CBCS SCHEME

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15PHY12/22

First/Second Semester B.E. Degree Examination, Jan./Feb.2021
Engineering Physics

Time: 3 hrs. Max. Marks: 80

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

Physical Constants : Mass of electron (m_e) = 9.11×10^{-31} kg
Velocity of light in air or vacuum (C) = 3×10^{8} ms^{-1}
Planck's constant (h) = 6.63×10^{-34} JS
Charge on electron (e) = 1.602×10^{-19} C
Boltzmann constant (k) = 1.38×10^{-23} JK^{-1}
Avagadro number (N_A) = 6.023×10^{23} $mole^{-1}$

Module-1

1 a. Explain the assumptions of quantum theory of radiation. Deduce Rayleigh-Jean's law and Wein's law from Planck's law. **(06 Marks)**

b. Define phase velocity and group velocity. Build the relation between group velocity and particle velocity. **(06 Marks)**

c. The ground state energy of an electron in an infinite well is 2.5×10^{-3} eV. What will be the ground state energy if the width of the wall is doubled? **(04 Marks)**

OR

2 a. Solve the Schrodinger wave equation and derive expression for energy values in the case of particle in a box. **(06 Marks)**

b. What is wave function? Explain the properties of wave function. **(06 Marks)**

c. A spectral line of wavelength 4500 A° has a width of 9×10^{-5} Å. Evaluate the minimum time spent by the electrons in the upper energy state between the excitation and de-excitation process. **(04 Marks)**

Module-2

3 a. Discuss the dependence of Fermi factor on temperature and energy. **(06 Marks)**

b. Define Meissener's effect and explain the application of superconductivity in Maglev vehicles. **(06 Marks)**

c. Calculate the drift velocity of electrons in a metal of thickness 1 mm across which a potential difference of 1 volt is applied. Calculate thermal velocity at temperature of 300 K. **(04 Marks)**

OR

4 a. Distinguish between Type – I and Type – II superconductors. **(06 Marks)**

b. Develop the expression for electrical conductivity based on free electron theory of metals. **(06 Marks)**

c. The electron and hole mobilities of silicon are 0.164 $m^2V^{-1}s^{-1}$ and 0.05 $m^2V^{-1}s^{-1}$ respectively. If the electron density is 1.5×10^{16} electrons m^{-3}. Calculate resistivity of silicon. **(04 Marks)**

Module-3

5 a. Derive the expression for the angle of acceptance and numerical aperture in an optical fiber. **(06 Marks)**

b. Explain the construction and working of a semiconductor LASER. **(06 Marks)**

c. A pulsed LASER has an output power of 1.5 mW per pulse and pulse duration is 25 nS. The number of photons emitted per pulse is estimated to 1.047×10^8. Find the wavelength of emitted LASER. **(04 Marks)**

OR

6 a. Derive the expression for energy density in terms of Einstein's A & B coefficients. **(06 Marks)**

b. Discuss the mechanisms involved in the attenuation of signal in optical fibers. **(06 Marks)**

c. An Optic fiber of 0.6 km long has input power of 120 mW emerging out with a power of 90 mW. Find the attenuation in the fiber. **(04 Marks)**

Module-4

7 a. Derive the expression for Interplanar spacing in a crystal. **(05 Marks)**

b. Discuss the seven crystal systems taking into account the basis vectors and interfacial angles. **(07 Marks)**

c. Find the Miller indices of a set of parallel planes which make intercepts in the ratio 2b : 7c and parallel to x-axis. **(04 Marks)**

OR

8 a. Estimate the atomic packing factor for simple cubic, bcc and fcc. **(06 Marks)**

b. Explain the crystal structure of diamond with suitable diagrams. **(06 Marks)**

c. X-rays are diffracted in the first order from (1 1 0) plane of a crystal with lattice constant 3.036 Å at a glancing angle of 9.6°. Calculate the wavelength of X-rays. **(04 Marks)**

Module-5

9 a. Construct and label Reddy shock tube and explain its working using suitable diagram. **(06 Marks)**

b. Briefly discuss arc discharge method and pyrolysis method to obtain carbon nanotubes. **(06 Marks)**

c. Explain the density of states in 1D, 2D and 3D structures using graphical representation. **(04 Marks)**

OR

10 a. Construct Scanning Electron Microscope (SEM) and explain its principle and working using suitable diagram. **(06 Marks)**

b. Explain the ball milling method and sol gel method to produce nanomaterials. **(06 Marks)**

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

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