JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -2 EXAMINATION- MAY-2023

COURSE CODE(CREDITS): 18B11PH211 (3) MAX. MARKS: 25

COURSE NAME: Engineering Physics-II

COURSE INSTRUCTORS: PBB, SKK, VSA, SKT, HAZ, SBD MAX. TIME: 1 Hr 30 Min

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Note: All questions are compulsory. Marks are indicated against each question in square brackets. All symbols have their usual meaning.

Q1 (a) Find the electric field inside a sphere which carries a charge density proportional to the distance from the origin, $\rho=kr$, where k is constant. [CO-1]

(b) Write the equation to calculate electric potential for spherical cloud of electrons with a uniform volume charge density $\rho = -\rho_0$ for $0 \leq R \leq b$ and $\rho=0$ for $R>b$. [CO-1] **[2+2=4]**

Q2 (a) Derive the Coulomb's law of electrostatics with the help of Maxwell's first equation. [CO-1]

(b) Show that equation of continuity $div\vec{J} + \frac{\partial \rho}{\partial t} = 0$ is contained in Maxwell's equations. [CO-2] **[2+2=4]**

Q3 (a) Explain the concept of Maxwell's displacement current and show how it leads to the modification of Ampere's law? [CO-2]

(b) Derive an expression for Poynting vector and derive an expression for the same. Explain its physical significance for an electromagnetic wave in free space. [CO-2] **[2+2=4]**

Q4 (a) If a 500 watt laser beam is concentrated by a lens into a cross sectional area of 10^{-10} m^2, find the value of Poynting vector and the amplitude of electric field. Given $\varepsilon_0 = 9 \times 10^{-12}$ S.I. units. [CO-2]

(b) A gas has only two particles a and b to be distributed in 3-compartments. Show with the help of table, how these particles can be arranged using (1) Maxwell Boltzmann (2)Fermi Dirac (3) Bose Einstein statistics. [CO-4] **[2+3=5]**

Q5 (a) Obtain an expression for Fermi energy at 0 K for system of spin ½ particles. [CO-4]

(b) At what temperature will the mean speed of hydrogen molecule be the same as that of nitrogen molecule at 35°C. Given molecular weight of nitrogen is 28 and that of hydrogen is 2. [CO-4] **[2+2=4]**

Q6 (a) Fermi energy of conduction electrons in Beryllium is 14.44 eV. Calculate the number of such electrons per cm^3. [CO-4]

(b) Derive an expression for most probable speed of molecules of CO_2 gas enclosed in volume. [CO-4] **[2+2=4]**

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h = 6.62 x 10^{-27} erg sec; 1 eV = 1.62 x 10^{-12} erg; N=6.02x10^{23}; m_e=9.1x10^{-31} kg; e=1.6x10^{-19}C; k=1.38x10^{-23} J/K