

Total No. of Questions: 6

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Enrollment No.....



Faculty of Engineering
End Sem (Even) Examination May-2022
EC3ES09 Engineering Materials

Programme: B.Tech.

Branch/Specialisation: EC

Duration: 3 Hrs.

Maximum Marks: 60

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

- Q.1 i. In which of the following Bravais lattices, not all axial angles are right angles? **1**
(a) Tetragonal (b) Rhombohedral
(c) Orthorhombic (d) Cubic
- ii. Which of the following is the weakest bond? **1**
(a) Ionic bonds (b) Metallic bonds
(c) Covalent bonds (d) Van der Waals forces
- iii. When does a ferromagnetic material become paramagnetic material? **1**
(a) At Curie temperature
(b) Below Curie temperature
(c) Above Curie temperature
(d) Never
- iv. A paramagnetic material had a magnetic field intensity of 10^4 A/m. If the susceptibility of the material at room temperature is 3.7×10^{-3} , calculate the magnetisation. **1**
(a) 37A/m (b) 3.7A/m (c) 370A/m (d) 0
- v. What is the basic property of electrical conducting materials? **1**
(a) Allows the passage of current through the materials
(b) Blocks the passage of current through the materials
(c) Leaks the current through the materials
(d) Reverses the direction of current in the materials
- vi. The normal metal passes into super conducting state at _____. **1**
(a) High temperature (b) Low temperature
(c) Critical temperature (d) No temperature

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[2]

- vii. What type of material is obtained when an intrinsic semiconductor is doped with pentavalent impurity? **1**
 (a) N-type semiconductor (b) Extrinsic semiconductor
 (c) P-type semiconductor (d) Insulator
- viii. The reciprocal of conductivity is _____. **1**
 (a) Viscosity (b) Resistivity
 (c) Turbidity (d) None of these
- ix. For total internal reflection to occur, which condition must be satisfied? **1**
 (a) $n_1 = n_2$ (b) $n_1 > n_2$
 (c) $n_1 < n_2$ (d) $n_1 \times n_2 = 1$
- x. Which of the following is an example of optical pumping? **1**
 (a) Ruby laser (b) Helium-Neon laser
 (c) Semiconductor laser (d) Dye laser
- Q.2 i. Calculate the miller indices for a plane which intercepts at a, b/3, 2c in a simple cubic unit cell. **2**
 ii. Write down lattice parameters (a,b,c, α , β , γ) for following crystal structure: **3**
 (a) Monolithic Crystal Structure
 (b) Orthorhombic
 (c) Cubic
- iii. Explain crystal imperfections. How are they classified? **5**
- OR iv. Explain following terms: **5**
 (a) Primary bonds (b) Coordination Number
 (c) Polarisation (d) Dielectric Parameters
 (e) Ferroelectric Material
- Q.3 i. Define relative permeability. Prove that $\mu_r = 1 + \chi$, where χ is the magnetic susceptibility. **2**
 ii. What is magnetostriction? Why does it occur in ferromagnetic materials? **3**
 iii. What is magnetic anisotropy? Explain how anisotropy can be induced by magnetic annealing? **5**

[3]

- OR iv. Explain domain theory of ferromagnetic materials? When a demagnetised ferromagnetic material is slowly magnetised by an applied magnetic field, what changes occur in the first domain structure? **5**
- Q.4 i. Compare the resistivity range of Conductor, Semi-conductor and Insulator. **2**
 ii. What do you mean by thermal conductivity? Write expression for it. **3**
 iii. What is critical field? Describe the effect of magnetic field on superconductors. **5**
- OR iv. Show that the heat developed per m³ per second in a conductor carrying a current density J as a result of an applied field E is given by: **5**
- $$W = \sigma E^2$$
- Where σ is the conductivity of the conductor.
- Q.5 i. Define direct & indirect band gap semiconductor with example. **2**
 ii. The resistivity of intrinsic germanium at 300 K is 0.47 Ω -m. If the electron and hole mobilities are 0.38 and 0.18 m²v⁻¹s⁻¹. Calculate the intrinsic carrier density at 300 K. **3**
 iii. What do you understand by drift and diffusion current in case of a transistor? Deduct Einstein relation relating to these currents. **5**
- OR iv. Explain the following: (with suitable diagram or graph) **5**
 (a) NPN Transistor (b) Zener Diode
- Q.6 Attempt any two: **5**
 i. What is LASER? What are its main components? Explain the working of Ruby laser with suitable diagram. **5**
 ii. What is meant by population inversion? Explain the operating principle of Nd-Yag laser. **5**
 iii. What is the structure of an optical fibre? Explain the following term: **5**
 (a) Acceptance Angle (b) Numerical aperture
 (c) Cut-Off parameters of a fibre.

Marking Scheme
EC3ES09 Engineering Materials

Q.1	i.	In which of the following Bravais lattices, not all axial angles are right angles? (b) Rhombohedral	1
	ii.	Which of the following is the weakest bond? (d) Van der Waals forces	1
	iii.	When does a ferromagnetic material become paramagnetic material? (c) Above Curies temperature	1
	iv.	A paramagnetic material had a magnetic field intensity of 10^4 A/m. If the susceptibility of the material at room temperature is 3.7×10^{-3} , calculate the magnetisation. (a) 37A/m	1
	v.	What is the basic property of electrical conducting materials? (a) Allows the passage of current through the materials	1
	vi.	The normal metal passes into super conducting state at _____. (c) Critical temperature	1
	vii.	What type of material is obtained when an intrinsic semiconductor is doped with pentavalent impurity? (a) N-type semiconductor	1
	viii.	The reciprocal of conductivity is _____. (b) Resistivity	1
	ix.	For total internal reflection to occur, which condition must be satisfied? (b) $N_1 > N_2$	1
	x.	Which of the following is an example of optical pumping? (a) Ruby laser	1
Q.2	i.	Procedure Ans= (2,6,1)	2
	ii.	:(a) Monolithic Crystal Structure (b) Orthorhombic (c) Cubic	3
	iii.	Definition Classification Description	5

OR	iv.	(a) Primary bonds (b) Coordination Number (c) Polarisation (d) Dielectric Parameters (e) Ferroelectric Material	1 Mark 1 Mark 1 Mark 1 Mark 1 Mark	5
		Q.3 i. Definition Prove	1 Mark 1 Mark	2
		ii. Definition Explain reason	1 Mark 2 Marks	3
		iii. Definition Explain reason	2 Marks 3 Marks	5
		OR iv. Definition Explain reason	2 Marks 3 Marks	5
Q.4	i.	Compare explanation)	(As per	2
		ii. Definition Expression	1 Mark 2 Marks	3
		iii. Definition Explain reason	2 Marks 3 Marks	5
		OR iv. Definition Reason	2 Marks 3 Marks	5
		sssQ.5 i. Each definition ii. Formula Procedure Ans $n_i = 2.37 \times 10^{19} \text{ m}^{-3}$	(1 Mark*2) 1 Mark 1 Mark 1 Mark	2 3
OR	iv.	iii. Definition Explain derivatives	2 Marks 3 Marks	5
		Q.6 (a) NPN Transistor (b) Zener Diode Attempt any two:	2.5 Marks 2.5 Marks	5
		i. Definition Component Ruby Laser diagram Explanation	1 Mark 1 Mark 1 Mark 2 Marks	5
		ii. Definition Diagram Explanation	2 Marks 1 Mark 1 Mark	5
		iii. Structure of fibre	2 Marks	5

Each Definition (1
Mark*3)
