Vitthalbhai Patel & Rajratna P.T.P.SCIENCE COLLEGE

VALLABH VIDYANAGAR

B.Sc. (Semester - 6)

Subject: Physics

Course: US06CPHY01 (Quantum Mechanics)

Internal Examination

Date: 05/03/2019 **Time: 10:00 a.m. to 12:00 Noon**

Tuesday **Total Marks: 50**

N.B: *(i) All the symbol have their usual meanings*

(ii) Figures at the right side of questions indicate full marks

Q-1 Multiple Choice Questions (Attempt All) **(08)**

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(1) The concept of matter wave was suggested by_____

(a) Schrodinger (b) Laplace

(c) Heisenberg (d) de Broglie

(2) The total probability of finding the particle in space must be _____

(a) Unity (b) zero

(c) Double (d) infinity

(3) The limit of a region-II for a square well potential is _____

(a) $-\infty < x < 0$ (b) $-a < x < a$

(c) $a < x < \infty$ (d) $-\infty < x < -a$

(4) For non-localized states of the square well potential _____

(a) $E = \infty$ (b) $E = 0$

(c) $E > 0$ (d) $E < 0$

(5) If A is an operator and $A^{\dagger}$ is an adjoint operator of A then $(A^{\dagger})^{\dagger}$ = _____

(a) A^{*} (b) A

(c) $A^{\dagger}$ (d) 1

(6) If $\delta_{m,n}$ is Kronecker delta function then $\delta_{m,n} = 1$ when _____

(a) $m > n$ (b) $m = n$

(c) $m \neq n$ (d) $m < n$

(7) Hamiltonian operator for simple harmonic oscillator is $H =$ _____

(a) $\frac{p^2}{2m}$ (b) $\frac{1}{2}kx^2$

(c) $\frac{p^2}{2m} + \frac{1}{2}kx^2$ (d) $\frac{p^2}{2m} + kx^2$

(8) Energy eigen value of an isotropic oscillator is given by E = _____

(a) $\hbar\nu$ (b) $\hbar\omega$

(c) $n\hbar\nu$ (d) $\left(n + \frac{3}{2}\right)\hbar\omega$

Q-2 Short Questions (Attempt any Five) **(10)**

(1) State the Heisenberg's uncertainty principle

(2) Define group velocity of the wave packet

(3) What is square well potential?

(4) State the physical significance of time independent Schrodinger equation

(5) Explain adjoint operator. Also define self adjoint operator.

(6) Define Dirac delta function and write its condition

(7) What is rigid rotator? State the expression for its energy level separation

(8) What is isotropic oscillator? Write down expressions for its energy

Q-3	Discuss the motion of a wave packet and derive the expression of group velocity of wave packet	**08**
	OR	
Q-3	Derive the one-dimensional Schrodinger equation for a free particle	**08**
Q-4	Explain the motion of a particle in a square well potential for bound state $(E < 0)$ and find the admissible solutions	**08**
	OR	
Q-4	Using the admissible solutions find the expression of energy eigen values and energy eigen functions for a particle in a square well	**08**
Q-5	Derive the momentum eigen functions and make it normalized by Box normalization	**08**
	OR	
Q-5	Prove that the product of uncertainty in observables is of the order of commutator	**08**
Q-6	Derive the dimension less Schrodinger equation for simple harmonic oscillator	**08**
	OR	
Q-6	Derive the radial equation for motion of a particle in central potential	**08**

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