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SECOND SEMESTER **B.Tech. (Group A & B)**

END SEMESTER EXAMINATION ***MAY-2012***

AP-113 APPLIED PHYSICS-II

Time: 3:00 Hours ***Max. Marks : 70***

Note : Answer any ***FIVE*** questions.
Assume suitable missing data, if any.

1[a] What is Compton effect? Derive an expression for the change in wavelength expected for a photon which is scattered through the angle ϕ by a particle of rest mass m_0. **7**

[b] Show that the de Broglie wavelength of a particle of rest mass m_0 and kinetic energy KE is given by

$$\lambda = \frac{hc}{\sqrt{KE\,(KE + 2m_0c^2)}}.$$ **4**

[c] The phase velocity of ocean waves is $\sqrt{\frac{g\lambda}{2\pi}}$, where g is the acceleration of gravity. Find the group velocity of ocean waves. **3**

2[a] Write the Schrodinger's equation, energy eigen values and energy eigen functions for a harmonic oscillator. Draw the first four energy eigen functions for the harmonic oscillator. Find the expectation values <x> for the first two states of a harmonic oscillator. **7**

[b] A beam of electrons is incident on a barrier 6.00 eV high and 0.200 nm wide. Find the energy they should have if 1.00 percent of them are to get through the barrier. **3**

[c] Find the momentum eigenfunctions and momentum eigen values for a particle trapped in an infinite potential box of width L. **4**

3[a] What are Fermions? Write the Fermi-Dirac distribution law. Apply Fermi-Dirac statistics to electron gas to find the expression for the Fermi energy of electrons in a metal. **7**

[b] Find the Fermi energy (in eV) in copper on the assumption that each copper atom contributes one free electron to the electron gas. The density of copper is 8.94×10^3 kg/m^3 and its atomic mass is 63.5 u. **4**

[c] Distinguish clearly between Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac Statistics. **3**

4 What are bosons? Derive the Bose-Einstein distribution law. Apply Bose-Einstein statistics to photon gas and hence derive planck's law for the spectral distribution of energy in black body radiation. **14**

5[a] Define Q-value of a nuclear reaction. Explain its physical significance. For the d-t fusion reaction

$$ {}_{1}^{2}H + {}_{1}^{3}H \rightarrow {}_{2}^{4}He + {}_{0}^{1}n $$

Calculate (i) the Q-value of the reaction and (ii) the rate at which deuterium and tritium are consumed to produce 1 MW. (Assume all energy from the fusion reaction is available). **7**

[b] What is Thermonuclear fusion? Explain the proton-proton cycle which is the chief nuclear reaction sequence that takes place in stars like the sun and cooler stars. What conditions should be fulfilled to produce Thermonuclear fusion in the laboratory. **7**

6[a] What is liquid drop model of a nucleus. Derive Von-Weizsacker semi empirical binding energy formula. **7**

[b] Find the energies needed to remove a proton from ${}_{2}^{4}He$, then to remove a neutron, and finally to separate the remaining neutron and proton. Compare the total with the binding energy of ${}_{2}^{4}He$. **7**

7[a] Show that the electric and magnetic field vectors, $\vec{E}$ *and* $\vec{B}$, in plane electromagnetic waves are mutually perpendicular in a plane normal to the direction of propagation. How are phases of $\vec{E}$ *and* $\vec{B}$ related to each other. **4**

[b] Show that the pointing vector $\vec{S} = (\vec{E} \times \vec{H})$ represents the energy flow per unit area per unit time both in magnitude and direction in case of a plane electromagnetic wave. **4**

[c] Write down and derive the wave equation for propagation of electric field $\vec{E}$ and magnetic field $\vec{B}$ in a non conducting medium. **6**

8 Write short notes on any ***TWO*** of the following: **2x7**

[a] Nuclear reactor

[b] Poynting theorem

[c] Nuclear Shell model

[d] Alpha and beta spectrum

Atomic Masses:-

$ {}_{2}^{4}He $: 4.002603 *u*

$ {}_{1}^{3}H $: 3.016050 *u*

$ {}_{1}^{2}H $: 2.014102 *u*

$ {}_{1}^{1}H $: 1.007825 *u*

$ {}_{0}^{1}n $: 1.008665 *u*