Total No. of Questions : 4]

SEAT No. :

P814

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T.Y. B.Sc.

PHYSICS

PH - 342 : Quantum Mechanics

(2013 Pattern) (Semester - IV) (Paper - II)

Time : 2 Hours]

[Max. Marks : 40

Instructions to the candidates:-

1) All the questions are compulsory.

2) Figures to the right indicate full marks.

3) Use of calculator & Log-table is allowed.

Q1) Attempt all of the following (one mark each) **[10]**

    a) Write the formula for expectation value of momentum.

    b) Define raising and lowering operator.

    c) What is wave group?

    d) What is a free particle?

    e) Define degeneracy.

    f) Write the time-energy uncertainty relation.

    g) Define Hamiltonian operator.

    h) Write the Schrodinger's steady state equation.

    i) Represent infinite one dimensional potential well graphically.

    j) What is rigid rotator?

Q2) Attempt any two of the following (5 marks each) **[10]**

    a) A ruby laser emits light of wavelength 693.4 nm. If this light is due to transition from n=2 to n=1 state of an electron in a one-dimensional box, find the width of the box

       [Given : h = 6.625×10^{-34} J -sec; c = 3×10^8m/sec, m = 9.1×10^{-31}kg]

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b) The moment of inertia of Hcl molecule is 2.7×10^{-40} gm-cm². What would be the separation between l = 0 and l = 1 energy levels.

c) Normalise the wave function

$$\psi(x) = Ae^{\frac{-x^2}{2a^2} + ikx}$$

Where A is normalisation constant. The range of x is from $-\infty$ to $+\infty$.

Q3) Attempt any two of the following (5 marks each) **[10]**

a) Show that the momentum operator $-i\hbar \dfrac{\partial}{\partial x}$ is hermitian operator.

b) Discuss a thought experiment of γ ray microscope to illustrate uncertainty relation.

c) Show that the ladder operator L_+ increases the eigen value of operator L_z by $\hbar$.

Q4) a) Attempt any one of the following **[8]**

i) Using Schrodinger's steady state equation, obtain the energy eigen values and eigen functions for a particle in one-dimensional infinitely deep potential well.

ii) Obtain equation of continuity and give its physical significance.

b) Attempt any one of the following **[2]**

i) What is tunneling effect? Give any two applications of tunneling effect.

ii) Calculate the de Broglie wavelength of an electron having momentum 2.73×10^{-23} kg-m/sec.

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