Code No: 09A1BS02 **R09** **Set No. 2**

I B.Tech Examinations,June 2011
ENGINEERING PHYSICS
Common to CE, ME, CHEM, BME, IT, MECT, MEP, AE, BT, AME, AIE, ICE, E.COMP.E, MMT, ETM, EIE, CSE, ECE, EEE
Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Show that the Kronig-Penney model leads to energy band structure in solids.
   (b) Explain the concept of effective mass of an electron. [9+6]

2. (a) What is meant by polarization mechanism in dielectrics? Discuss the different polarization mechanisms in dielectrics.
   (b) Distinguish between ferro-electricity and piezo-electricity.
   (c) Find the electric susceptibility of a dielectric gas having dielectric constant of 1.000041. [7+5+3]

3. (a) Explain the terms:
      i. Spontaneous emission and
      ii. Stimulated emission.
   (b) Distinguish between Ruby laser and He-Ne laser.
   (c) Explain the need of a cavity resonator in a laser. [4+7+4]

4. (a) Distinguish between Maxwell-Bolzmann statistics and Bose-Einstein statistics.
   (b) Write notes on black body radiation.
   (c) What is the concept of electron gas? [6+5+4]

5. (a) Write notes on line defects of crystals.
   (b) What is Burger's vector? In what direction do the Burger's vector lie with respect to
      i. An edge dislocation,
      ii. Screw dislocation.
   (c) Two metals have the formation energies as 0.73 eV and 0.96 eV. What will be the ratio of their vacancy fractions? [6+5+4]

6. (a) Describe any three processes by which nanomaterials are fabricated.
   (b) Write the important applications of nanomaterials. [9+6]

7. (a) Describe with a suitable example, the formation of covalent bond in solids.
   (b) Compare the properties of metallic and hydrogen bonds in solids.
   (c) What is Madelung constant? Explain. [4+7+4]

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8. (a) Derive an expression for carrier concentration of n-type semiconductors.
   (b) Explain Hall effect and its importance.
   (c) Calculate the intrinsic carrier concentration for Ge at 27^0C. [for Ge, Atomic weight = 72.6, Density = 5400 kg/m^3, Band gap = 0.70 eV]. [7+4+4]

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Code No: 09A1BS02 **R09** **Set No. 4**

I B.Tech Examinations,June 2011
ENGINEERING PHYSICS
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Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Discuss the essential features of a laser beam.
   (b) Explain the various pumping mechanisms that are adopted in lasers.
   (c) Explain the uses of lasers in industry and medical fields. [5+5+5]
2. (a) Derive an expression for density of holes in intrinsic semiconductors.
   (b) Write notes on direct band gap and indirect band gap semiconductors. [7+8]
3. (a) What is electronic polarization? Derive an expression for electronic polarizability in terms of the radius of the atom.
   (b) What is piezo-electricity? Write the applications of piezo-electric materials.
   (c) The electronic polarizability of a dielectric material having no ions and permanent dipoles, is 1.5×10^{-40} farad-m^2. The density of the material is 2.5×10^{28} atoms per m^3. Calculate the dielectric constant of the material. [7+5+3]
4. (a) Describe the top-down methods by which nanomaterials are fabricated.
   (b) Explain how X-ray diffraction can be used to characterize nanoparticles.[9+6]
5. (a) What is Bloch theorem? Explain.
   (b) What are Brillouin zones? Explain using E-K diagram.
   (c) What is effective mass of an electron? Derive an expression for the effective mass of an electron. [4+5+6]
6. (a) Explain the types of defects in metallic lattices:
      i. Vacancy,
      ii. Schottky defect and
      iii. Interstitial defect
   (b) Derive an expression for concentration of Frenkel defect in an ionic crystal. [8+7]
7. (a) Explain the concept of dual nature of the light.
   (b) Describe the experimental verification of matter waves using Davisson-Germer experiment.

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(c) Calculate the wavelength of matter wave associated with a neutron whose kinetic energy is 1.5 times the rest mass of electron.
(Given that Mass of neutron = 1.676×10^{-27} kg, Mass of electron = 9.1×10^{-31} kg, Planck's constant = 6.62×10^{-34} J-sec, Velocity of light = 3×10^{8} m/s). [4+7+4]

8. (a) Describe the formation of various types of bonds in solids with suitable examples.

(b) Derive an expression for estimation of cohesive energy of a solid. [7+8]

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Code No: 09A1BS02 **R09** **Set No. 1**

I B.Tech Examinations,June 2011
ENGINEERING PHYSICS
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Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What is internal field in a dielectric material?
   (b) Derive an expression for calculation of internal field for a cubic dielectric crystal.
   (c) Write notes on dielectric theory of ferro-electricity. [3+7+5]

2. (a) Write notes on:
      i. Origin of nanotechnology and
      ii. Nano-scale.
   (b) Describe the "combustion" method and "physical vapour deposition" method in the fabrication of nano-structures.
   (c) Write the applications of nanotechnology in Electronic Industry. [4+7+4]

3. (a) Derive Bragg's law of X-ray diffraction.
   (b) Describe with a neat diagram, Laue's method for the determination of crystal structure.
   (c) A beam of X-rays is incident on an ionic crystal with lattice spacing 0.313 nm. Calculate the wavelength of X-rays if the first order Bragg reflection takes place at a glancing angle of $7^0 48'$. [4+7+4]

4. (a) Explain the terms:
      i. Nearest neighbour distance,
      ii. Coordination number and
      iii. Packing fraction, relating to crystal structures.
   (b) Compare the structure of zinc blende with that of diamond.
   (c) If iron has BCC structure with atomic radius of 124 pm, calculate the density of the crystal. (Atomic weight of iron = 55.9 gm per mol, Avagadro's number = 6.023×10^{23} per mol). [3+7+5]

5. (a) Distinguish between Maxwell-Bolzmann statistics and Fermi-Dirac statistics.
   (b) Write notes on "Theroy of Black Body Radiation".
   (c) What is photon gas? Explain. [6+5+4]

6. (a) Explain the terms:

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i. Spontaneous emission,
ii. Stimulated emission,
iii. Optical pumping and
iv. Population inversion.

(b) What are Einstein's coefficients of radiation? Derive relation between them.

(c) Write the applications of lasers in the medical field. [6+5+4]

7. (a) Write notes on:
   i. Bloch theorem and
   ii. Effective mass.

   (b) Explain, in detail, the origin of energy gap using energy band theory of solids. [6+9]

8. (a) Derive an expression for carrier concentration of n-type semiconductors.

   (b) Explain the variation of Fermi level with temperature in the case of n-type semiconductors.

   (c) If the effective mass of holes in a semiconductor is 5 times that of electrons, at what temperature would the Fermi level be shifted by 15% from the middle of the forbidden energy gap? [Given that the energy gap for the semiconductor is 1.20 eV]. [7+4+4]

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Code No: 09A1BS02 **R09** **Set No. 3**

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Time: 3 hours **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Draw and explain the energy band diagram for a p-n junction diode in an unbiased condition.
   (b) Write a detailed note on Photo Diodes. [7+8]
2. (a) Write notes on point defects in crystals.
   (b) What is Burger's vector? What is Burger's circuit? Explain.
   (c) If the average energy required to create a Frenkel defect in an ionic crystal is 1.35 eV, calculate the ratio of Frenkel defects at 25^0C and 350^0C. [5+6+4]
3. (a) Derive an expression between electronic polarization and electric susceptibility of the dielectric medium.
   (b) Describe Lorentz method to calculate the internal field of a cubic structure.
   (c) What is pyro-electricity? Write the applications of pyro-electric materials. [5+5+5]
4. (a) What is black body? State Rayleigh-Jeans law of black body radiation.
   (b) Derive Schrodinger's wave equation for the motion of an electron.
   (c) Calculate the velocity and kinetic energy of an electron having wavelength of 0.21 nm. [4+7+4]
5. (a) Discuss Kronig - Penney model for the motion of an electron in periodic potential.
   (b) Write a detailed notes on Brillouin zones. [7+8]
6. (a) Distinguish between optical fibers and conventional electrical cables used for transmission of signals.
   (b) Draw the block diagram of fiber optic communication system and explain the functions of each block in the system. [6+9]
7. (a) Describe an experimental method to determine the sound absorption coefficient of material.
   (b) Discuss the factors which are affecting the architectural acoustics and suggest your remedy.

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(c) A hall has a volume of 1500 m^3. Its total absorption is equivalent to 100 m^2 of open window. What will be the effect on the reverberation time, if the absorption is increased by 100 m^2 of open window, by filling the hall with audience? [6+5+4]

8. (a) Derive an expression for minimum potential energy of a molecule.

(b) Explain the formation of covalent bond in a solid. What is hybridization?

(c) Find the energy required to form K^+ and Cl^- ion pair from a pair of K and Cl atoms. (Given that the Ionization energy of K = 4.1 eV and Electron affinity of Cl = 3.6 eV). [6+5+4]

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