

- 3 a. Choose your answers for the following :
- The unit (units) of electric field intensity, E , is (are)
 A) Volt/m B) N/Coulomb C) J/Coulomb D) Both A and B
 - In a conductor, the resistivity, ρ , increases as
 A) Temperature decreases B) Temperature increases
 C) Does not depend on temperature D) None of these
 - The Fermi factor at E_{F_0} for $T > 0$ K is
 A) 0 B) 0.5 C) 1.0 D) 0.25
 - The mobility μ of conduction electrons in a metal is given by
 A) $\frac{E}{V_d}$ B) $\frac{V_d}{E}$ C) $\frac{\sigma}{ne}$ D) Both B and C (04 Marks)
- b. Derive an expression for the electrical conductivity, σ , in a metal. (06 Marks)
- c. Discuss any two successes (or merits) of the quantum free electron theory of conduction. (06 Marks)
- d. The Fermi level for a metal is 3.1 eV, Calculate the energies for which the probability of occupancy at 300 K are 98% and 50%. (04 Marks)

- 4 a. Choose your answers for the following :
- The dipole moment of two charges $+q$ and $-q$ separated by a distance d is given by
 A) $+qd$ B) $-qd$ C) q^2/d D) q^2d
 - Temperature independent polarization mechanisms are
 A) Electronic and orientational
 B) Ionic and orientational
 C) Electronic and space charge
 D) Electronic and ionic
 - Ferroelectric materials are
 A) Magnetic
 B) Dielectrics
 C) Magnetic materials which behave like dielectrics
 D) Dielectric materials that behave like magnetic
 - In the B-H curve, the points X and Y represent respectively

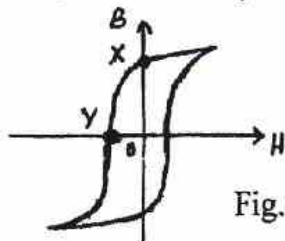


Fig.Q4(a)(iv)

- Coercive field and remnant magnetization
- Remnant magnetization and coercive field
- Saturation density and coercive field
- Remnant magnetization and susceptibility

- b. Arrive at an expression for the internal field in a linear array of dielectric molecules placed in an electric field. (08 Marks)
- c. What is Lorentz field? Deduce Clausius Mossotti relation. (04 Marks)
- d. A solid dielectric material has electronic polarisability equal to $7 \times 10^{-40} \text{ Fm}^2$. If it is a cubic structure, calculate the relative permittivity of the material if it has $3 \times 10^{28} \text{ atoms/m}^3$. (04 Marks)

PART – B

- 5 a. Choose your answers for the following :
- The life time of an electron in a metastable state is of the order of
A) Nano seconds B) Micro seconds C) Few seconds D) Milli seconds
 - The excitation mechanism for pumping in a diode laser is
A) Forward bias B) Optical C) Electrical discharge D) None of these
 - The energy of laser pulse is 10^{-10} J. If the power of the laser is 8 mW, the duration of the pulse is
A) 125 ns B) 0.125 ns C) 12.5 ns D) 1.25 ns
 - In the He-Ne laser the ratio of the partial pressures of He and Ne gases is
A) 1 : 10 B) 10 : 1 C) 1 : 100 D) 100 : 1 (04 Marks)
- b. Discuss the principle, construction and working of a semiconductor laser. State two advantages and two applications of the same. (12 Marks)
- c. The ratio of population of two energy states in a laser is 1.059×10^{-30} . If the temperature of the system is 57°C , what is the wavelength of the laser? (04 Marks)

- 6 a. Choose your answers for the following :
- Type – I superconductors are
A) Diamagnetic B) Paramagnetic C) Ferromagnetic D) Antiferromagnetic
 - For a superconductor, stronger the magnetic field applied to it
A) Higher is the critical temperature B) Lower is the critical temperature
C) Critical temperature remains same D) None of these
 - The number of modes supported by an optical fiber whose V. no. is 40 is
A) 1600 B) 1200 C) 800 D) 3200
 - The numerical aperture of an optical fiber is 0.309. Its angle of acceptance is approximately
A) 18° B) 17° C) 18.5° D) 17.5° (04 Marks)
- b. Derive the condition for ray propagation through an optical fiber. (06 Marks)
- c. Discuss the construction, working and applications of squids. (06 Marks)
- d. A signal with input power 200 mW loses 10% of its power after traveling a distance of 3000 m. Find the attenuation coefficient of the fiber. (04 Marks)

- 7 a. Choose your answers for the following :
- The inter atomic distance for the NaCl lattice is
A) 5.63 \AA B) 2.81 \AA C) 11.26 \AA D) 1.41 \AA
 - The number of lattice points/unit cell in diamond is
A) 4 B) 6 C) 2 D) 8
 - According to Bragg's law which of the following triplets corresponds to the first three orders of reflection?
A) $10^\circ, 23.9^\circ, 40.4^\circ$ B) $12^\circ, 24.57^\circ, 38.6^\circ$ C) $15^\circ, 38.4^\circ, 42^\circ$ D) $14^\circ, 28^\circ, 42^\circ$
 - In the Bragg's spectrometer, if the detector rotates by 6° , the crystal table would have rotated by
A) 3° B) 12° C) 2° D) 9° (04 Marks)

- b. Arrive at an expression for the inter planar spacing for a family of Bravais planes with miller indices (h, k, l) . (06 Marks)
- c. Determine the coordination number, number of lattice points per unit cell and atomic packing factor for the FCC lattice. (or face centred cubic lattice) (06 Marks)
- d. Draw the following planes in the unit cube: i) $(\bar{1}, 0, 2)$ ii) $(1, \bar{1}, \bar{2})$ (04 Marks)

8 a. Choose your answers for the following :

- i) Reduction of 3-d bulk material in all the three directions results in
 A) 2-d film B) 1 d wire C) Quantum dot D) Quantum particle
- ii) In mechanical scaling, the dimensional dependence of frequency is
 A) L^{-1} B) L C) L^2 D) L^{-2}
- iii) Which of these is not employed in non destructive testing?
 A) Ultrasound method B) Dynamic testing
 C) Testing by chemical interaction D) Magnetic methods
- iv) Ultrasonic waves in solids are
 A) Longitudinal B) Transverse
 C) Could be both A and B D) None of these (04 Marks)
- b. Write short notes on: i) Carbon nano tube ii) Self organization on the nano scale (08 Marks)
- c. Discuss the principle and working of the ultrasonic method of nondestructive testing. (08 Marks)

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