



CBCS SCHEME

17PHY12/22

First/Second Semester B.E. Degree Examination, July/August 2021 Engineering Physics

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions.

2. Physical constants : Plank's constant, $h = 6.63 \times 10^{-34}$ JS, Electron charge, $e = 1.602 \times 10^{-19}$ C velocity of light, $C = 3 \times 10^8$ m/s, Mass of electron $m_e = 9.11 \times 10^{-31}$ kg, Boltzmann's constant, $K = 1.38 \times 10^{-23}$ J/K, Avogadro's number, $N_A = 6.23 \times 10^{23}$ molecule/mole.

1. a. State assumptions of quantum theory of radiation. Explain how Plank's radiation law reduces to Wein's law and Rayleigh – Jean's law under certain conditions. (08 Marks)
b. Define the group velocity and phase velocity. Obtain relation between them. (08 Marks)
c. The inherent uncertainty in the measurement of time spent by Iridium – 191 nuclei in the excited state is found to be 1.4×10^{-10} S. Estimate the uncertainty that results in its energy in ev in the excited state. (04 Marks)
2. a. State and explain Heisenberg uncertainty principle. Discuss its significance and show that a free electron cannot exist within the nucleus of an atom. (08 Marks)
b. Setup time-independent Schrodinger wave equation and explain eigen function and eigen values. (08 Marks)
c. Calculate the de-Broglie wavelength associated with an electron with a kinetic energy of 2000ev. (04 Marks)
3. a. Discuss the various drawbacks of classical free electron theory. What are the assumptions made in quantum free electron theory to overcome the same? (08 Marks)
b. Define Fermi energy and Fermi factor. And discuss the Fermi factor $f(E)$, for cases $E < E_F$, $E > E_F$ at $T = 0$ and $E = E_F$ at $T \neq 0$. (08 Marks)
c. The resistivity of intrinsic germanium at 27°C is equal to 0.47 ohm-metre. Assuming electron and hole motilities as 0.38 and $0.18\text{m}^2\text{V}^{-1}\text{S}^{-1}$ respectively. Calculate the intrinsic carrier density. (04 Marks)
4. a. Explain types of superconductors. And write a short note on Maglev vehicle. (08 Marks)
b. Give the expressions of concentration of electrons and holes in an intrinsic semiconductor. Obtain the expression for electrical conductivity of intrinsic semiconductor. (08 Marks)
c. Calculate the drift velocity and thermal velocity of conduction electrons in copper at a temperature of 300K, when a copper wire of length 2m and resistance 20×10^{-3} ohm carries a current of 15A. Given the mobility of free electrons in copper is 4.3×10^{-3} m^2/VS . (04 Marks)

- 5 a. Explain construction and working of CO₂ laser with energy level diagram. (08 Marks)
 b. Discuss types of optical fibers with neat diagrams. (06 Marks)
 c. Define the terms :
 i) Population inversion
 ii) Stimulated emission
 iii) Optical pumping. (03 Marks)
 d. A medium in thermal equilibrium at temperature 300k has two energy levels with a wavelength separation of 1 μ m. Find the ratio of population densities of upper and lower levels. (03 Marks)
- 6 a. Derive an expression for energy density of radiation in terms of Einstein's coefficients. (06 Marks)
 b. Describe the recording and reconstruction processes in Holography with the help of suitable diagrams. (06 Marks)
 c. Discuss the point to point optical fiber communication system. (04 Marks)
 d. Calculate the numerical aperture and angle of acceptance of a given optical fiber. If the refractive indices of the core and cladding are 1.563 and 1.498 respectively. (04 Marks)
- 7 a. Derive the expression for interplanar spacing in terms of Miller indices for cubic structure. (05 Marks)
 b. Describe briefly the seven crystal systems. (07 Marks)
 c. Define allotropy and polymorphism with examples. (04 Marks)
 d. Draw the following planes in a cubic unit cell :
 i) (100) ii) ($\bar{1}21$) iii) (132) iv) (101). (04 Marks)
- 8 a. Describe crystal structure of diamond. (06 Marks)
 b. What are Miller indices? Explain the procedure to find the Miller indices with an example. (05 Marks)
 c. Define packing factor and calculate the packing factor for BCC and FCC crystal structures. (05 Marks)
 d. Calculate the glancing angle for incidence of X-rays for wavelength 0.58 \AA on the plane (132) of NaCl, which results in second order diffraction maxima taking the lattice spacing as 3.81 \AA . (04 Marks)
- 9 a. With the neat diagram, explain construction and working of Reddy shock tube. (06 Marks)
 b. Describe arc discharge method of obtaining carbon nanotubes with the help of a diagram. (05 Marks)
 c. Define Mach number. Distinguish between subsonic and supersonic waves with example. (05 Marks)
 d. Describe sol-gel method of producing nano-materials. (04 Marks)
- 10 a. Describe the principle, construction and working of a Scanning Electron Microscope (SEM). Give two applications. (08 Marks)
 b. What is shock wave? State laws of conservation of mass, momentum and energy of a closed system. (04 Marks)
 c. Describe the density of states for various quantum structures. (08 Marks)
