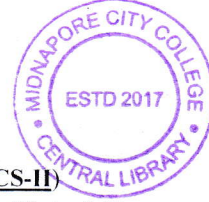


PG (CBCS)
M.SC. Semester- IV Examination, 2026
PHYSICS
PAPER: PHS 407A
(ADVANCED CONDENSED MATTER PHYSICS-II)



Full Marks: 40

Time: 2 Hours

The figures in the right-hand margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP-A

Answer any **FOUR** of the following questions:

4×2=8

1. Distinguish between superconducting energy gap and band gap energy of a semiconductor.
2. What is Bloch wall?
3. Define 1-2-3 superconductor and write its application?
4. Explain temperature independence of Pauli paramagnetism.
5. State condition for ferromagnetism in terms of exchange integral.
6. Calculate the frequency of the electromagnetic waves radiated by a Josephson junction having a voltage of 650 μV across its terminal.

GROUP-B

Answer any **FOUR** of the following questions:

4×4=16

7. What is flux quantization? Show that value of fluxoid $\Phi_0 = \frac{\pi\hbar c}{e}$.
8. Explain superconductivity according to Ginzburg – Landau theory.
9. Explain coherence length (ξ). Estimate the intrinsic coherence length (ξ) of Al if the energy gap is $3.4 \times 10^{-4} \text{ eV}$, $V_F = 2.02 \times 10^6 \text{ m/s}$.
10. Show how positive exchange integral leads to ferromagnetism.
11. Calculate resonance frequency for proton in magnetic field of 1 T.
12. Write resonance condition in EPR.

GROUP-C

Answer any **TWO** of the following questions:

2×8=16

13. Formulate the BCS Hamiltonian for ground state of many cooper pair and expression of energy gap of superconductor. 5+3

(P.T.O.)

(2)

14. (i) Explain AC Josephson effect. Show that the current oscillates with frequency, $\omega = \frac{2ev}{h}$.
(ii) Write a short note on high T_c superconductor. 4+4
15. In an NMR experiment, the resonance frequency is observed to be **64 MHz**. Find the magnetic field strength if $\gamma = 2.6 \times 10^8 \text{ rad s}^{-1} \text{ T}^{-1}$; At temperature **300 K**, calculate the population ratio of spin states for electrons in that magnetic field. 4+4
16. (i) A material has two sublattices with unequal magnetic moments. Explain whether it is ferromagnetic, antiferromagnetic, or ferrimagnetic and justify with equations.
(ii) Calculate Curie temperature of a FCC structure, with Given: $J = 1.2 \times 10^{-21} \text{ J}$; spin $S = 1/2$. 4+4

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