REV-01
MSP/03/08

2024/11

SET A

M.Sc. PHYSICS
THIRD SEMESTER
CONDENSED MATTER PHYSICS- I
MSP - 303A

[USE OMR FOR OBJECTIVE PART]

Duration: 1:30 hrs. **Full Marks: 35**

Objective

Choose the correct answer from the following: ***1×10=10***

1. In the tight-binding model, it is assumed that the crystal potential is
   a. weak
   b. strong
   c. neither weak nor strong
   d. absent

2. The number of orbitals in a band inside the first Brillouin zone (BZ) is equal to (ignoring the electron spin)
   a. number of unit cells in the crystal
   b. twice the number of unit cells in the crystal
   c. square of the number of unit cells in the crystal
   d. twice the square of the number of unit cells in the crystal

3. With increasing the magnetic field, the degeneracy of each of the Landau levels
   a. decreases
   b. increases
   c. remains same
   d. none of these

4. In the de Haas – van Alphen effect, the oscillatory behavior is observed in
   a. resistivity
   b. thermal conductivity
   c. magnetic moment
   d. polarizability

5. Meissner effect is the phenomenon of
   a. perfect diamagnetism
   b. paramagnetism
   c. ferromagnetism
   d. none of these

6. Potential energy of a dipole is least for the dipole being_____ to the field.
   a. parallel
   b. perpendicular
   c. Distant
   d. None of the above

7. Relative dielectric constant is given by
   a. $\varepsilon.\varepsilon_r$
   b. $\varepsilon/\varepsilon_r$
   c. $\varepsilon.\varepsilon_r/2$
   d. $\varepsilon.\varepsilon_r/2$

8. Franck condon principle says that the transitions lead to _____ in nucleic position
   a. Shift
   b. No change
   c. Distortion
   d. Splitting

9. The Downconversion and upconversion have excitation and emission in the range of
   a. UV, Vis& Vis, IR resp.
   b. UV, Vis& UV, IR resp
   c. UV, Vis & Vis, UV resp
   d. UV, Vis & IR, Vis resp

10. Emission in Thermoluminescence occur in the range of
   a. Vis
   b. UV, Vis
   c. IR
   d. Vis, IR

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(Descriptive)

Time : 1 hr. 15 mins. **Marks: 25**

[Answer question no.1 & any two (2) from the rest]

1. Draw the dispersion curve in the empty-lattice model under the extended zone scheme, periodic zone scheme, and reduced zone scheme. **5**

2. Explain dielectric properties of a medium. Discuss the different types of Polarizabilities in a medium. **4+6=10**

3. **a.** The energy of the band in the tight-binding model: **6+4=10**

$$E(\vec{k}) = E_\nu - \beta - \gamma \sum e^{i\vec{k}\cdot\vec{X}_j}$$

Where β and γ are constants, $\vec{X}_j$ is the position of the j-th atom relative to the atom at the origin.
Find the energy expression for a *simple cubic* lattice, using the nearest-neighbor approximation.

b. Draw the first three Brillouin zones for a square lattice with lattice spacing a.

4. **a.** Explain the Frank-Condon Principle **4+6=10**

b. Elaborate (i) Photoluminescence (ii) Thermoluminescence.

5. **a.** Draw the $H - M$ diagram for type-1 and type-2 superconductors. **4+6=10**

b. Discuss the two-fluid model.

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