Code No: **Z0221/R07**

$\boxed{\textbf{Set No. 1}}$

I B.Tech Supplementary Examinations, January 2014
APPLIED PHYSICS
(Common to EEE,ECE,CSE,EIE,BME,IT,E.Con.E,CSS,ETM,ECC and ICE)

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

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) Explain the terms:
    i. basis,
    ii. space lattice and
    iii. lattice parameters.
   (b) Distinguish between a primitive cell and a unit cell.
   (c) Chromium has BCC structure. Its atomic radius is 0.1249 nm. Calculate the free volume per unit cell. [6+4+6]

2. (a) Derive one-dimensional time independent Schrodinger wave equation for an electron.
   (b) Show that the energies of a particle in a potential box, are quantized. [10+6]

3. (a) What are the salient features of Sommerfeld theory of metals? Explain.
   (b) Explain the Fermi-Dirac distribution function of electrons.
   (c) Use the Fermi distribution function to obtain the value of F(E) for E - E_F = 0.01 eV at 200 K. [6+6+4]

4. (a) Explain the terms:
    i. Magnetic flux density
    ii. Magnetic field strength
    iii. Magnetization and
    iv. Magnetic susceptibility. How they are related to each other?
   (b) What are hard and soft magnetic materials? Write their characteristic properties and applications. [8+8]

5. (a) Explain the terms
    i. transition temperature
    ii. critical magnetic field and
    iii. critical current, relating to superconductivity.
   (b) Write a note on Meissner effect of superconductivity.
   (c) The London penetration depth for Pb at 3.0 K and 7.1 K are respectively 39.6 nm and 173 nm. Calculate the transition temperature as well as depth at absolute zero. [6+6+4]

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6. (a) What is population inversion relating to laser action? Explain.

    (b) Describe the various methods to achieve population inversion.

    (c) Explain the important components of a laser system.   [6+6+4]

7. (a) Describe the structure of an optical fiber.

    (b) Explain, in detail, the basic principle of an optical fiber.

    (c) Write the applications of fiber optics in medicine and industry.   [6+6+4]

8. (a) What are nanomaterials? Explain

    (b) Describe the fabrication of nanomaterials.   [6+10]

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$\boxed{\textbf{Set No. 2}}$

I B.Tech Supplementary Examinations, January 2014
APPLIED PHYSICS
(Common to EEE,ECE,CSE,EIE,BME,IT,E.Con.E,CSS,ETM,ECC and ICE)

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

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) State and explain Bragg's law.

   (b) Describe with suitable diagram, the powder method for determination of crystal structure.

   (c) A beam of X-rays of wavelength 0.071 nm is diffracted by (1 1 0) plane of rock salt with lattice constant of 0.28 nm. Find the glancing angle for the second order diffraction. [4+8+4]

2. (a) Discuss the de Broglie hypothesis of duality of matter particles.

   (b) Describe GP Thomsons experiment to verify the wave nature of matter.[6+10]

3. (a) Explain the terms

      i. drift velocity and
      ii. mobility of electrons in a metal.

   (b) Explain the Fermi-Dirac distribution function of electrons. Explain the effect of temperature on the distribution.

   (c) Find the temperature at which there is 1% probability that a state with an energy of 0.75 eV above Fermi energy will be occupied. [4+8+4]

4. (a) Explain the following:

      i. Electric Polarization
      ii. Polarization vector
      iii. Electric displacement and
      iv. Polarizability.

   (b) Distinguish between Ferro-electrics and Piezo-electrics. [8+8]

5. (a) Distinguish between D.C.Josephson effect and A.C.Josephson effect.

   (b) Describe BCS theory of superconductivity.

   (c) Write important applications of superconductors. [6+6+4]

6. (a) Explain the characteristics of a LASER.

   (b) Describe the construction and working of Ruby laser.

   (c) Write any four applications of laser. [4+8+4]

7. (a) Distinguish between light propagation in (i) step index and (ii) graded index optical fibers.

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(b) Discuss the various advantages of communication with optical fibers over the conventional coaxial cables.

(c) Calculate the refractive indices of core and cladding of an optical fiber with a numerical aperture of 0.33 and their fractional difference of refractive indices being 0.02. [6+6+4]

8. (a) What are nanomaterials? Explain

(b) Describe the fabrication of nanomaterials. [6+10]

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Set No. 3

I B.Tech Supplementary Examinations, January 2014
APPLIED PHYSICS
(Common to EEE,ECE,CSE,EIE,BME,IT,E.Con.E,CSS,ETM,ECC and ICE)

Time: 3 hours
Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) Explain how the X-ray diffraction can be employed to determine the crystal structure.

   (b) The distance between (1 1 0) planes in a body-centered cubic structure is 0.203 nm. Find the size of the unit cell, and the radius of the atom. [10+6]

2. (a) Derive one-dimensional, time independent Schrodinger wave equation for an electron.

   (b) Deduce the expression for energy of an electron confined to a potential box of width 'd'.

   (c) Find the lowest energy of an electron confined to a one-dimensional box of width 0.1 nm. [6+6+4]

3. (a) What is Fermi energy? Explain.

   (b) Explain the Fermi-Dirac distribution function of electrons. Illustrate graphically the effect of temperature on the distribution.

   (c) The Fermi energy of silver is 5.5 eV. An electron in silver has an energy which is 1% above Fermi energy. At what temperature we can expect a 10% probability of electron at this energy level? [4+8+4]

4. (a) Explain the terms:

    i. dielectric displacement and
    ii. relative dielectric constant.

   (b) Explain, in detail, electronic polarization and ionic polarization. [6+10]

5. (a) Distinguish between intrinsic and extrinsic semiconductors with suitable examples.

   (b) Derive an expression for the density of holes in valence band of an intrinsic semiconductor. [8+8]

6. (a) Describe the various methods to achieve population inversion relating to lasers.

   (b) With the help of a suitable diagram, explain the principle, construction and working of a semiconductor laser. [6+10]

7. (a) What are important features of optical fibers?

   (b) Describe the communication process using optical fibers.

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(c) Write the uses of fiber optics in different fields. [4+6+6]

8. (a) What are nanomaterials? Explain.

(b) How the physical and chemical properties of nano-particles vary with their size? [6+10]

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$\boxed{\textbf{Set No. 4}}$

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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) Explain the different types of bonding in solids with suitable examples.

   (b) The distance between (1 1 0) planes in a body centered cubic structure is 0.203 nm. Calculate the size of the unit cell, and the radius of the atom. [12+4]

2. (a) Write short notes on:
      i. Planck's quantum theory and
      ii. Heisenberg's uncertainty principle.

   (b) Explain, in detail, the properties of matter waves. [10+6]

3. (a) Discuss with suitable mathematical expressions, the Kronig-Penney model for the energies of an electron in a metal.

   (b) Explain the classification of metals, semiconductors and insulators based on band theory. [10+6]

4. (a) Explain
      i. Electronic polarization
      ii. Ionic polarization
      iii. Orientational polarization and
      iv. Space-charge polarization.

   (b) What is meant by local field in a dielectric material? Explain how the local field could be calculated for a cubic dielectric crystal. [6+10]

5. (a) Write a note on intrinsic semiconductors.

   (b) Derive an expression for the carrier concentration in n-type extrinsic semiconductors. [6+10]

6. (a) What is population inversion relating to laser action? Explain.

   (b) Show that the rate of probability of stimulated emission and absorption are equal when the system is in equilibrium. [6+10]

7. (a) Explain the principle of an optical fiber.

   (b) Explain how the optical fibers are classified.

   (c) Calculate the angle of acceptance of a given optical fiber, if the refractive indices of the core and the cladding are 1.563 and 1.498 respectively.[6+6+4]

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8. (a) Write a detailed note on nanoscience and nanotechnology.

   (b) Write the important applications of nanomaterials in medicine. [10+6]

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