Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(EE-OLD)/SEM-3/MS(EE)-301/2012-13

2012

ELECTRICAL ENGINEERING MATERIALS

Time Allotted : 3 Hours *Full Marks :* 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

   i) Which of the following polarizability is depends on time ?

      a) Electronic polarizability

      b) Ionic polarizability

      c) dipolar polarizability

      d) Both (a) and (b).

   ii) The conductivity of conducting materials is

      a) directly proportional to the mobility of free electron

      b) inversely proportional to the mobility of free electron

      c) directly proportional to the squire of the mobility of free electron

      d) inversely proportional to the squire of the mobility of free electron.

iii) The energy loss in a dielectric is proportional to

a) complex dielectric constant

b) imaginary dielectric constant

c) real dielectric constant

d) none of these.

iv) The internal field in solids is equal to

a) $E + P/\varepsilon_o$ b) $E + P/2\varepsilon_o$

c) $E + P$ d) $E + P/3\varepsilon_o$.

v) Fusing current is the current to fuse the wire

a) exact b) maximum

c) minimum d) over.

vi) Piezoelectric effect is the production of electricity by

a) chemical effect b) varying field

c) temperature d) pressure.

vii) The critical magnetic field B_c of a superconductor

a) varies linearly with temperature

b) is independent with temperature

c) increases with increasing temperature

d) decreases with increasing temperature.

viii) With the insertion of a dielectric, the capacity of a capacitor

a) increases b) decreases

c) does not change d) changes arbitrarily.

ix) An ion is

a) a free electron

b) a free neutron

c) a free proton

d) an atom with unbalanced electric charge.

x) Materials which store electric energy are classified as

a) magnetic materials b) dielectric materials

c) insulating materials d) conducting materials.

xi) Which one has the lowest electrical breakdown voltage among the following materials ?

a) PVC b) Mica

c) Porcelain d) Bakelite.

xii) Hard ferrites are used for making

a) transformer core

b) electrical machinery

c) lightweight permanent magnet

d) high frequency equipments.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. a) What is Curie temperature ?

b) Derive the Curie-Weiss law of Ferromagnetism. 1 + 4

3. a) What is a meant by mobility of electrons in a metal ?

b) Calculate the mobility of electrons in copper if the number of free electrons per unit volume of copper is $8{\cdot}5 \times 10^{28}\ m^{-3}$, & the resistivity of copper is $1{\cdot}7 \times 10^{-8}\ \Omega m$. 2 + 3

4. Show that the imaginary part of dielectric constant of a dielectric material gives rise to absorption of energy by the material from an alternating field. 5

5. Compare the merits & demerits of the uses of Cu & Al as conductors for power transmission lines. 5

6. Briefly describe the principle of operation of solar cell. 5

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Distinguish between ferromagnetic, ferrimagnetic & anti-ferromagnetic materials.
   b) Define the term 'spontaneous magnetization'. Derive the relation between relative permeability (μ_r) & magnetic susceptibility (χ) of a magnetic material.
   c) Discuss the various uses of ferrites. 6 + 6 + 3
8. a) Explain free electron theory of metals.
   b) Derive Widermann-Franz law in connection with thermal conductivity of metals.
   c) What are the factors on which the fusing current depends ? 6 + 6 + 3
9. a) Explain the term 'Superconductivity'. Name some of the important superconducting elements, compounds & alloys.
   b) State the application of superconductors.
   c) State the desirable properties of high resistivity materials. 6 + 3 + 6
10. a) Explain the mechanism of polarisation in dielectric materials.
    b) Derive the expression of orientational polarization in terms of electric field & temperature.
    c) The dielectric constant of helium measured at 0°C & at 1 atmosphere is 1·0000684. Under these conditions, the gas contains $2{\cdot}7 \times 10^{25}$ atoms / m^3 . Calculate the radius of the electron cloud (atomic radius) & the displacement χ when a helium atom is subjected to a field of 10^6 V/m. 4 + 6 + 5
11. Write notes on any *two* of the following : $2 \times 7\frac{1}{2}$
    a) Thermionic converters
    b) MHD generators
    c) Fuel cell.