

EEBEC 046

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B.Tech. III Semester (Main/Back) Examination, Dec. - 2016
Electronic Instrumentation & Control Engineering
3EI5A Electromagnetic Properties of Materials
EC, EI

Time : 3 Hours

Maximum Marks : 80
 Min. Passing Marks : 26

Instructions to Candidates:

Attempt any five questions, selecting one question from each unit. All questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Unit - I

1. a) Define relative permittivity, dipole moment, electronic polarization, and polarization vector. (8)
- b) The electronic polarizability of the Ar atom is $1.7 \times 10^{-40} \text{ Fm}^2$. What is the static dielectric constant of solid Ar (below 84 K) if its density is 1.8 gcm^{-3} ? (8)

OR

1. a) Define dielectric loss, loss tangent energy store, and loss in dynamic polarization. (8)
- b) From the following equivalent definition of the coupling coefficient,

$$k^2 = \frac{\text{mechanical energy stored}}{\text{Total energy stored}}$$

Show that $k^2 = 1 - \frac{f_s^2}{f_a^2}$ Given that typically for an X-cut quartz crystal, $k = 0.1$, what is f_a for $f_s = 1 \text{ MHz}$? What is your conclusion. (8)

Unit - II

2. a) Classify the magnetic materials and provide a summary of the magnetic properties of these classes of materials. (10)
- b) Define and explain the soft and hard magnetic materials. (6)

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2. a) Define magnetic flux density, magnetic permeability, magnetic susceptibility and magnetostatic energy. (8)

b) A paramagnetic material has 10^{28} atoms/m³. The magnetic moment of each atom is 1.8×10^{-23} amperemetre². Calculate the paramagnetic susceptibility at 300 K. What would be the dipole moment of a bar of this material 0.1 meter long and 1 sq.cm cross - section placed in a field of 8×10^4 ampere/metre? (8)

Unit - III

a) Explain the degenerate and non - degenerate semiconductors. (5)

b) Explain direct and indirect band gap semiconductors? (5)

c) Describe the electrical properties of semiconducting materials. (6)

OR

3. a) What is effect of temperature on semiconducting materials? Discuss (5)

b) Describe the thermistors and sensors (5)

c) Explain the variation of semiconductor conductivity, resistance and bandgap with doping. (6)

Unit - IV

4. a) Explain electrical conductivity and mobility of metals. Show that electrical conductivity of metal is directly proportional to the square root of temperature. (8)

b) Evaluate the temperature at which there is one percent probability that a State, with an energy 0.5 eV above the Fermi energy will be occupied by an electron. (8)

OR

4. a) Write short notes on : Type I and Type II superconductors. (6)

b) A super conducting Sn has a critical temperature of 3.7 k is zero magnetic field and a critical field of 0.306 T at 0K, Find the critical field of 2k. (5)

c) Calculate the critical current which can flow through a long thin superconducting wire of aluminium of diameter 1 mm. The critical magnetic field for Al is 7.9×10^3 ampers/metre. (5)

Unit - V

5. a) What is the nanomaterials and explain the change in band structure at nano stage. (6)

b) Explain the fabrication & characterization of nanomaterials. (6)

OR

5. a) Describe the structure of single wall and multi - wall carbon nanotube. (6)

b) Describe the electronic and optical properties at nano stage of material. (6)

c) List the potential applications of nano materials? (6)

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