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M.Tech (Material Science and Technology), 3<sup>rd</sup> Semester  
MST -301: Magnetism and Super Conductivity

Time allowed: 3 Hours

Max. Marks: 50

Note: Attempt five questions in all, selecting at least two questions from each Unit.

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UNIT - I

- I. a) Explain and derive the Langevin's theory of paramagnetism.  
b) Write the ground state of the following:-  
i)  $Mn^{3+}$  with  $3d^4$                       ii)  $Ho^{3+}$  with  $4f^{10}$                       Configurations                      (6,4)
- II. Explain Pauli paramagnetism, Van Vleck paramagnetism and nuclear paramagnetism. (10)
- III. Using Weiss Theory of Ferromagnetism, derive the relation:-  
$$\chi_m = \frac{C}{T - T_c}$$
 (10)
- IV. a) What is the difference between Hard and Soft magnetic materials?  
b) What is double exchange interaction and how it is useful in CMR materials? (5,5)

UNIT - II

- V. Using London equations derive the London penetration depth  
$$\lambda_L = \left( \frac{m}{\mu_0 n_s e^2} \right)^{1/2}$$
 (10)
- VI. What is energy gap in superconductivity? Explain this with heat capacity and thermal conductivity properties of superconductors. (10)
- VII. Explain the terms:-  
i) Vortex State                      ii) London penetration  
iii) Coherence Length                      iv) Ginzburg Landau parameter (10)
- VIII. What is Josephson Effect? Explain the DC and AC Josephson effect. (10)

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