

M.Sc. Sem.-1 Examination

403

Medical Physics

March 2022

Time : 2-00 Hours]

[Max. Marks : 50

Instructions: All questions in **Section – I** carry equal marks.
Attempt any **Three** questions in **Section – I**.
Questions in **Section – II** is **COMPULSORY**.

Section – I

- Q-I A. What is Bragg's law? Discuss Laue X-ray diffraction method 7
B. Discuss rotating crystal X-ray diffraction method 7
- Q-II A. Discuss Powder X-ray diffraction method. Write an equation for Bragg's law. 7
B. Give brief introduction of heat capacity of a solid and discuss Einstein's theory on heat capacity of a solid 7
- Q-III A. Derive Fermi Dirac distribution for free electron gas. Using it obtain the equation for the Fermi energy and average kinetic energy at an absolute zero temperature. 7
B. State and prove Bloch theorem. 7
- Q-IV A. The solution of Schrodinger equation for an electron in one-dimensional periodic potential leads to the condition

$$P \frac{\sin \alpha a}{\alpha a} + \cos \alpha a = \cos ka$$
Discuss the formation of energy bands on the basis of Kronig-Penney model. 7
B. What is Hall effect? Deduce an expression for Hall coefficient of a solid having only one type of carriers. 7
- Q-V A. What is hysteresis? Discuss the hysteresis in ferromagnetic materials. 7
B. Discuss the classical theory of diamagnetism and derive Langevin equation. 7
- Q-VI A. Explain the Meissner effect. Show that superconductor behaves like diamagnet. 7

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- B. Derive the London equations for the macroscopic theory of superconductors and discuss how does it help in understanding super conducting state of material. What is penetration depth? 7
- Q-VII A. Discuss theory of electronic polarizability and optical absorption 7
B. Discuss polarization of dielectric materials and discuss dielectric constant with relevant equations. 7
- Q-VIII A. What do you understand by 'photovoltaics'? Discuss working function of it. Write uses and advantages of photovoltaic solar cells 7
B. Derive Clausius-Mosotti equations 7

Section – II

- Q-IX MCQs 8
1. In phonon vibrations frequency of an optical branch is
A. $>$ acoustic branch B. $=$ acoustic branch
C. $<$ acoustic branch D. independent
2. Debye temperature (θ_D) =
A. $\frac{k}{hv_m}$ B. $\frac{kh}{v_m}$
C. $\frac{v_m}{kh}$ D. $\frac{hv_m}{k}$
3. The Hall coefficient for n-type semiconductor is
A. $R_H = \frac{1}{n_e}$ B. $R_H = -\frac{1}{n_e}$
C. $R_H = \frac{r}{n_e}$ D. $R_H = rn_e$
4. The temperature at which antiferromagnetic substance behaves as paramagnetic is called
A. Debye temperature B. Curie temperature
C. Fermi temperature D. Neel temperature
5. The energy spectrum of an electron moving in a periodic potential consists of
A. continuous energy regions. B. forbidden energy regions.
C. forbidden and allowed energy regions. D. intermediate energy regions.

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6. Which statistics does a Cooper pair follow?
- A. Maxwell-Boltzmann B. Fermi-Dirac
C. Bose-Einstein D. Any of the above.
7. The static electronic polarizability is expressed as
- A. $\frac{e}{m\omega_0}$ B. $\frac{e^2}{m\omega_0}$
C. $\frac{e}{m\omega_0^2}$ D. $\frac{e^2}{m\omega_0^2}$
8. Displacement vector (D) =
- A. $\frac{q}{A}$ B. $\frac{A}{q}$
C. qA D. 2qA

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