CBCS SCHEME

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15PHY12/22

First/Second Semester B.E. Degree Examination, Jan./Feb. 2023
Engineering Physics

Time: 3 hrs. Max. Marks: 80

Note: **1.** ***Answer FIVE full questions, choosing ONE full question from each module.***

2. ***Physical Constants:*** ***Planck's constant: = 6.63 × 10^{-34} J.S***
Mass of electron : 9.1 × 10^{-31} kg
Boltzmann constant: 1.38 × 10^{-23} J/K,
Avogadro number: 6.025 × 10^{26}/Kmol,
Velocity of light: 3 × 10^{8} m/s

Module-1

1 a. Setup time independent Schrödinger wave equation for motion of a particle in one dimension. **(07 Marks)**

b. Explain Compton's scattering. Give its physical significance. **(05 Marks)**

c. Compare the Kinetic energies of a electron and a neutron when both are associated with same wavelength. Given $m_n = 1.675 \times 10^{-27}$ Kg and $m_e = 9.1 \times 10^{-31}$kg. **(04 Marks)**

OR

2 a. What is a wave function? Explain the physical meaning of wave function. Mention the properties of proper wave function. **(07 Marks)**

b. Define phase velocity and group velocity. Derive the relation between phase velocity and group velocity. **(05 Marks)**

c. The uncertainity in the measurement of position of an electron is equal to its deBrogli's, wavelength. Determine the uncertainity in its, momentum. **(04 Marks)**

Module-2

3 a. Explain how Quantum free electron theory overcomes the draw backs of classical free electron theory. **(06 Marks)**

b. Explain BCS theory of superconductivity. **(06 Marks)**

c. Calculate the probability of an electron occupying an energy level 0.02eV above Fermi level at 200K and 400K in a material. **(04 Marks)**

OR

4 a. List out the similarities and differences between classical free electron theory and Quantum free electron theory. **(06 Marks)**

b. Explain the law of mass action. Derive the expression for conductivity of an intrinsic semiconductor. **(06 Marks)**

c. The resistivity of intrinsic silicon at 27°C is 3000Ωm, Assuming electron and hole mobilities of 0.17 and 0.035 m^2/ Volt.sec respectively, calculate the intrinsic carrier concentration at 27°C. **(04 Marks)**

Module-3

5 a. Describe the construction and working of semiconductor laser. **(06 Marks)**

b. Derive the expression for energy density in terms of Einstein's coefficients. **(06 Marks)**

c. Calculate acceptance angle, Numerical aperture V-number and no. of modes in an optical fibre of core radius 50μm, core and cladding refractive indices 1.41 and 1.4 at wavelength 8400A°. **(04 Marks)**

OR

6 a. Explain the types of optical fibres with neat diagrams. **(06 Marks)**

b. Describe the construction and working of CO_2 laser. **(06 Marks)**

c. Find the number of modes of the standing waves and their frequency separation in a resonant cavity of length 5 meters of a laser source operating at wavelength 6328A°. **(04 Marks)**

Module-4

7 a. Define Miller indices. Derive the expression for interplanar spacing in terms of Miller indices for cubic system. **(07 Marks)**

b. Write a note on Perovskites. **(05 Marks)**

c. A X-ray beam of wavelength 0.7A° undergoes first order Bragg reflection from the plane (302) of a simple cubic crystal at a glancing angle 35°. Determine the Atomic radius. **(04 Marks)**

OR

8 a. State Bragg's law. Determine interplanar spacing of a cubic structure using Bragg's spectrometer. **(06 Marks)**

b. Explain the terms :
i) Space lattice ii) Allotropy iii) Polymorphism. **(06 Marks)**

c. Draw the following planes in a simple cubic unit cell.
$(0\bar{1}0)$, $(1\bar{1}0)$, $(1\bar{2}3)$, $(\bar{1}\,\bar{1}\,0)$. **(04 Marks)**

Module-5

9 a. What are carbon nanotubes? Describe the arc-discharge method of producing carbon nanotubes. **(06 Marks)**

b. Discuss the construction and working of a Reddy shock tube with necessary diagrams. **(06 Marks)**

c. Give the graphical representation of density of states for 0D, 1D, 2D and 3D structures. **(04 Marks)**

OR

10 a. Describe the principle, construction and working of scanning electron microscope. **(07 Marks)**

b. Describe Sol-gel method of preparation of nanomaterials with necessary diagrams. **(04 Marks)**

c. The distance between two pressure sensors in a shock tube is 100mm. The time taken by a shock wave to travel this distance is 100μs. If the velocity of the sound under same conditions is 340m/s, find shock speed and Mach number of the shock wave? **(05 Marks)**

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