

Name :

Roll No. :

Invigilator's Signature :

**CS/B.TECH/EE(O)/SEM-3/MS (EE)-301/2011-12
2011**

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)

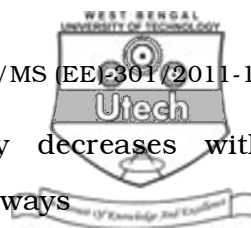
1. Choose the correct alternatives for any *ten* of the following :

$$10 \times 1 = 10$$

- i) Fermi level can be defined as
- a) that level which has a 50% probability of occupation by an electron at any temperature
 - b) the energy corresponding to the highest filled level at 0°K
 - c) both (a) and (b)
 - d) none of these.



- ii) Super conducting material above super conducting transition temperature behaves like a
- a) diamagnetic material
 - b) paramagnetic material
 - c) ferromagnetic material
 - d) none of these.
- iii) "The various contributions to the resistivity of metals are independently additive" this is the statement of
- a) Joules law
 - b) Matthiessen's rule
 - c) Ohm's law
 - d) None of these.
- iv) Titanium alloys are
- a) magnetic
 - b) prone to corrosion
 - c) cheap and easy to machine
 - d) alloys with high strength.
- v) A platinum wire senses temperature because of it's
- a) high resistivity
 - b) high coefficient of resistance
 - c) high melting point
 - d) non-corroding texture.



vi) In a semiconductor the resistivity decreases with temperature in which of the following ways

- a) linearly
- b) non-linearly
- c) exponentially
- d) none of these.

vii) PZT is an example of

- a) ferroelectric material
- b) piezoelectric material
- c) pyroelectric material
- d) ferromagnetic material.

viii) Ferrites are

- a) diamagnetic material
- b) ferromagnetic material
- c) ferrimagnetic material
- d) anti-ferromagnetic material.

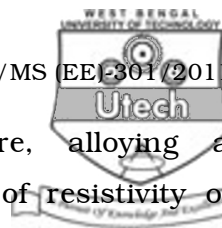
ix) Eddy current loss is proportional to the

- a) frequency
- b) square root of the frequency
- c) square of the frequency
- d) cube of the frequency.

- ### GROUP – B

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

- 4



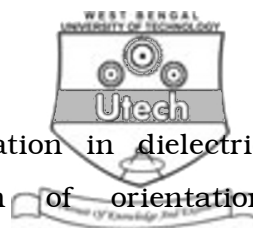
4. a) Explain the effect of temperature, alloying and mechanical stressing on the value of resistivity of a conducting material. 3
- b) Calculate the length of a heater element having 0.4 mm dia. to get a resistance of 400 Ω and 1000 W, if Nichrome wire having $\rho = 100 \times 10^{-8}$ ($\Omega\text{-m}$) is used. 2
5. a) Derive the expression $D = \epsilon_0 E + P$. 3
- b) Define the Lorentz Field in Dielectrics. 2
6. a) Explain the different polarizations in a polyatomic material. 4
- b) State the Curic-Weiss Law of Ferroelectricity. 1

GROUP – C

(Long Answer Type Questions)

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

7. a) Give an account of the phenomenon of superconductivity and its behaviour in magnetic field.
- b) “The conductor for motor winding is expected to be very high degree of purity.” Explain.
- c) Define relaxation time and collision time. Calculate the mobility and relaxation time of electrons of a metal having resistivity $2.25 \times 10^{-2} \Omega\text{m}$ and concentration of conduction electron 3.34×10^{20} per m^{-3} . $5 + 5 + 5$



8. a) Explain the mechanism of polarization in dielectric materials. Derive the expression of orientation polarization in terms of electric field and temperature. 7 + 8
- b) 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.
9. a) Explain B-H hysteresis curve in terms of domain wall displacement and domain wall rotation for ferromagnetic material.
- b) Describe the behaviour of ferromagnetic material above its Curie temperature. State and explain Curie-Weiss law for ferromagnetic material.
- c) Derive the Curie-Weiss law of ferromagnetism. 7 + 3 + 5
10. a) The total conductivity of an intrinsic semiconductor is the sum of electron and hole contribution. Explain which contribution is greater.
- b) Smart material is not a special kind of material but a drastic change of any of its properties is observed in response to an external stimuli. Explain.
- c) Draw and explain the applied field versus produced current diagram for a $p-n$ junction in forward bias and reverse bias. Write expressions to determine the current. 5 + 5 + 5



11. Write short notes on any *three* of the following : 3×5

- a) Fnell Cells
- b) Hysteresis Diagram and its use/selection of magnetic materials in Transformers
- c) Smart materials
- d) MHD generator
- e) Piezoelectricity
- f) Tonic conductivity in insulation.

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