COLLEGE OF ENGINEERING PUNE

Autmun Semester : End Sem Exam : Physics I(AS-101)

Class : F.Y.B.Tech. 2012-2013 Date:28/11/12

Max. Marks: 50 Time : 3 hrs

Instructions:

1. *Solve **any five** questions..*
2. *Figures to the right indicate **full marks**.*
3. *Do not keep **mobile phones** with you; the handset will be retained by exam cell.*
4. ***Symbols** carry their usual meanings, otherwise specified. Assume the **suitable data** Wherever required.*
5. *1 amu = 1.66054×10^{-27} Kg.*

Q.1 A) i) Compare between nuclear fission and fusion with suitable examples.

ii) Define Q value of a nuclear reaction. Derive expression for Q in terms of masses.

iii) Calculate Q value of the reaction: $_7N^{14} + {}_2He^4 \longrightarrow {}_1P^1 + {}_8O^{17}$

Mass of $_2He^4$ = 4.002603 amu, Mass of $_7N^{14}$ = 14.0031 amu

Mass of $_1P^1$ = 1.007825 amu, Mass of $_8O^{17}$ = 16.9994 amu (6)

B) Consider the wave function of a particle $\psi(x) = A\left(1 - \frac{x}{a}\right)$ for a/2 < x < a and is zero everywhere else. Find the normalization constant A. Obtain <x>. (4)

Q.2 A) i) Derive the conditions for bright and dark fringes for a monochromatic light beam reflected from wedge shaped thin film of transparent material.

ii) Calculate wavelength of light reflected from a wedge shaped film having wedge angle 1.94×10^{-4} rad and fringe width 0.12 cm. (Assume normal incidence) (6)

B) i) State De-Broglie hypothesis and justify it on the basis of Planck's hypothesis for Photon.

ii) Find De-Broglie wavelength for an electron accelerated through a potential difference of 182 Volts. (h = 6.63×10^{-34} J.S ,m_e = 9.1×10^{-31} kg,) (4)

Q.3 A) The wave function for a particle in infinite potential well is given as

$\psi_n(x) = \sqrt{\frac{2}{a}} \sin\left(\frac{n\pi x}{a}\right)$ where $0 \le x \le a$. Find <x> and <p_x>

Also sketch the wave functions and the probability densities for first three quantum States. (6)

B) Explain the working of He-Ne laser with suitable energy level diagrams. (4)

Q.4 A) i) An analyzer examines two adjacent plane polarized beams A & B, whose planes of polarization are mutually perpendicular. After the rotation of analyzer, at one position of analyzer, beam B shows zero intensity. From this position if analyzer is rotated by 30 degrees then the intensities of the beams are found to be equal. Determine the ratio of intensities of the beams. (3)

ii) A length of 25 cm of a solution containing 50 gm of solute per liter causes rotation of plane polarized light by 5 degrees. Find the rotation of plane of polarization of 75 cm of solution containing 100 gm of solute per liter. (3)

B) Establish four–factor formula of a nuclear reactor. (4)

Q.5 A) i) State and explain in brief the conditions for acceptable wave function.

ii) Using Heisenberg's uncertainty principle for position and momentum prove that the electron cannot reside inside the atomic nucleus. (Assume max. K.E. of electron is 4MeV and radius of nucleus is 10^{-14} m) (6)

B) i)Calculate number of lines of grating per unit length which will just resolve sodium lines 5890 A.U. & 5896 A.U. in first order. (2)

ii) Explain in brief any four characterstics of laser beam. (2)

Q.6 A) Obtain Schrödinger's time independent equation from time dependent equation. (5)

B) At what temperature are rates of spontaneous and stimulated emission equal?
(Given $\lambda = 5000\ A^0$. $h=6.626 \times 10^{-34}$JS, $k= 1.38 \times 10^{-23}$ J/K) (5)

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