

0101N1429

Candidate's Seat No : _____

M.Sc. Sem.-1 Examination

403

Medical Physics

January-2024

Time : 2-30 Hours]

[Max. Marks : 70

Q.1 (a) Describe Rotating crystal method for X-ray diffraction [14]

(b) Give brief introduction about X-rays and discuss Bragg's law $n\lambda = 2d \sin \theta$

OR

Q.1 (a) What do you understand by Reciprocal system? Discuss construction of Reciprocal lattice of simple cubic system. [14]

(b) Describe Debye model for specific heat.

Q.2 (a) Consider free electron gas in a one dimensional box of length L and obtain its allowed wave functions. Show that energy eigen values E_n for electron is proportional to n^2 . [14]

(b) Discuss the formation of energy bands in the solid. What is density of states? Show that it has the same meaning as $Z(E)$ in the Fermi distribution function.

OR

Q.2 (a) Discuss the behavior of an electron moving in one-dimensional periodic potential $V(x)$ having period 'a' using Kronig-Penney model and show that the solution of Schrodinger equation for such an electron leads to the condition [14]

$$P \frac{\sin \alpha a}{\alpha a} + \cos \alpha a = \cos ka$$

(b) What is Hall Effect? Deduce an expression for Hall coefficient of a solid having only one type of charge carriers. A current of 10 mA flows through n-type Ge strip of 1 mm thickness and 1mm width placed in a magnetic field B. If the voltage produced across the strip is 1 mV, determine the magnitude of B. (Given: Hall coefficient = $10^{-2} \text{ m}^3/\text{C}$)

Q.3 What are antiferromagnetic materials? Discuss the phenomenon of antiferromagnetism for (i) $T > T_N$ and (ii) $T < T_N$, where T_N is Neel temperature. [14]

OR

Q.3 (a) Explain the Meissner effect. Show that superconductor behaves like diamagnet. [14]

(b) What is a SQUID? Explain how this interferometer leads to oscillations. Describe how superconductors can be useful as switching devices.

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- Q.4** (a) List four polarization processes and discuss any one with relevant equations [14]
(b) Give brief introduction about dielectric materials. List name of three dielectric materials and write four Maxwell's equations

OR

- Q.4** (a) Give brief introduction about photoconductivity and photoconductive effect. [14]
List various types of photoconductivity. List name of three photoconductive materials. List two applications of photoconductive cells.

(b) Discuss dielectric constant with relevant equation and derive Clausius-Mosotti relation.

- Q.5** Attempt any **seven** out of twelve from the following (Each question is of **two** [14] marks):

- (i) Which type of superconductors exhibit vortex region on their magnetization curve?
- (ii) The fermi energy of silver is 5.51 eV. What is the average energy of free electron at 0 K?
- (iii) Which statistics does a cooper electron pair follow?
- (iv) A paramagnetic material has susceptibility of 2.8×10^{-4} at 350 K. Calculate its susceptibility at 300 K.
- (v) What is a Fermi sphere?
- (vi) What do you mean by the term coercivity in context to Hysteresis (B→H) curve for the ferromagnetic materials?
- (vii) Write two drawbacks of photoconductive cells.
- (viii) What is local electric field?
- (ix) Define dipole moment.
- (x) Write an appropriate equation for Polarization vector
- (xi) Explain electric flux density in brief.
- (xii) Define dipole.

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