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14PHY12/22

First/Second Semester B.E. Degree Examination, Dec.2018/Jan.2019
Engineering Physics

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, choosing one full question from each module.*
2. Physical constants: Velocity of light $C = 3 \times 10^8$ ms^{-1}, electron charge $e = 1.602 \times 10^{-19}C$, mass of electron $m_e = 9.11 \times 10^{-31}$ kg, Planck's constant $h = 6.625 \times 10^{-34}$ JS, Boltzmann constant $K = 1.38 \times 10^{-23}$ JK^{-1}.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. What is a black body? Explain the energy distribution curve of black body spectrum. **(07 Marks)**

b. Show that Planck's law reduces to Wien's law and Rayleigh Jeans law under certain conditions. **(05 Marks)**

c. What is a wave function? Mention any two characteristics of wave function. **(04 Marks)**

d. An electron has a speed of 4.8×10^5 m/s accurate to 0.012%. With what accuracy can we locate the electron? **(04 Marks)**

OR

2 a. Obtain the relation between phase and group velocity. **(04 Marks)**

b. Prove non-existence of electrons inside the nucleus of an atom on the basis of Heisenberg's uncertainty principle. **(04 Marks)**

c. Obtain the one dimensional time independent Schrodinger wave equation. **(06 Marks)**

d. Find the kinetic energy and group velocity of an electron with Re-Broglie wavelength of 0.2nm. **(06 Marks)**

Module-2

3 a. Derive an expression for electrical conductivity in metals based on quantum free electron theory. **(05 Marks)**

b. Explain the failure of classical free electron theory. **(06 Marks)**

c. Some hypothetical metal is known to have an electrical resistivity of 4×10^{-8} Ωm. Through a specimen of this metal that is 25mm thick is passed a current of 30A when a magnetic field of 0.75 tesla is simultaneously imposed in a direction perpendicular to that of the current, a hall voltage of -1.26×10^{-7}V is measured. Compute : i) The electron mobility for this metal, ii) The number of free electrons per cubic meter. **(06 Marks)**

d. A superconducting tin has a critical field of 306 gauss at 0K and 217 gauss at 2K. Find the critical temperature of superconducting tin. **(03 Marks)**

OR

4 a. What are charge carriers in semiconductors? State law of mass action. Obtain expression for Fermi level in an intrinsic semiconductor using concentration of electrons and holes formulae. **(06 Marks)**

b. Explain Type I and Type II superconductors. **(06 Marks)**

c. Write a note on BCS theory. **(05 Marks)**

d. The resistivity of pure silicon at room temperature is 3000 Ωm. Calculate the intrinsic carrier density (Given $\mu_n = 0.14 m^2 v^{-1} s^{-1}$ and $\mu_p = 0.05\ m^2 v^{-1} s^{-1}$). **(03 Marks)**

Module-3

5 a. Obtain the expression for energy density of radiation under equilibrium condition in terms of Einsten's coefficients. **(07 Marks)**

b. Describe the construction and working of semiconductor diode laser. **(07 Marks)**

c. The refractive indices of the core and cladding of a step-index optical fibre are 1.45 and 1.40 respectively and its core diameter is 45μm. Calculate its relative refractive index difference, numerical aperture, V-number at wavelength 1000nm and the number of modes. **(06 Marks)**

OR

6 a. Explain the terms spontaneous emission, stimulated emission, population inversion and pumping. **(06 Marks)**

b. A laser is emitting photons of wavelength 632.8nm and the temperature of operation is 300K. Find the ratio of population of two energy states responsible for the release of photons. **(03 Marks)**

c. What is holography? Explain the construction of a hologram. **(05 Marks)**

d. Discuss the different types of optical fibres with suitable diagrams. **(06 Marks)**

Module-4

7 a. Discuss the seven crystal systems. **(07 Marks)**

b. Derive the expression for the interplanar spacing of planes in terms of Miller indices in a cubic structure. **(05 Marks)**

c. Discuss Perovskites structure. **(04 Marks)**

d. An X-ray beam of wavelength 0.7 Å undergoes minimum order Bragg reflection from the plane (302) of cubic crystal at glancing angle 39.12°. Calculate the lattice constant. **(04 Marks)**

OR

8 a. Calculate the atomic packing factor for SC, BCC and FCC lattices. **(06 Marks)**

b. Draw the following planes in a cubic unit cell (112) and (101). **(05 Marks)**

c. Describe how Bragg's spectrometer is used to determine the wavelength of an X-ray beam. **(06 Marks)**

d. Derive Bragg's law. **(03 Marks)**

Module-5

9 a. Derive conservation of momentum equation. **(05 Marks)**

b. Distinguish between acoustic, ultrasonic, subsonic and supersonic waves. **(04 Marks)**

c. Give an account of density of states on 0D, 1D, 2D and 3D structures. **(07 Marks)**

d. Write a note on carbon nanotubes. **(04 Marks)**

OR

10 a. What is shock wave? Mention any three applications of shock waves. **(04 Marks)**

b. Write a note on Reddy's shock tube. **(04 Marks)**

c. Describe the top-down and bottom-up approach for preparing nanometerials. **(06 Marks)**

d. Discuss the principle and working of scanning electron microscope. **(06 Marks)**

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