

Enrollment No: _____

Exam Seat No: _____

C.U.SHAH UNIVERSITY

Summer Examination-2016

Subject Name : Introduction to Quantum Mechanics

Subject Code : 4SC06QMC1

Branch: B.Sc. (Physics)

Semester : 6

Date : 19/05/2016

Time : 02:30 To 05:30

Marks : 70

Instructions:

- (1) Use of Programmable calculator & any other electronic instrument is prohibited.
 - (2) Instructions written on main answer book are strictly to be obeyed.
 - (3) Draw neat diagrams and figures (if necessary) at right places.
 - (4) Assume suitable data if needed.
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Q-1 Attempt the following questions:

14

- a) Write equation of Higenberg uncertainty principle.
- b) What is called free particle?
- c) Write Schrodinger's equation for free particle in three dimension.
- d) Give the Max Born's physical interpretation of wave function
- e) Give the expectation value of position of particle.
- f) Give any two conditions of wave-function Ψ .
- g) The momentum operator is given by.....
- h) Define angular momentum operators.
- i) Write the equation of potential energy for simple harmonic oscillator.
- j) $[x, P_x] = \dots\dots\dots$
- k) $[x, P_z] = \dots\dots\dots$
- l) $(AB)^+ = \dots\dots\dots$
- m) Define the Adjoint operator.
- n) Write the plank's equation for energy



Attempt any Four Questions from Q-2 to Q-8

- Q-2 Attempt all questions (14)**
- a) Obtain Schrodinger's equation for free particle in one dimension. 7
 - b) Explain: Box normalization. 4
 - c) Obtain the formula of D'Broglie's wavelength. 3
- Q-3 Attempt all questions (14)**
- a) Explain: Conservation of Probability. 7
 - b) Derive: Ehrenfest's theorem 7
- Q-4 Attempt all questions (14)**
- a) Obtain time independent Schrodinger's equation. 7
 - b) Explain: Normalization of wave function. 4
 - c) Obtain the normalized function for $\phi = e^{i\theta}$, where $0 < \theta < 2\pi$. 3
- Q-5 Attempt all questions (14)**
- a) Obtain the solution of square well potential, if energy is negative ($E < 0$). 7
 - b) Explain the quantum mechanical tunneling for square potential barrier. 7
- Q-6 Attempt all questions (14)**
- a) Define: Self adjoint operator, Show that eigen value of Self adjoint operator is real. 5
 - b) Write short note on Dirac Delta function. 5
 - c) Prove that momentum operator is Self adjoint. 4
- Q-7 Attempt all questions (14)**
- a) Show that expectation values of a self-adjoint operator is real. 5
 - b) Prove that $[L_x, L_y] = i\hbar L_z$ 5
 - c) Prove that $L^2 = r^2 p^2 - (\vec{r} \cdot \vec{p})^2 + i\hbar(\vec{r} \cdot \vec{p})$. 4
- Q-8 Attempt all questions (14)**
- a) Obtain Schrodinger's equation and eigen values for simple harmonic oscillator. 7
 - b) Obtain the solution of the radial equation and energy levels for hydrogen atom. 7

