15411

M.Sc. EXAMINATION

(For Batch 2021 & Onwards)

(Second Semester)

PHYSICS

MSc/Phy/2/CC6

Solid State Physics

Time : Three Hours   *Maximum Marks* : 70

Note : Attempt *Five* questions in all by selecting *one* question from each Unit. Question No. **1** is compulsory. All questions carry equal marks and use of simple calculator is allowed.

1. (a) Discuss the Brillioun Zone interpretation of X-ray diffraction.

(b) Prove that the lighter atoms at zone boundary are in rest in acoustical branch.

(c) What is thermal effective mass of electron ? Explain.

(d) What do you understand by isotopic effect in superconductivity ? Explain.

$$3.5 \times 4 = 14$$

Unit I

2. (a) What is Bravais lattice ? Discuss the three dimensional Bravais lattice in detail.

(b) Show that the diffraction pattern is a map of reciprocal lattices. $7 \times 2 = 14$

3. What is Structure Factor ? How its helps to understand the crystal structure ? Discuss the crystal structure of BCC and FCC lattices.

14

Unit II

4. (a) Discuss the dispersion relation for mono atomic basis.

(b) Prove that the momentum carried by the phonon is zero except for $k = 0$ mode. $7 \times 2 = 14$

5. (a) Discuss the dispersion relation for a crystal with diatomic-atomic basis and discuss the motion of different masses atoms at $K = 0$ and zone boundary in different branches.

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(b) Discuss the energy level and density of states for free electron gas in one dimensional crystal. 4

Unit III

6. (a) Discuss the motion of electron in magnetic field and hence Hall effect.

   (b) Discuss the terms 'Cyclotron resonance' and 'Magneto resistance'. $7 \times 2 = 14$

7. Discuss, how the Kronig-Penney model explains that the motion of electron in periodic potential leads to the band formation in solids. 14

Unit IV

8. (a) Discuss the BCS theory and BCS ground state in superconductivity ?

   (b) Derive and discuss the occurrence of London equation in superconductivity.

   $7 \times 2 = 14$

9. (a) What is coherence length ? Derive an expression for coherence length.

   (b) Show that the magnetic flux passing through a superconducting ring is quantized. $7 \times 2 = 14$

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