Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech(EE-NEW)/SEM-3/MS(EE)-301/2009-10

2009

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 × 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 × 5 = 15

2. a) Mention two insulating materials used for power and distribution transformers.

   b) What is Plastics ? What are the properties that make it more suitable as insulating materials ? 2 + 3

3. Explain briefly the properties and applications of gaseous insulator SF-6. 3 + 2

4. What are the uses of dielectric materials ? Point out the different polarization phenomenon in dielectric materials. 2 + 3

5. a) What are soft and hard magnetic materials ?

   b) Give two examples and applications of these materials. 2 + 3

6. What is internal field ? Derive the expression of internal field for dense materials and hence derive Clausius-Mosotti relation.

7. Explain ohms law and the occurrence of conductivity. Show that $\sigma = ne^2 \tau/m$ and hence define the relaxation time.

GROUP – C

(Long Answer Type Questions)

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

8. a) The total conductivity of an intrinsic semiconductor is the sum of electron and hole contribution. Explain which contribution is greater.

   b) Determine the carrier concentration (n) for Germanium intrinsic semiconductor of resistivity 5000 (Ω m). The mobility of hole and electrons are 0·19 & 0·39 $m^2 \ v^{-1} \ s^{-1}$ respectively.

   c) Discuss the effect of temperature and impurity on the resistivity in conducting material. 4 + 5 + 6

9. a) What are the reasons of magnetic property in materials ? Explain with diagram the origin of the same in Fe – system.

   b) What is Bohr magneton ? Iron has a saturation magnetization of $1{\cdot}71 \infty 10^6$ A/m. What is the average number of Bohr magnetons per atom that contribute to this magnetization ? Iron has the BCC crystal structure with a = 0·287 nm.

   c) What is magnetostriction ? Explain.

   (2 + 4) + (2 + 3) + 4

10. a) Deduce Wiedemann-Franz Law assuming electrons in metals behave as classical gas.

b) What do you mean by fusing current ? Discuss the advantages of cartridge type fuse over rewireable.

c) What are the chief characteristics of ferroelectric materials ? How does the dielectric constant of a ferroelectric crystal vary with temperature ? Mention some of the uses of ferroelectric crystals. 5 + 5 + 5

11. a) What is relative dielectric constant ? Briefly describe with the help of atomic model the dependence of relative dielectric constant (ε_r) on the electronic polarizability (α_e) in the medium.

b) What is Clausius-Mosotti relation of dielectric constant ? Develop the relation for elemental dielectric systems.

c) What should be the nature of relative dielectric constant (ε_r) under A.C. field ? How is it related with the dielectric loss in the system ?

(1 + 4) + (1 + 4) + (1 + 4)

12. Answer any *three* of the following : 3 × 5

a) Fuel cells

b) Domain theory of ferromagnetism

c) MHD generator

d) Hysteresis loss

e) Thermoelectric generator

f) Smart material.