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

I B.Tech Regular Examinations, Apr/May 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) Draw the (112) and (120) planes, and the [112] and [120] directions of a simple cubic crystal. [4]
   (b) Derive an expression for the inter-planar spacing in the case of a cubic structure. [8]
   (c) Calculate the glancing angle at (110) plane of a cubic crystal having axial length 0.26 nm corresponding to the second order diffraction maximum for the X-rays of wavelength 0.065 nm. [4]
3. (a) What is Frenkel defect? Explain. [6]
   (b) Derive an expression for the concentration of Frenkel defects present in a crystal at any temperature. [10]
4. (a) Explain the origin of energy bands in solids. [6]
   (b) Assuming the electron - lattice interaction to be responsible for scattering of conduction electrons in a metal, obtain an expression for conductivity in terms of relaxation time and explain any three draw backs of classical theory of free electrons. [6]
   (c) Find the temperature at which there is 1% probability of a state with an energy 0.5 eV above Fermi energy. [4]
5. (a) Explain the polarization mechanism in dielectric materials. [8]
   (b) What are the important requirements of good insulating materials? [4]
   (c) A parallel plate capacitor of area 650 mm^2 and a plate separation of 4 mm has a charge of 2×10^{-10} C on it. When a material of dielectric constant 3.5 is introduced between the plates, what is the resultant voltage across the capacitor? [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) 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) Define the relative refractive index difference of an optical fibre. Show how it is related to numerical aperture. [6]
   (b) Draw the block diagram of an optical fibre communication system and explain the function of each block. [10]

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

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APPLIED PHYSICS
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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) Define crystal lattice, unit cell, lattice parameter and coordination number. [8]
   (b) Consider a body centered cubic lattice of identical atoms having radius R. Compute
      i. the number of atoms per unit cell
      ii. the coordination number and
      iii. the packing fraction. [8]

2. (a) What are Miller indices? Draw (111) and (110) planes in a cubic lattice. [6]
   (b) Explain Bragg's law of X-ray diffraction. [6]
   (c) The Bragg's angle for reflection from the (111) plane in a FCC crystal is 19.2^o for an X-ray wavelength of 1.54 A.U. Compute the cube edge of the unit cell. [4]

3. (a) Explain Schottky and Frenkel defects with the help of suitable figures. [10]
   (b) Explain the significance of Burgers vector. [6]

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) Obtain a relation between electronic polarization and electric susceptibility of the dielectric medium. [6]
   (b) What is dielectric breakdown? Explain briefly the various factors contributing to breakdown in dielectrics. [6]
   (c) A parallel plate capacitor having a plate separation of 2×10^{-3} m across which a potential of 10 V is applied. Calculate the dielectric displacement, when a material of dielectric constant 6.0 is introduced between the plates. [4]

6. (a) Explain Meissner effect. [6]

(b) What is meant by isotopic effect? Explain with suitable example. [6]

(c) A superconducting material has a critical temperature of 3.7 K, and a magnetic field of 0.0306 tesla at 0 K. Find the critical field at 2 K. [4]

7. (a) Explain the terms:
   i. Absorption.
   ii. Spontaneous emission.
   iii. Stimulated emission.
   iv. Pumping mechanism.
   v. Population inversion.
   vi. Optical cavity. [12]

   (b) Mention the medical applications of lasers. [4]

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 Regular Examinations, Apr/May 2007
APPLIED PHYSICS
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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) 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 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) What is Frenkel defect? Explain. [6]
   (b) Derive an expression for the concentration of Frenkel defects present in a crystal at any temperature. [10]
4. (a) Explain the origin of energy bands in solids. [6]
   (b) Assuming the electron - lattice interaction to be responsible for scattering of conduction electrons in a metal, obtain an expression for conductivity in terms of relaxation time and explain any three draw backs of classical theory of free electrons. [6]
   (c) Find the temperature at which there is 1% probability of a state with an energy 0.5 eV above Fermi energy. [4]
5. (a) What is ferromagnetism? What are the distinguishing features of ferromagnetism? [8]
   (b) What are ferrites? Explain the magnetic properties of ferrites and mention their industrial applications. [8]
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) 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) Define the relative refractive index difference of an optical fibre. Show how it is related to numerical aperture. [6]

   (b) Draw the block diagram of an optical fibre communication system and explain the function of each block. [10]

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

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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 "Unit Cell" and "Lattice Parameters". What is a primitive cell and how does it differ from unit cell? [6]
   (b) Describe the crystal structure of CsCl. [4]
   (c) Chromium has BCC structure. Its atomic radius is 0.1249 nm. Calculate the free volume/unit cell. [6]
2. (a) What are Miller indices? Draw (111) and (110) planes in a cubic lattice. [6]
   (b) Explain Bragg's law of X-ray diffraction. [6]
   (c) The Bragg's angle for reflection from the (111) plane in a FCC crystal is 19.2^o for an X-ray wavelength of 1.54 A.U. Compute the cube edge of the unit cell. [4]
3. (a) Show that the wavelength of an electron accelerated by a potential difference 'V' volts, is $\lambda = 1.227 \times 10^{-10}/\sqrt{V}$ m for non-relativistic case. [6]
   (b) Describe an experiment to establish the wave nature of electrons. [6]
   (c) Explain the difference between a matter wave and an electromagnetic wave. [4]
4. (a) Explain the origin of energy bands in solids. [6]
   (b) Assuming the electron - lattice interaction to be responsible for scattering of conduction electrons in a metal, obtain an expression for conductivity in terms of relaxation time and explain any three draw backs of classical theory of free electrons. [6]
   (c) Find the temperature at which there is 1% probability of a state with an energy 0.5 eV above Fermi energy. [4]
5. (a) What is intrinsic break down in dielectric materials? [4]
   (b) Explain electronic polarization in atoms and obtain an expression for electronic polarisability in terms of the radius of the atom. [8]

(c) A parallel plate capacitor has an area of 100 cm^2, with a separation of 1 cm and is charged to a potential of 100 V. Calculate the capacitance of the capacitor and the charge on the plates. [4]

6. Explain the following: [6+5+5]

   (a) Critical magnetic field of a superconductor as a function of temperature.

   (b) Meissner effect.

   (c) Cryotrons.

7. (a) Explain with a neat diagram

      i. absorption

      ii. spontaneous emission and

      iii. stimulated emission of radiation. [8]

   (b) What is population inversion? How it is achieved by optical pumping? [8]

8. (a) Describe the construction of a typical optical fibre and give the dimensions of the various parts. [4]

   (b) Define the acceptance angle and numerical aperture. Obtain an expression for the numerical aperture of an optical fibre. [8]

   (c) Calculate the numerical aperture and acceptance angle for an optical fibre with core and cladding refractive indices being 1.48 and 1.45 respectively. [4]

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