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

I B.Tech Regular Examinations,June 2010
ENGINEERING PHYSICS
Common to CE, ME, CHEM, BME, IT, MECT, MEP, AE, BT, AME, 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) What is statistical mechanics? Write notes on Bose-Einstein statistics.
   (b) Write notes on black body radiation.
   (c) Calculate the energies that can be possessed by a particle of mass 8.50×10^{-31}kg which is placed in an infinite potential box of width 10^{-9}cm. [6+5+4]

2. (a) What is the meaning of nanotechnology? Explain.
   (b) Describe the processes of "sol-gel" and "precipitation" in the fabrication of nano- structures.
   (c) Write the applications of nanotechnology in Electronic Industry. [4+7+4]

3. (a) Write notes on volume 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]

4. (a) Discuss the band theory of solids and explain the formation of bands and concept of holes.
   (b) What is effective mass of an electron? Derive an expression for the effective mass of an electron. [9+6]

5. (a) Explain the formation and properties of an ionic crystal, with a suitable example.
   (b) Derive an expression for the cohesive energy of an ionic crystal. [7+8]

6. (a) What is Meissner effect? Explain, in detail.
   (b) Distinguish a super-conductor and a normal metal, both maintained at same temperature.
   (c) Write notes on magnetic levitation. [5+5+5]

7. (a) Explain the characteristics of a laser beam.
   (b) Describe the construction of He-Ne laser and discuss with relevant ELD, the working of He-Ne laser.
   (c) What are the differences between a laser diode and an LED? [4+7+4]

8. (a) Derive an expression for carrier concentration of p-type semiconductors.
   (b) Explain Hall effect and its importance.
   (c) For a semiconductor, the Hall coefficient is -6.85 $\times$ 10^{-5} m^3/coulomb, and electrical conductivity is 250 $m^{-1}\Omega^{-1}$. Calculate the density and mobility of the charge carriers. [7+4+4]

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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) Obtain an expression for Fermi energy at T > 0 K.
   (b) Derive an expression for density of states of electrons.
   (c) Write short notes on:
      i. De Broglie wavelength and
      ii. Heisenberg's uncertainty principle. [4+7+4]

2. (a) Derive Bragg's law of crystal diffraction.
   (b) Describe, in detail, Debye-Scherrer method for the determination of crystal parameter.
   (c) A certain crystal reflects monochromatic X-rays strongly when Bragg's angle is 21^0 for the second order diffraction. Calculate the glancing angle for third order spectrum. [4+7+4]

3. (a) What is bonding in solids? Write the list of different types of bonding in solids.
   (b) Describe with suitable examples, the formation of covalent and Vander-Waal's bonds in solids.
   (c) What is bonding energy of a molecule? Explain. [4+7+4]

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) Discuss the propagation mechanism of light waves in optical fibers.
   (b) Derive the expression for the numerical aperture of an optical fiber.
   (c) A step index fiber has a numerical aperture of 0.16, and core refractive index of 1.45. Calculate the acceptance angle of the fiber and the refractive index of the cladding. [5+6+4]

6. (a) Using Kronig-Penney model show that the energy spectrum of an electron contains a number of allowed energy bands separated by forbidden bands.
   (b) Define effective mass of an electron. Explain its physical significance. [9+6]

7. (a) Show that the application of forward bias voltage across p-n junction causes an exponential increase in number of charge carriers in opposite regions.

(b) Write notes on "Liquid Crystal Display".

(c) The current in a p-n junction at 27^0C, is 0.18 μA when a large reverse bias voltage is applied. Calculate the current when a forward bias of 0.98 V is applied. [7+4+4]

8. (a) Define the terms magnetic induction (B), magnetization (M) and magnetic field (H). Obtain an expression relating to these quantities.

(b) What are ferrites? Prove that ferrites are superior to ferro-magnetic materils. Write the applications of ferrites.

(c) The magnetic susceptibility of aluminum is 2.3×10^{-5}. Find its permeability and relative permeability. [6+5+4]

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

I B.Tech Regular Examinations,June 2010
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) Explain the principle behind the functioning of an optical fibre.
   (b) Derive an expression for numerical aperture of an optical fibre.
   (c) Write any three applications of optical fibres. [4+7+4]
2. (a) Distinguish between intrinsic and extrinsic semicondutors.
   (b) Derive an expression for the density of holes in the valence band of an intrinsic semiconductor. [7+8]
3. (a) What is bonding in solids? Write the list of different types of bonding in solids.
   (b) Describe with suitable examples, the formation of ionic and covalent bonds in solids.
   (c) What is cohesive energy of a molecule? Explain. [4+7+4]
4. (a) What is Bloch theorem? Explain.
   (b) Write the conclusions given by Kronig-Penney model.
   (c) For an electron under motion in a periodic potential, plot the curve between the effective mass of the electron and wave number, and explain. [5+5+5]
5. (a) Describe any three processes by which nanomaterials are fabricated.
   (b) Describe the important applications of nanotechnology. [9+6]
6. (a) Define magnetic moment. What is Bohr magneton? Explain.
   (b) What are the characteristics of diamagnetic, paramagnetic and ferromagnetic substances? Explain their behavior with the help of examples.
   (c) If a magnetic field of strength 300 amp/metre produces a magnetization of 4200 A/m in a ferromagnetic material, find the relative permeability of the material. [3+9+3]
7. (a) Explain the concept of dual nature of the light.
   (b) Describe the experimental verification of matter waves using Davisson-Germer experiment.

(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) Write notes on Bragg's law.
(b) Describe Bragg's X-ray spectrometer method in the determination crystal structure.
(c) Calculate the glancing angle of (1 1 1) plane of a cubic crystal having axial length 0.19 nm corresponding to the second order diffraction maximum for the X-rays of wavelength 0.058 nm. [4+7+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) Explain Fermi-Dirac distribution function. Illustrate the effect of temperature on the distribution.
   (b) Derive an expression for density of states of an atom. [8+7]
2. (a) Derive the expressions for:
      i. Acceptance angle and
      ii. Numerical aperture of an optical fiber.
   (b) Describe the different types of fibers by giving the refractive index profiles and propagation details. [8+7]
3. (a) What are Brillouin zones? Explain using E-K diagram.
   (b) Define effective mass of an electron. Explain its physical significance.
   (c) What is a hole? List out the properties of a hole. [5+5+5]
4. (a) Write notes on 'point defects' in crystals..
   (b) Derive the expression for the density of Frenkel defects in a metallic crystal.
   (c) What is Burgers vector? Explain. [5+5+5]
5. (a) Describe the different methods of acoustic quieting.
   (b) Describe various method to achieve soundproofing. [7+8]
6. (a) Explain the terms:
      i. Magnetic induction,
      ii. Magnetic susceptibility,
      iii. Permeability of a medium and
      iv. Intensity of magnetization.
   (b) What are hard and soft magnetic materials? Give their characteristic properties and applications.
   (c) A paramagnetic material has a magnetic field intensity of 10^4 amp/m. If the susceptibility of the material at room temperature is 3.7×10^{-3}. Calculate the magnetization and flux density of the material. [6+5+4]
7. (a) What do you understand by Miller indices of a crystal plane?

(b) Show that in a cubic crystal the spacing (d) between consecutive parallel planes of Miller indices (h k l) is given by $d = a\ (h^2 + k^2 + l^2)^{-1/2}$.

(c) NaCl crystals have FCC structure. The density of NaCl is 2.18 gm/cm^2. Calculate the distance between two adjacent atoms. (Molecular weight of NaCl = 58.5). [4+7+4]

8. (a) Derive an expression for density of electrons in intrinsic semiconductors.

(b) Explain the variation of Fermi level with temperature in the case of p-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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