Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 11626

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2012.

Second Semester

Mechanical Engineering

PH 2161/182202/PH 23/080040002 — ENGINEERING PHYSICS — II

(Common to all branches)

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define drift velocity. How is it different from thermal velocity of an electron?
2. Define Fermi level.
3. Write an expression for electrical conductivity of an intrinsic semiconductor.
4. What are the differences between elemental semiconductor and compound semiconductor?
5. Every magnetic material has an intrinsic diamagnetism. Explain.
6. State the use of magnetic levitation.
7. Define dielectric constant.
8. Distinguish between dielectric loss and dielectric breakdown.
9. What is shape memory effect?
10. What are the different crystalline forms of carbon?

PART B — (5 × 16 = 80 marks)

11. (a) (i) List the drawbacks of classical free electron theory. (4)

(ii) Obtain Wiedemann Franz law using the expressions of electrical and thermal conductivity and find the expression for Lorentz number. (4)

(iii) The density of Silver is 10.5×10^3 kg/m^3. The atomic weight of silver is 107.9. Each silver atom provides one conduction electron. The conductivity of silver at 20°C is 6.8×10^7 ohm^{-1} m^{-1}. Calculate the density of electrons and also the mobility of electrons in silver. (4)

(iv) Calculate the electrical and thermal conductivities of a metal with the relaxation time of 10^{-14} second at 300 K. The electron density is 6×10^{26} m^{-3}. (4)

Or

(b) (i) Derive an expression for electrical conductivity based on Quantum theory. (8)

(ii) Write the expression for Fermi distribution function and explain with suitable diagram. How does it vary with temperature? (4)

(iii) Calculate the Fermi energy and Fermi temperature in a metal. The Fermi velocity of electrons in the metal is 0.86×10^6 m/s. (4)

12. (a) (i) Assuming the Fermi-Dirac distribution derive an expression for the concentration of electrons per unit volume in the conduction band of an intrinsic semiconductor. (12)

(ii) Find the intrinsic carrier concentration and Position of Fermi energy level I in Silicon with respect to the VB edge. Given $m_h = 0.92\ m_0$; $m_e^* = 0.49\ m_0$. $N_C = 2.21 \times 10^{25}/m^3$ and $N_V = 8.60 \times 10^{24}/m^3$ and $T = 300$ K. (4)

Or

(b) (i) With neat sketches, explain how Fermi level varies with impurity concentration and temperature in both p-type and n-type semiconductors. (4 + 4)

(ii) What is Hall effect? Describe an experimental arrangement to measure the Hall co-efficient. (2 + 6)

13. (a) (i) Explain the domain theory of Ferromagnetism. Using that theory, explain the formation of hysteresis in ferromagnetic materials. (8)

(ii) The magnetic field strength of Silicon is 1500 A/m. If the magnetic susceptibility is -0.3×10^{-5}, calculate the magnetization and flux density in Silicon. (4)

(iii) Differentiate a soft magnetic material from a hard magnetic material. (4)

Or

(b) (i) Explain any four properties of superconductors. (8)

(ii) Differentiate between Type I and Type II superconductors. (4)

(iii) Describe high temperature superconductors. (4)

14. (a) (i) Explain electronic polarization in atoms and obtain an expression for electronic polarizability in terms of the radius of atoms. (2 + 8)

(ii) If a NaCl crystal is subjected to an electric field of 1000 V/m and the resulting polarization is $4.3 \times 10^{-8}\ C/m^2$, calculate the relative permittivity of NaCl. Take the value $\varepsilon_0 = 8.86 \times 10^{-12}\ Fm^{-1}$. (2)

(iii) The number of atoms in a volume of one cubic meter of hydrogen gas is 9.8×10^{26}. The radius of hydrogen atom is 0.53 Å. Calculate the polarizability and relative permittivity. (4)

Or

(b) (i) What is meant by 'internal field'? Obtain an expression for internal field using Lorentz method. (2 + 6)

(ii) A solid contains 5×10^{28} identical atoms per m^3, each with a polarizability of $2 \times 10^{-40}\ Fm^2$. Assuming that internal field is given by the Lorentz relation, calculate the ratio of internal field to the applied field. $\varepsilon_0 = 8.854 \times 10^{-12}\ Fm^{-1}$. (4)

(iii) The dielectric constant of water is 80. Is water a good dielectric? Is it useful for energy storage in capacitors? Justify your answer. (4)

15. (a) (i) What are shape memory alloys? Describe the characteristics of shape memory alloys. (8)

(ii) List out any four applications of shape memory alloys. (4)

(iii) Mention any two advantages and two disadvantages of SMAs. (4)

Or

(b) (i) What are nanoparticles? Explain how nanoparticles can be produced using ball-milling technique. (2 + 6)

(ii) Describe the mechanical, chemical and magnetic properties of nanoparticles. (8)