



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) $E + P/\epsilon_0$
 - b) $E + P/2\epsilon_0$
 - c) $E + P$
 - d) $E + P/3\epsilon_0$
- 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.



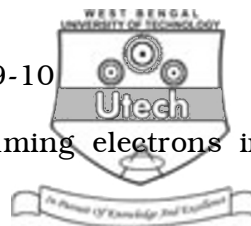
GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

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 $5000 \text{ (} \Omega \text{ m)}$. The mobility of hole and electrons are 0.19 & $0.39 \text{ m}^2 \text{ v}^{-1} \text{ s}^{-1}$ 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 $1.71 \times 10^6 \text{ A/m}$. What is the average number of Bohr magnetons per atom that contribute to this magnetization ? Iron has the BCC crystal structure with $a = 0.287 \text{ nm}$.
- 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 rewirable.
- 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.

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