



**ENGINEERING & MANAGEMENT EXAMINATIONS, DECEMBER - 2008**  
**ELECTRICAL ENGINEERING MATERIALS**  
**SEMESTER - 3**

Time : 3 Hours ]

[ Full Marks : 70

**GROUP - A****( Multiple Choice Type Questions )**

1. Choose the correct answer from the given alternatives for any *ten* of the following :

10 × 1 = 10

- i) The average drift velocity  $v_x$  of electrons in a metal is related to the electric field  $E$  & the collision time,  $\tau$  as

a)  $\sqrt{\frac{eE\tau}{m}}$

b)  $\sqrt{\frac{m}{eE\tau}}$

c)  $\frac{eE\tau}{m}$

d)  $\frac{m}{eE\tau}$

- ii) Spontaneous magnetization is shown, by the

a) paramagnetic compounds

b) ferromagnetic compounds

c) anti-ferromagnetic compounds

d) ferrimagnetic compounds. 

- iii) Dielectric materials are essentially

a) magnetic material

b) conducting material

c) insulating material

d) semiconducting material. 

- iv) Eddy current loss is proportional to the

a) frequency

b) square of the frequency

c) square root of the frequency

d) cube of the frequency. 

- v) Ferrites are

a) ferromagnetic material

b) ferrimagnetic material

c) paramagnetic material

d) diamagnetic material.



- vi) Thermal conductivity of a superconductor
- increases with increase in temperature
  - increases with decrease in temperature
  - is independent of temperature
  - increases initially & then decreases with increase in temperature.
- vii) With insertion of a dielectric, the capacity of a capacitor
- increases
  - decreases
  - does not change
  - changes arbitrarily.
- viii) If  $k$  is the thermal conductivity &  $a$  is the electrical conductivity, then Lorentz number is given by
- $\frac{k}{a}$
  - $\frac{k}{aT}$
  - $\frac{kT}{a}$
  - $\frac{a}{kT}$ .
- ix) Sulphur hexafluoride is a
- ferromagnetic material
  - solid insulator material
  - gaseous dielectric material
  - good conducting material.
- x) Which of the following materials can be used in cable shields ?
- Copper
  - Aluminium
  - Cast iron
  - Lead.
- xi) The material with lowest resistivity is
- constant an
  - german silver
  - magnanin
  - nichrome.
- xii) Breakdown in a dielectric may occur due to
- electric breakdown
  - thermal breakdown
  - electrochemical breakdown
  - any of these.

**GROUP - B****( Short Answer Type Questions )**Answer any *three* of the following.

3 × 5 = 15

2. a) What is Curie temperature ?  
 b) Derive the Curie-Weiss law of Ferromagnetism. 1 + 4
3. a) What is 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  $8.5 \times 10^{28} \text{ m}^{-3}$ , & the resistivity of copper is  $1.7 \times 10^{-8} \Omega\text{m}$ . 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* questions.

3 × 15 = 45

7. a) Distinguish between ferromagnetic, ferrimagnetic & anti-ferromagnetic materials.  
 b) Define the term 'spontaneous magnetization'. Derive the relation between relative permeability ( $\mu_r$ ) & magnetic susceptibility ( $\chi$ ) of a magnetic material.  
 c) Discuss the various uses of ferrites. 6 + 6 + 3
8. a) Explain free electron theory of metals.  
 b) Derive Widemann-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 superconductor's.  
 c) State the desirable properties of high resistivity materials. 6 + 3 + 6



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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  $0^{\circ}\text{C}$  & at 1 atmosphere is 1.0000684. Under these conditions, the gas contains  $2.7 \times 10^{25}$  atoms /  $\text{m}^3$ . Calculate the radius of the electron cloud ( atomic radius ) & the displacement  $\chi$  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.

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