First/Second Semester B.E. Degree Examination, June/July 2017

Engineering Physics

Time: 3 hrs.   Max. Marks:100

Note: 1. *Answer FIVE full questions, selecting ONE full question from each module.*
     2. *Physical constants : Velocity of light, $c = 3 \times 10^8$ m/s*
                            Planck's constant, $h = 6.625 \times 10^{-34}$ JS
                            Mass of electron, $m = 9.1 \times 10^{-31}$ kg
                            Boltzmann constant, $k = 1.38 \times 10^{-23}$ J/K
                            Avagadro number, $N_A = 6.02 \times 10^{26}$/K mole

Module-1

1   a. State and explain Planck's law of radiation. Show that it reduces to Wien's law and Rayleigh-Jeans law under certain conditions. **(06 Marks)**

    b. State Heisenberg's uncertainty principle. Using this principle show that an electron does not exist within the nucleus of an atom. **(06 Marks)**

    c. What is the physical significance of wave function? Mention its properties. **(04 Marks)**

    d. Estimate the potential difference through which an electron is needed to be accelerated so that its de Broglie wavelength becomes equal to 20 Å. **(04 Marks)**

2   a. Define phase velocity and group velocity. Show that group velocity is equal to particle velocity. **(06 Marks)**

    b. Derive the expression for energy eigen value for a material particle in a one dimensional infinite potential well. **(07 Marks)**

    c. What are matter waves? Mention their properties. **(03 Marks)**

    d. A material particle is moving with a speed of 4×10^5 m/s. If the uncertainty in the measurement of its position is equal to its de-Broglie wavelength, what is the uncertainty in the measurement of its velocity? **(04 Marks)**

Module-2

3   a. Explain the drawbacks of classical free electron theory of metals. **(06 Marks)**

    b. What is critical field? Explain type-I and type-II superconductors. **(06 Marks)**

    c. Find the resistivity of an intrinsic semiconductor with an intrinsic carrier concentration of 2.5×10^{19}/m^3. The mobilities of electrons and holes are 0.4 m^2/Vs and 0.20 m^2/Vs respectively. **(04 Marks)**

    d. Explain in brief the construction and working of Maglev vehicle. **(04 Marks)**

4   a. State and explain law of mass action for semiconductors. Derive an expression for Fermi level in an intrinsic semiconductor. **(07 Marks)**

    b. What is superconductivity? Explain BCS theory of superconductivity. **(05 Marks)**

    c. Define terms: i) drift velocity,   ii) relaxation time,   iii) density of states,   iv) Fermi energy. **(04 Marks)**

    d. Calculate the probability of an electron occupying an energy level 0.2 eV below the Fermi level at 1000 K. **(04 Marks)**

Module-3

5 a. Describe the construction and working of CO_2 laser with necessary diagrams. **(07 Marks)**
   b. What is attenuation in an optical fiber? Explain various factors contributing to the fiber loss.
      (06 Marks)
   c. Describe point to point communication system using optical fibers with the help of a block diagram. **(04 Marks)**
   d. Calculate the wavelength of emission from a GaAs semiconductor laser whose band gap energy is 1.44 eV. **(03 Marks)**

6 a. Describe the recording and reconstruction processes in holography with the help of suitable diagram. **(06 Marks)**
   b. With neat diagrams, explain the different types of optical fibers. **(06 Marks)**
   c. Discuss the application of lasers in welding and cutting. **(04 Marks)**
   d. Calculate the number of modes that can propagate inside an optical fiber, given: n_{core} = 1.47, n_{clad} = 1.43, core diameter = 60 µm, λ = 1.5 µm. **(04 Marks)**

Module-4

7 a. Explain in brief the seven crystal system with neat diagrams. **(07 Marks)**
   b. With a neat diagram, explain the structure of the diamond and calculate its atomic packing factor. **(05 Marks)**
   c. Discuss allotropy and polymorphism. **(04 Marks)**
   d. Copper has fcc structure and the atomic radius is 0.1278 nm. Calculate the interplanar spacing for (111) plane. **(04 Marks)**

8 a. What are liquid crystals? Mention their classifications. Explain the working of LCD with necessary diagram. **(07 Marks)**
   b. What are Miller indices? Derive an expression for interplanar spacing interms of Miller indices for cubic lattice. **(06 Marks)**
   c. Write a short note on perovskites. **(03 Marks)**
   d. Draw the crystal planes (110), (1$\bar{1}$2) in a cubic crystal. **(04 Marks)**

Module-5

9 a. Define Mach number. Distinguish between subsonic and supersonic waves. **(04 Marks)**
   b. Describe the construction and working of Reddy shock tube with the help of a diagram. Give the characteristics of Reddy tube. **(06 Marks)**
   c. Discuss ball milling method of synthesis of nanomaterials. Mention any two of its disadvantages. **(06 Marks)**
   d. Explain the properties of carbon nanotubes. **(04 Marks)**

10 a. Describe the principle, construction and working of scanning electron microscope. **(06 Marks)**
    b. Explain the experimental method of producing shock waves and measuring its Mach number using Reddy shock tube. **(06 Marks)**
    c. Explain the pyrolysis method of synthesis of carbon nanotubes. Mention two applications of carbon nanotubes. **(04 Marks)**
    d. What are shock waves? Give three applications of shock waves. **(04 Marks)**

* * * * *