

M.Sc. DEGREE (CSS) EXAMINATION, AUGUST 2015**Second Semester**

Faculty of Science

Branch II – Physics – A – Pure Physics

PH 2C 08 – CONDENSED MATTER PHYSICS

(2012 Admission onwards)

Time : Three Hours

Maximum Weight : 30

Part A (Short Answer Questions)*Answer any six questions.**Each question carries 1 weight.*

1. Why does density of iron increases when metallic iron changes from bcc structure to fcc structure?
2. What do you mean by reciprocal lattice?
3. What are the assumptions of Drude and Lorentz in explaining the behaviour of free electrons in metals?
4. How does electrical conductivity of a metal vary with impurity content?
5. Give the nature of motion of an electron in a periodic potential.
6. Discuss the drift and diffusion phenomenon in the semiconductor.
7. What is Fermi energy and Fermi momentum?
8. What are the important characteristics of Debye's theory of specific heat of solids?
9. Explain adiabatic demagnetization in paramagnetic salts.
10. What are metamaterials? Why is it showing negative refractive indices?

(6 × 1 = 6)

Part B (Short Essay / Problems)*Answer any four questions.**Each question carries 2 weight.*

11. Calculate the Debye temperature for diamond given Young's modulus – 10^{12} N/m² and density = 3500 kg/m³.
12. Evaluate the carrier concentration and conductivity of the intrinsic g_e at $T = 300$ K, $m = 9.1 \times 10^{-31}$ /kgf, $E_g = 0.68$ eV, $\mu_e = 0.38$ m²/V-sec, $\mu_h = 0.18$ m²/V-sec, $K_B = 1.38 \times 10^{-23}$ J/K and $h = 1.055 \times 10^{-34}$ J-sec.

Turn over

13. Discuss the Weiss theory of ferromagnetism.
14. State Hund's rules. Apply these rules to find out electronic configuration of Ho^{3+} which has incomplete 4f shell.
15. Describe the structure and properties of carbon clusters.
16. Discuss the flux quantisation of a superconducting ring.

(4 × 2 = 8)

Part C (Essay Type Questions)

Answer all questions.

Each question carries 4 weight.

17. (a) Describe Ewald's construction. Determine reciprocal lattice to fcc lattice and bcc lattice.
- Or*
- (b) On the basis of free electron theory derive an expression for the electrical and thermal conductivity of metal and hence establish Wiedemann-Franz-Lorentz law.
18. (a) Distinguish between reduced zone extended zone, and periodic zone scheme of representing energy bands. Derive an expression for the effective mass of the electron in a crystal and explain its physical significance.

Or

- (b) Explain the Hall effect. Derive an expression for the Hall coefficient of semiconductor on two band model carriers.
19. (a) Discuss the variation of specific heat of solids with temperature and give Einstein's theory to explain it.
- Or*
- (b) Discuss the quantum theory of paramagnetism and obtain an expression for the paramagnetic susceptibility.
20. (a) Explain Heisenberg's exchange interaction. Show that it explain ferromagnetism. Discuss the difference in nature of magnetic susceptibility of a ferromagnetic and anti-ferromagnetic substance.

Or

- (b) Discuss the thermodynamic and electrodynamic properties of superconductors.

(4 × 4 = 16)