

**M. SC. PHYSICS EXAMINATION, 2022**

( 3rd Year, 2nd Semester )

**CONDENSED MATTER PHYSICS (II)**

**PAPER – 408**

Time : Two hours

Full Marks : 40

*Use separate answer script for each group.*

**Group – A**

Answer *any two* questions.

1. a) What are plasma and plasma frequency? Using equation of motion of one electron how can you distinguish between a transparent solid and an opaque solid considering plasma frequency of the material?
- b) Derive dispersion curve of electromagnetic wave in plasma. 7+3
2. a) Explain the phenomena of photoconductivity with traps.
- b) Show that the photoconductivity decreases if the trap levels are increased in the material.
- c) Find out the momentum of exciton inside the solid. 2+5+3

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3. a) Distinguish between the properties of a solid crystal and liquid crystal.
- b) What do you mean by the “order parameter” (OP)? Show that the OP for liquid crystal is in between zero and one.
- c) Describe the magnetic properties of a liquid crystal.  
3+5+2

**Group – B**

Answer *any two* questions.

4. i) What is the lower critical field of a superconductor?  
ii) Explain the idea of flux quantization in a superconducting ring.  
iii) Using Josephson current, explain the superconducting quantum interference in a network made of two Superconductor-Insulator-Superconductor (SIS) junctions. 2+5+3
5. a) What is a type-II superconductor?  
b) Explain variation of magnetization ( $M$ ) as a function of magnetic field ( $H$ ) of a type-II superconductor for (i)  $T > T_c$  and (ii)  $T < T_c$ .  
c) What is dc Josephson effect? Derive an equation for the current across a Josephson junction in absence of any voltage source. 2+3+5

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6. What is the exchange field in one dimensional ferromagnetic spin chain? How do you explain the existence of the spin wave and its wave length related to the similar spin arrangement? Derive the dispersion relation of magnon quasi-particle associated with any three dimensional spin arrangement. 2+2+6