3EBEC046

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3E1615

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 1.7×10^{-40} 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,

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

Show that $k^2 = 1 - \frac{fs^2}{fa^2}$ Given that typically for an X-cut quartz crystal, k = 0.1, what is f_a for f_s = 1MHz? 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)**

OR

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

b) A paramagnetic material has 10^{28} atoms/matms^3. The magnetic moment of each atom is 1.8×10^{-23} amperemetre^2. 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

3. 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 sensitors **(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.

b) Explain the fabrication & characterization of manomaterials.

OR

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

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

c) List the potential applications of nano materials?

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