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SEAT No._____ **No. of Printed Pages : 2**

SARDAR PATEL UNIVERSITY

B.Sc. EXAMINATION (Semester- 6)

[49|A20]

Monday, 26th March2018

10:00 a.m. to 01:00 p.m.

Subject: PHYSICS

Course: US06CPHY01

Title: Quantum Mechanics

Total Marks:70

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) **(10)**

(1) The Non-normalized wave function must have _____ norm
(a) infinite (b) finite
(c) zero (d) complex

(2) For normalized wave function $\psi \to 0$ as $r \to$ ___
(a) 0 (b) A
(c) -1 (d) 1

(3) The function representing matter waves must be _____
(a) zero (b) real
(c) complex (d) infinity

(4) The limit of a region-I for a square well potential is _____
(a) $-\infty < x < 0$ (b) $a < x < \infty$
(c) $-a < x < a$ (d) $-\infty < x < -a$

(5) For $E > 0$, the particle has a _____ kinetic energy
(a) positive (b) zero
(c) negative (d) infinity

(6) If there exist only one eigen function corresponding to a given eigen value, then the eigen value is called _____
(a) non degenerate (b) degenerate
(c) discrete (d) continuum

(7) For any operator A and a wave function ϕ_a if $A\phi_a = a\phi_a$ then a is called _____
(a) eigen function (b) probability density
(c) eigen value (d) probability amplitude

(8) The value of constant of integration for Box normalized momentum eigen function is _____
(a) $1/2\sqrt{L}$ (b) $1/\sqrt{2\pi}$
(c) $1/\sqrt{\pi}$ (d) $1/\sqrt{L}$

(9) In a rigid rotator distance between two particles is _____
(a) constant (b) zero
(c) infinite (d) variable

(10) Energy of an isotropic oscillator is _____
(a) continues (b) discrete
(c) 0 (d) $h\upsilon$

(P.T.O.)

Q-2 Short Questions (Attempt any Ten) **(20)**

(1) State the de Broglie hypothesis
(2) What you mean by $|\psi|^2$
(3) Write the admissible conditions on the wave functions
(4) What are the stationary states and energy spectra?
(5) What is square potential barrier?
(6) Write any two postulates of wave mechanics
(7) Define self adjoint operator
(8) Define degenerate and non-degenerate eigen values
(9) What is observable? Also state expansion postulate
(10) Write down expression for ∇^2 in spherical polar coordinates
(11) Define central potential? Write down the Hamiltonian for a particle in a central potential
(12) What is isotropic oscillator? Write down expressions for its energy

Q-3 (a) Derive the one dimensional Schrodinger equation for a free particle **05**
(b) Discuss the concept of matter wave and show the experimental agreement for electron **05**

OR

Q-3 (a) Discuss the normalization and probability interpretation of a wave function **05**
(b) Discuss Ehrenfest's theorem in detail **05**

Q-4 Describe the motion of a particle in a square well potential for bound state $(E < 0)$ and find the admissible solutions **10**

OR

Q-4 Derive the expression of energy eigen values and energy eigen functions for a particle in a square well **10**

Q-5 (a) Derive eigen function in momentum space and normalized it by δ function normalization method **06**
(b) Discuss the adjoint of operator with their properties **04**

OR

Q-5 (a) State uncertainty principle and discuss it for quantum mechanical observables **06**
(b) Write a detailed note on Dirac delta function **04**

Q-6 (a) What is angular momentum? Derive the expression of angular momentum operator L^2 in terms of spherical polar coordinates **06**
(b) Derive the dimension less Schrodinger equation for simple harmonic oscillator **04**

OR

Q-6 (a) What is an isotropic oscillator? Obtain the expression of its energy eigen value **06**
(b) Write note on rigid rotator **04**

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