Code No: R05010201 **Set No. 1**

I B.Tech Supplimentary Examinations, Aug/Sep 2007
APPLIED PHYSICS
(Common to Electrical & Electronic Engineering, Electronics & Communication Engineering, Computer Science & Engineering, Electronics & Instrumentation Engineering, Bio-Medical Engineering, Information Technology, Electronics & Control Engineering, Computer Science & Systems Engineering, Electronics & Telematics, Electronics & Computer Engineering and Instrumentation & Control Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the terms [6]
   i. basis
   ii. space lattice and
   iii. unit cell.
   (b) Describe the seven crystal systems with diagrams. [10]
2. (a) State and explain Bragg's law. [6]
   (b) Describe with suitable diagram, the powder method for determination of crystal structure. [6]
   (c) A beam of X-rays of wavelength 0.071 nm is diffracted by (110) plane of rock salt with lattice constant of 0.28 nm. Find the glancing angle for the second order diffraction. [4]
3. (a) Explain the various point defects in a crystal. [8]
   (b) Obtain the expression for the equilibrium concentration of vacancies in a solid at a given temperature. [8]
4. (a) What is Fermi level? [2]
   (b) Explain Fermi-Dirac distribution for electrons in a metal. Discuss its variation with temperature. [8]
   (c) Calculate the free electron concentration, mobility and drift velocity of electrons in aluminum wire of length of 5 m and resistance 0.06 Ω carrying a current of 15 A, assuming that each aluminum atom contributes 3 free electrons for conduction.
   Given: Resistivity for aluminum = 2.7×10^{-8} Ω-m.
   Atomic weight = 26.98
   Density = 2.7×10^3 kg/ m^3
   Avagadro number = 6.025×10^{23} [6]
5. (a) What is Piezo-electricity? [4]

(b) Obtain an expression for the internal field seen by an atom in an infinite array of atoms subjected to an external field. [8]

(c) The dielectric constant of He gas at NTP is 1.0000684. Calculate the electronic polarizability of He atoms if the gas contains 2.7×10^{25} atoms per m^3. [4]

6. (a) Distinguish between intrinsic and extrinsic impurity semiconductors with suitable examples. [6]

(b) Derive an expression for the density of holes in the valence band of an intrinsic semiconductor. [6]

(c) The following data are given for intrinsic germanium at 300 K:
$n_i = 2.4 \times 10^{19}/m^3$, $\mu_e = 0.39\ m^2\ V^{-1}\ s^{-1}$, $\mu_p = 0.19\ m^2\ V^{-1}s^{-1}$. Calculate the resistivity of the sample. [4]

7. (a) With necessary theory and energy level diagram, explain the working of a Helium-Neon gas laser. [10]

(b) Mention some important applications of lasers. [6]

8. (a) Derive expressions for the numerical aperture and the fractional index change of an optical fibre. [8]

(b) Write a note on the applications of optical fibres. [4]

(c) Calculate the fractional index change for a given optical fibre if the refractive indices of the core and the cladding are 1.563 and 1.498 respectively. [4]

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Code No: R05010201 **Set No. 2**

I B.Tech Supplimentary Examinations, Aug/Sep 2007
APPLIED PHYSICS
(Common to Electrical & Electronic Engineering, Electronics & Communication Engineering, Computer Science & Engineering, Electronics & Instrumentation Engineering, Bio-Medical Engineering, Information Technology, Electronics & Control Engineering, Computer Science & Systems Engineering, Electronics & Telematics, Electronics & Computer Engineering and Instrumentation & Control Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Prove that which type of the cubic crystal structure has closest packing of atoms? [8]
   (b) Derive the relation between the atomic radius and the unit cell dimension of the crystal, mentioned above. [8]
2. (a) Sketch the following planes of a cubic unit cell: (001), (120) and $(\bar{2}11)$. [3]
   (b) Explain Bragg's law of X-ray diffraction. [5]
   (c) Describe Laue's method for determination of crystal structure. [8]
3. (a) Explain Schottky and Frenkel defects with the help of suitable figures. [10]
   (b) Explain the significance of Burgers vector. [6]
4. (a) What is Fermi level? [2]
   (b) Explain Fermi-Dirac distribution for electrons in a metal. Discuss its variation with temperature. [8]
   (c) Calculate the free electron concentration, mobility and drift velocity of electrons in aluminum wire of length of 5 m and resistance 0.06 Ω carrying a current of 15 A, assuming that each aluminum atom contributes 3 free electrons for conduction.
   Given: Resistivity for aluminum = 2.7×10^{-8} Ω-m.
   Atomic weight = 26.98
   Density = 2.7×10^3 kg/ m^3
   Avagadro number = 6.025×10^{23} [6]
5. (a) What is orientational polarization? Explain. [6]
   (b) Obtain expression for the mean dipole moment when a polar material is subjected to an external electric field. [10]
6. (a) Derive the continuity equation for electrons. [8]
   (b) What physical law is manifested in the continuity equation. [4]

(c) Find the diffusion coefficient of electrons in silicon at 300 K if μ is 0.19 m^2/V-S. [4]

7. (a) Explain the characteristics of a laser beam. [4]
   (b) What is population inversion? [4]
   (c) With a neat sketch explain the construction and working of a ruby laser. [8]

8. (a) Explain the principle behind the functioning of an optical fibre. [4]
   (b) Derive an expression for acceptance angle for an optical fibre. How it is related to numerical aperture? [8]
   (c) An optical fibre has a numerical aperture of 0.20 and a cladding refractive index of 1.59. Find the acceptance angle for the fibre in water which has a refractive index of 1.33. [4]

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Code No: R05010201 **Set No. 3**

I B.Tech Supplimentary Examinations, Aug/Sep 2007
APPLIED PHYSICS
(Common to Electrical & Electronic Engineering, Electronics & Communication Engineering, Computer Science & Engineering, Electronics & Instrumentation Engineering, Bio-Medical Engineering, Information Technology, Electronics & Control Engineering, Computer Science & Systems Engineering, Electronics & Telematics, Electronics & Computer Engineering and Instrumentation & Control Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Show that FCC is the most closely packed of the three cubic structures by working out the packing factors. [10]
   (b) Describe the structure of NaCl. [6]
2. (a) Explain how the X-ray diffraction can be employed to determine the crystal structure. [10]
   (b) The distance between (110) planes in a Body-Centered Cubic structure is 0.203 nm. What is the size of the unit cell? What is the radius of the atom? [6]
3. (a) Explain the influence of point defects in crystals and how do they affect the properties of materials. [8]
   (b) Obtain an expression for the energy required to create a vacancy in the crystal. [8]
4. (a) How does the electrical resistance of a metal change with temperature? [4]
   (b) Discuss the motion of an electron in a periodic lattice. [8]
   (c) Find the relaxation time of conduction electrons in a metal having resistivity 1.54×10^{-8} Ω-m, if the metal has 5.8×10^{28} conduction electrons per cubic meter. [4]
5. (a) With usual notation show that $P = \in_o (\in_r -1)E$ [6]
   (b) What is dipolar relaxation? Discuss the frequency dependence of orientational polarization. [6]
   (c) A solid elemental dielectric, with density 3×10^{28} atoms / m^3 shows an electronic polarisability of 10^{-40} farad-m^2. Assuming the internal electric field to be a Lorentz field, calculate the dielectric constant of the material. [4]
6. (a) Distinguish between metals, semiconductors and insulators. [6]
   (b) Explain the effect of temperature on resistivity of a semiconductor. [4]
   (c) Derive an expression for the number of electrons per unit volume in the conduction band of an intrinsic semiconductor. [6]

7. (a) Explain the characteristics of a laser beam. [4]
   (b) Describe the construction and working of a ruby laser. [8]
   (c) Discuss how lasers are helpful in induced fusion and isotope separation processes. [4]

8. (a) Explain the basic principle of an optical fibre. [4]
   (b) Describe graded index optical fibre and explain the transmission of signal through it. [8]
   (c) What are different losses in optical fibres? Write brief note on each. [4]

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Code No: R05010201 **Set No. 4**

I B.Tech Supplimentary Examinations, Aug/Sep 2007
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the bonding in NaCl. [6]
   (b) Calculate the bond energy for NaCl molecule. [6]
   (c) Calculate the potential energy of the system of Na^+ and Cl^- ions when they are 0.25 nm apart. [4]

2. (a) Explain Bragg's law of X-ray diffraction. [6]
   (b) Describe Laue's method for determination of crystal structure. [6]
   (c) A beam of X-rays is incident on a NaCl crystal with lattice spacing 0.282 nm. Calculate the wavelength of X-rays if the first order Bragg reflection takes place at a glancing angle of $8^o35'$. Also calculate the maximum order of diffraction possible. [4]

3. (a) Describe edge and screw dislocations. Draw Burgers circuit and slip planes for them. [10]
   (b) Explain the significance of Burgers vector. [6]

4. (a) What is Fermi level? [2]
   (b) Explain Fermi-Dirac distribution for electrons in a metal. Discuss its variation with temperature. [8]
   (c) Calculate the free electron concentration, mobility and drift velocity of electrons in aluminum wire of length of 5 m and resistance 0.06 Ω carrying a current of 15 A, assuming that each aluminum atom contributes 3 free electrons for conduction.
   Given: Resistivity for aluminum = 2.7×10^{-8} Ω-m.
   Atomic weight = 26.98
   Density = 2.7×10^3 kg/ m^3
   Avagadro number = 6.025×10^{23} [6]

5. (a) Draw and explain B-H curve for a ferromagnetic material placed in a magnetic field. [6]

(b) Discuss the theory of paramagnetism. [6]

(c) State the properties of diamagnetic materials. [4]

6. (a) Explain n-type and p-type semiconductors. Indicate on an energy level diagram the conduction and valence bands, donor and acceptor levels for an intrinsic and extrinsic semiconductors. [10]

(b) Explain the detailed mechanism of current conduction in n and p type semiconductors. [6]

7. (a) What do you understand by population inversion? How it is achieved? [6]

(b) Derive the relation between the probabilities of spontaneous emission and stimulated emission in terms of Einstein's coefficients. [10]

8. (a) Explain the difference between a step-index fibre and graded index fibre. [6]

(b) What are the advantages of an optical fibre communication system over the conventional ones? [6]

(c) A fibre has the core and cladding refractive indices 1.45 and 1.44 respectively. Find the relative refractive index difference. [4]

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