CBCS SCHEME

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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 $0.18 m^2V^{-1}S^{-1}$ 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 CO_2 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 1μm. Find the ratio of population densities of upper and lower levels. **(03 Marks)**

6 a. Derive an expression for energy density of radiation interms 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 interms 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) $(1\bar{2}1)$ 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°A on the plane (132) of NaCℓ, which results in second order diffraction maxima taking the lattice spacing as 3.81°A. **(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)**

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