g) What are lyotropic liquid crystals?
- (h) Name a liquid crystal which is of biological importance.

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