Dr Vineet Sharma

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT
FINAL EXAMINATION
SEMESTER SUMMER-JUNE 2016
B.Tech. VI Semester

COURSE CODE: 10B11PH611 MAX. MARKS: 50
COURSE NAME: MATERIALS SCIENCE
COURSE CREDITS: 04 MAX. TIME: 2 HRS

Note: *All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means. Scientific calculators are allowed.*

1. Deriving an expression for the acceptance angle of an optical fibre show that the numerical aperture is $n_1(2\Delta)^{1/2}$, where n_1 is the refractive index of the core of the optical fibre and Δ is the fractional refractive index change. [7]

2. Compute the numerical aperture, acceptance angle and the critical angle of an optical fibre having core refractive index $n_1 = 1.50$ and the cladding refractive index $n_2 = 1.45$. [3]

3. (a) What is attenuation and how is it different from pulse dispersion in an optical fibre? [2]
   (b) Compute the cut-off parameter and the number of modes supported by a fibre having core refractive index $n_1 = 1.54$ and cladding refractive index $n_2 = 1.50$; core radius **25 μm** and operating wave length **1300 nm**. [3]

4. What is Meissner effect and why it contradicts the result for magnetic flux obtained from Maxwell's equation? Also discuss why perfect diamagnetism is an essential property to define the superconducting state. [7]

5. Calculate the critical current for a wire of lead having a diameter of **1 mm** at **4.2 K**. The critical temperature for lead is **7.18 K** and the critical field is 6.5×10^4 **A/m**. [3]

6. Discuss London's phenomenological theory of superconductors and arrive at London's equations. How it explains the Meissner effect? [5]

7. Derive an expression for Larmour frequency of an electron revolving around the nucleus in an atom. [10]

8. Give an account of Weiss theory of ferromagnetism. On the basis of this derive ferromagnetic susceptibility and explain Curie temperature. [5]

9. A paramagnetic specimen has 10^{28} **atoms/m**^{3}. The magnetic moment of each atom is 1.8×10^{-23} **Am**^{2}. Calculate the paramagnetic susceptibility at **300 K**. What would be the dipole moment of a bar of this material **0.1 m** long and **1 cm**^{2} cross-section placed in a field of 8×10^4 **A/m**. Given $\mu_o = 4\pi \times 10^{-7}$ **Hm**$^{-1}$ and $k_B = 1.38 \times 10^{-23}$ **JK**$^{-1}$. [5]