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PHY12/22

Second Semester B.E. Degree Examination, Dec. 07 / Jan. 08
Engineering Physics

Time: 3 hrs. Max. Marks:100

Note : ***Answer any FIVE full questions.***

1 a. Define phase velocity and group velocity. Derive the equation for group velocity. **(10 Marks)**

b. Show that particle velocity and group velocity are identical. **(05 Marks)**

c. An electron beam has a de Broglie wavelength of 2×10^{-12} m. Find the kinetic energy, phase and group velocities of de Broglie waves. **(05 Marks)**

2 a. Derive one-dimensional time-independent Schrondinger wave equation for an electron. **(09 Marks)**

b. State Heisenberg's uncertainty principle in three forms. **(05 Marks)**

c. A particle is moving in one-dimensional deep potential well of width 20 $\overset{0}{A}$. Calculate the probability of finding the particle at a/2 and a/3, where 'a' is the width of deep potential well and the interval being 4 $\overset{0}{A}$. **(06 Marks)**

3 a. Derive an expression for electrical conductivity of metals. Show that $R \alpha \sqrt{T}$ as proposed by classical free electron theory. **(10 Marks)**

b. Write a note on thermionic emission. **(05 Marks)**

c. Obtain an electron concentration, the mobility and drift velocity in a metal for the following data:
Length = 5 m, electron density = 2.7×10^{-8} ohm-m, R = 6×10^{-2} Ω, I = 15 amp, atomic weight = 26.98×10^{-3} kg/mol, valency = 3, density = 2.7×10^{3} kg/m^3. **(05 Marks)**

4 a. Describe different mechanisms of electrical polarization. **(08 Marks)**

b. Explain how static dielectric constant is determined. **(06 Marks)**

c. Discuss three applications of superconductivity. **(06 Marks)**

5 a. Explain the conditions for the production of laser. Obtain an expression for the energy density of photons in terms of Einstein's coefficients. **(09 Marks)**

b. Calculate the energy difference in eV between the two energy levels of the Ne atoms of a He-Ne gas laser, the transition between which results in the emission of a light of wavelength 632.8 nm. Also calculate the number of photons emitted per second, if the optical power output is 2 mW. **(06 Marks)**

c. What are the applications of laser? Explain. **(05 Marks)**

6 a. Using total internal reflection concept, obtain an expression for the "acceptance angle" in an optical fiber. **(06 Marks)**

b. Explain how Bragg's X-ray spectrometer is used in the verification of Bragg's law. Calculate the glancing angle for incidence of X-rays of wavelength 0.58 $\overset{0}{A}$ on the plane [1 3 2] of NaCl which results in second order diffraction maxima having lattice constant 3.81 $\overset{0}{A}$. **(10 Marks)**

c. Explain the advantages and disadvantages of optical fibers when used for communication. **(04 Marks)**

7 a. Explain the crystal structure of diamond and calculate the packing fraction for FCC structure. **(08 Marks)**

b. Sketch the following planes in a cubic structure:
i) (3 2 2) ii) (0 0 1) iii) (0 T T). **(06 Marks)**

c. Polonium belongs to simple cubic lattice. If the lattice constant is 3.36 A^0, calculate its density. The atomic mass of polonium is 209. **(06 Marks)**

8 a. Write the advantages and disadvantages of composite materials. **(06 Marks)**

b. Write a note on smart materials. **(06 Marks)**

c. Explain nano-devices and their advantages. **(08 Marks)**