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15PHY12/22

First/Second Semester B.E. Degree Examination, Dec.2016/Jan.2017
Engineering Physics

Time: 3 hrs.

Max. Marks: 80

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

2. Physical Constants : Velocity of light, $c = 3 \times 10^8 \text{ ms}^{-1}$,

Planck's constant, $h = 6.625 \times 10^{-34} \text{ J.S.}$

Mass of electron, $m_e = 9.1 \times 10^{-31} \text{ kg}$,

Avogadro number, $N_A = 6.02 \times 10^{26} / \text{Kmol}$,

Boltzmann constant, $k = 1.38 \times 10^{-23} \text{ J/K}$,

Charge of an electron, $e = 1.602 \times 10^{-19} \text{ C}$

Module-1

- 1 a. State Planck's radiation law. Show how Planck's law could be reduced to Wien's law and Rayleigh-Jeans law. (07 Marks)
- b. State Heisenberg's uncertainty principle and show that electron does not exist inside the nucleus by this principle. (05 Marks)
- c. Find deBroglie wavelength of a particle of mass 0.58 MeV/c² has a kinetic energy 90 eV, where c is velocity of light. (04 Marks)

OR

- 2 a. Using Schrodinger's time independent wave equation obtain eigen values and eigen function for a particle in a one dimensional potential well of infinite height. (07 Marks)
- b. Define phase velocity and group velocity. Show that group velocity is equal to particle velocity. (05 Marks)
- c. The inherent uncertainty in the measurement of time spent by Iridium - 191 nuclei in the excited state is found to be $1.4 \times 10^{-12} \text{ s}$. Estimate the uncertainty that results in its energy in eV in the excited state. (04 Marks)

Module-2

- 3 a. Explain Meissner effect. Write any three differences between Type-I and Type-II superconductors. (07 Marks)
- b. Explain the failure of classical electron theory. (05 Marks)
- c. For intrinsic Gallium Arsenide, the electric conductivity at room temperature is $10^{-6} \text{ ohm}^{-1} \text{ m}^{-1}$. The electron and hole mobilities are respectively $0.85 \text{ m}^2/\text{V.S}$ and $0.04 \text{ m}^2/\text{V.S}$. Calculate the intrinsic carrier concentration at room temperature. (04 Marks)

OR

- 4 a. State law of mass action. Obtain an expression for electrical conductivity of semiconductors. (07 Marks)
- b. Explain the BCS theory of super conductivity. (05 Marks)
- c. Calculate the probability of finding an electron at an energy level 0.02 eV above Fermi level at 200 K. (04 Marks)

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Module-3

- 5 a. Describe construction and working of carbon dioxide laser with suitable diagrams. (07 Marks)
 b. Obtain an expression for the numerical aperture of an optical fiber. (05 Marks)
 c. Find the ratio of population of two energy levels in a medium at thermal equilibrium, if the wavelength of light emitted at 291 K is 6928 Å. (04 Marks)

OR

- 6 a. Describe the recording and reconstruction process in holography with the help of suitable diagrams. (07 Marks)
 b. Discuss point to point optical fiber communication system. (05 Marks)
 c. Calculate the numerical aperture and angle of acceptance for an optical fiber having refractive indices 1.563 and 1.498 for core and cladding respectively. (04 Marks)

Module 4

- 7 a. Describe briefly the seven crystal systems. (07 Marks)
 b. Describe with a neat diagram the crystal structure of diamond. (05 Marks)
 c. Draw the crystal planes (102) (111) (011) and (002) in a cubic crystal. (04 Marks)

OR

- 8 a. Define atomic packing factor. Calculate the atomic packing factor for sc, bcc and fcc structures. (07 Marks)
 b. Describe the construction and working of a Bragg's x-ray spectrometer. (05 Marks)
 c. An x-ray beam of wavelength 0.7 Å undergoes first order Bragg's reflection from the plane (302) of a cubic crystal at glancing angle 35° , calculate the lattice constant. (04 Marks)

Module 5

- 9 a. Explain Ball Milling method of synthesis of nano materials. (06 Marks)
 b. Describe hand operated Reddy shock tube with diagram. (05 Marks)
 c. Define shock waves. Mention its applications. (05 Marks)

OR

- 10 a. Explain the working of SEM with the help of a neat diagram. (07 Marks)
 b. Mention Rankine-Hugonit shock equations and expand the terms. (05 Marks)
 c. Write any four applications of carbon nano tubes. (04 Marks)