Q.P.Code: 09180

(2½ Hours) **[Total Marks: 60]**

N.B. : (1) All questions are compulsory.
(2) Draw neat diagrams wherever necessary.
(3) Figures to the right indicate full marks.
(4) Use of scientific calculator is allowed.

Q.1 (A) Attempt any **one:** (8)

1) Explain the frequency dependence of the real part of permittivity in dielectric solids. Clearly indicate the ranges of ionic, dipolar and electronic contributions to the permittivity.

2) For a homogeneous linear dielectric with n atoms per unit volume, placed in an uniform electric field E, find the local field in the medium and hence find the Clausius-Mossotti relation for the dielectric susceptibility χ.

(B) Attempt any **one:** (4)

1) Explain the concept of Lorentz Oscillator.
2) Discuss the P-E loop in ferroelectric materials.

Q.2(A) Attempt any **one:** (8)

1) How electrical conductivity is derived in the semi-classical approach (Drude model)? Explain the features of this model.

2) Explain the concept of effective mass. Also discuss the motion of electrons in bands.

(B) Attempt any **one:** (4)

1) Explain the Mathissen's rule.
2) Explain the thermoelectric effect in brief.

Q.3(A) Attempt any **one:** (8)

1) Explain how hysteresis loop is formed in magnetic materials? Explain different parameters in it.

2) Estimate ground state of various transition elements (3d) and rare earth elements (4f) and determine Lande g-factor

(B) Attempt any **one:** (4)

1) Sketch the hysteresis loop for hard and soft magnetic materials. Comment on it.
2) Define magetostriciton and its application.

Q.4 (A) Attempt any **one:** (8)

1) Explain the concept of High temperature superconductivity. How it differs from conventional superconductivity?

2) Distinguish between Type I and Type II superconductors.

(B) Attempt any **one:** (4)

1) What are cooper pairs? How they are formed?
2) How superconductors are perfectly diamagnetic? Discuss it.

Q.5 Attempt any **four** (12)

1) Explain the IR spectroscopy in brief.
2) Write a note on Maxwell's equations.
3) Explain the Widemann Franz law for free electrons.
4) In a certain copper sample, the electron drift velocity is 2.16 m/s in an electric field of 500V/m. Estimate the electron mobility and relaxation time.
5) Explain the magetoresistance phenomenon and its applications.
6) On the basis of susceptibility how magnetic materials are classified?
7) Explain Meissner effect with neat diagrams.
8) List the applications of High Tc superconductors.
