JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT
TEST -3 EXAMINATION- 2024
BTech-1 Semester (CSE/IT/ECE/CE)

COURSE CODE (CREDITS): 18B11PH211 (3) MAX. MARKS: 35
COURSE NAME: Engineering Physics-II
COURSE INSTRUCTORS: PBB, VSA, SKT, HAZ MAX. TIME: 2 Hour

Note: (a) All questions are compulsory.
(b) Marks are indicated against each question in square brackets.
(c) The candidate is allowed to make suitable numeric assumptions wherever required for solving problems

Q1. (a). For O_2 gas at NTP calculate (i) most probable speed (ii) average speed and (iii) root mean square speed. **[3-marks] [CO-2]**

(b). Determine the velocity and kinetic energy of a neutron having de Broglie wavelength *2Å*. **[3-marks] [CO-5]**

(c). Calculate the total energy of an electron orbiting around the nucleus in a hydrogen atom using Bohr model **[3-marks] [CO-2]**

Q2. (a). Using the Fermi Dirac law of energy distribution in terms of Fermi energy for electrons within a metal, derive an expression for the average speed of electrons at *0 K*. **[4-marks] [CO-4]**

(b). Derive an expression for the average kinetic energy of electrons in a conductor at *0 K* using the Fermi Dirac law of distribution of energy in terms of Fermi energy for electrons **[3-marks] [CO-4]**

(c). Calculate the Fermi energy of electrons in a metal of atomic weight *'w' and* density *'ρ'* and each atom of which gives out 'φ' free electrons. Given *Avogadro* number = 6.02×10^{23} **[3-marks] [CO-4]**

Q3. (a). Derive an expression between volume and pressure for a perfect gas during an adiabatic transformation. **[4-marks][CO-3]**

(b). Air at NTP is compressed adiabatically to half its volume, calculate the change in its temperature. Given γ = *1.4* and T_1 = *273 K* for air. **[3-marks] [CO-3]**

(c). A Carnot engine whose low-temperature reservoir is at *7°C* has an efficiency of *50%*. It is desired to increase the efficiency to *70%*. By how many degrees should the temperature of the high-temperature reservoir be increased? **[3-marks] [CO-3]**

Q4. (a). Derive an expression for the entropy of a perfect gas in terms of temperature and volume. **[3-marks] [CO-3]**

(b). Calculate the change in entropy when *10 grams* of ice at *0°C* is converted into steam at *100°C*. *(*Given Latent heat of ice = *80 calories,* specific heat of water =*1* and latent heat of steam at *100°C = 540 calories)* **[3-marks][CO-3]**

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h=6.626x10^{-34} Js; m_e=9.1x10^{-31} kg; c=3x10^8 m/s; e=1.6x10^{-19} C; $\int_0^\infty e^{-ax^2}dx = \frac{1}{2}\sqrt{\frac{\pi}{a}}; \int_0^\infty x^4 e^{-ax^2}dx = \frac{3}{8a^2}\sqrt{\frac{\pi}{a}}$; k = 1.38x10^{-23} J/K; 1 amu = 1.67377 x 10^{-27} kilograms; $m_n = m_p$ = 1.67377 x 10^{-27} kilograms