

**3E1615**

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**3E1615**

**B. Tech. III Semester (Main) Examination-2014**  
**Electronic Instrumentation & Control**  
**3EI5A Electromagnetic Properties of Materials**  
**(Common to EC & EIC)**

**Time : 3 Hours****Maximum Marks : 80****Min. Passing Marks : 24****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.

Use of following supporting material is permitted during examination.

1. Scientific calculator.

**Unit - I**

1. a) Explain the significance of electronic polarization? Also derive the following expression for  $\epsilon_r$

$$\epsilon_r = 1 + \frac{N\alpha_e}{\epsilon_0}$$

Where N = number of molecules per unit volume

$\alpha_e$  electronic polarizability.

**(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 84K) if its density is  $1.8 \text{ gcm}^{-3}$ ?

**(8)****OR**

1. a) Explain frequency dependence on dielectric constant and dielectric loss. Also draw the spectrum of dielectric constant v/s frequency.

**(8)**



- b) A typical 1MHz quartz crystal has the following properties:

$f_s = 1\text{MHz}$  ;  $f_a = 1.0025\text{ MHz}$ ,  $C_o = 5\text{PF}$ .  $R = 20\Omega$  . Calculate the equivalent circuit parameter and quality factor of the crystal. Where  $f_s$  = mechanical resonant frequency  $f_a$  = anti resonant frequency. (8)

### Unit - II

2. a) Name the categories into which magnetic materials can be classified. Mention their magnetic properties and examples. (8)
- b) Explain the principle of the giant magnetostriction resistor (GMR). (8)

### OR

2. a) Explain the soft and hard magnetic materials and their applications. (8)
- b) Write short notes on
- i) Magnetostriction.
- ii) BH hysteresis loop. (4+4)

### Unit - III

3. a) Explain and draw the energy band diagrams for semiconductors. (8)
- b) An n-type si semiconductor containing  $10^{16}$  phosphorus atoms  $\text{cm}^{-3}$  has been doped with  $10^{17}$  boron atoms  $\text{cm}^{-3}$ . Calculate the electron and hole concentrations in this semiconductor. (8)

### OR

3. a) Explain the electronic properties and applications of Germanium and silicon. (8)
- b) A si sample has been doped with  $10^{17}$  arsenic atoms  $\text{cm}^{-3}$ . Calculate the conductivity of the sample at  $27^\circ\text{C}$  and at  $127^\circ\text{C}$ ? (8)

### Unit - IV

4. What is Meissner effect? Explain and draw the characteristics of Type I and Type II superconductors and their applications. (16)



OR

4. a) Write short notes on

i) Energy band gap structures of metals .

ii) Matthiessen's rule.

(4+4)

b) Explain the electrical properties of conductive and resistive materials. (8)

Unit - V

✓ 5. Explain fabrication and characterization of Nanomaterials.

(16)

OR

✓ 5. Write down the physical properties of Nanomaterials and also give the applications of Nanomaterials.

(16)