

First / Second Semester B.E. Degree Examination, Dec.08/Jan.09

Engineering Physics

Time: 3 hrs.

Max. Marks:100

Note : Answer any FIVE full questions.

Constants : $h = 6.63 \times 10^{-34} \text{ JS}$ $e = 1.6 \times 10^{-19} \text{ C}$, $k = 1.38 \times 10^{-23} \text{ J/K}$

$c = 3 \times 10^8 \text{ m/s}$, $m_e = 9.1 \times 10^{-31} \text{ kg}$, $N_A = 6.025 \times 10^{26} / \text{K mol}$

$\epsilon_0 = 8.85 \times 10^{-12} \text{ F/m}$.

- 1 a. Explain Davisson and Germer experiment to establish the wave nature of electrons. (10 Marks)
- b. Derive an expression for the de Broglie wavelength using the concept of group velocity. (06 Marks)
- c. The position and momentum of a 2keV electron are simultaneously determined and if its position is located within 0.12nm, what is the percentage of uncertainty in its momentum. (04 Marks)
- 2 a. Assuming the time-independent Schrodinger wave equation, obtain eigen functions and eigen values for a particle in one dimensional potential well of infinite height and discuss the solutions for $n = 1$. (10 Marks)
- b. What is Meissner effect and give its Experimental proof. (04 Marks)
- c. Explain Type I and Type II super conductors. (06 Marks)
- 3 a. Define drift velocity, mean free path and relaxation time. Derive an expression for electrical conductivity in metals using free electron model. (10 Marks)
- b. Discuss the merits of quantum free electron theory. (05 Marks)
- c. Find the temperature at which there is 1% probability that a state with energy 0.5eV above Fermi energy is occupied. (05 Marks)
- 4 a. Mention the different types of polarization mechanisms. Derive an expression for internal field in case of solids for one dimensional array of atoms. (10 Marks)
- b. Explain the properties and applications of hard and soft magnetic materials. (06 Marks)
- c. If a NaCl crystal is subjected to an electric field of 1000V/m and the resulting polarization is $4.3 \times 10^{-8} \text{ C/m}^2$, calculate the dielectric constant of NaCl. (04 Marks)
- 5 a. Distinguish between stimulated emission and Spontaneous emission. Define population inversion, Active medium and Resonator. (07 Marks)
- b. Explain the construction and working of a Ruby laser with energy level diagram. (08 Marks)
- c. The ratio of population of two energy levels out of which one corresponds to a Meta stable state is 1.059×10^{-30} . Find the wavelength of light emitted at 330°K. (05 Marks)
- 6 a. Define numerical aperture and derive an expression for numerical aperture in terms of refractive indices of core and cladding. (05 Marks)
- b. A fiber with an input power of 9.0kW has a loss of 1.5dB/km. If the fiber is 3000m long what is the out put power? (05 Marks)
- c. Derive Bragg's law and describe how Bragg's x-ray spectrometer can be used to determine the wavelength of x-rays. (10 Marks)
- 7 a. Explain seven crystal systems. (07 Marks)
- b. Derive an expression for inter planar spacing in a cubic system. Explain with a neat sketch the diamond crystal structure. (10 Marks)
- c. Draw the following planes in a cubic lattice (001), (101), (122). (03 Marks)
- 8 a. Discuss the different types of nano-scale systems. (08 Marks)
- b. What are composite materials? Give their classification, properties and applications. (08 Marks)
- c. Explain briefly about the working of MEMS. (04 Marks)
