

Exam Seat No: _____

Enrollment No: _____

C.U.SHAH UNIVERSITY

Wadhwan City

Subject Code : 5SC01PHC3

Summer Examination-2014

Date: 17/06/2014

Subject Name:- Quantum Mechanics-I

Branch/Semester:- M.Sc(Physics)/I

Time:10:30 To 1:00

Examination: Remedial

Instructions:-

- (1) Attempt all Questions of both sections in same answer book / Supplementary
- (2) Use of Programmable calculator & any other electronic instrument is prohibited.
- (3) Instructions written on main answer Book are strictly to be obeyed.
- (4) Draw neat diagrams & figures (If necessary) at right places
- (5) Assume suitable & Perfect data if needed

SECTION-I**Q.1 Write answers of the following Questions.**

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|--|---|
| 1. What is Hilbert Space? | 1 |
| 2. Define Raising and lowering operators. | 2 |
| 3. What is Mach application of variational principle in quantum mechanics? | 1 |
| 4. Define: Matrix. | 1 |
| 5. Who gave the concept of using matrices in quantum mechanics? Why? | 1 |
| 6. Give the formula of Hermite Function. | 1 |
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- | | |
|--|---|
| Q.2 A. Discuss the solution of Harmonic Oscillator in Polar Co-ordinates | 5 |
| B. Discuss Spherical harmonics and obtain Y_{00} , Y_{10} and Y_{20} . | 5 |
| C. Derive the Energy Eigen value of Hydrogen atom. | 4 |

OR

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| Q.2 A. Explain Power Series solution | 5 |
| B. Derive Angular momentum commutation relation. | 5 |
| C. Discuss the Comparison between Classical and Quantum oscillator. | 4 |
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| Q.3 A. What is One dimensional Harmonic Oscillator? Derive the following equation, | 7 |
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$$\frac{d^2h}{d\xi^2} - 2\xi \frac{dh}{d\xi} + h(\square - 1) = 0$$

- | | |
|--|---|
| B. Discuss Harmonic oscillator energy spectrum in brief and plot Eigen function for $n=0$ to $n=5$. | 7 |
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OR

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| Q.3 A. Using the relations of rectangular and spherical polar coordinates, obtain | 7 |
|---|---|
- $$L_z = i \frac{\partial}{\partial \phi} ?$$
- | | |
|--|---|
| B. Using radial Schrödinger equation. Solve the attractive coulomb potential problem and obtain the energy Eigen value | 7 |
|--|---|

$$E_n = -\frac{mz^2 e^4}{2 \hbar^2 n^2}$$



SECTION-II

Q.4 Write answers of the following Questions.

1. What happens at Classical turning point in WKB approximation? 1
2. What is unitary matrix? 2
3. What are applications of time dependent perturbation theory? 2
4. What is trial wave function? How it is selected? 2

- Q.5 A. Explain the Bra and Ket Notation in Brief. 5
B. Discuss the Dirac-delta function with necessary diagram. 5
C. What is Stark effect? Discuss 4

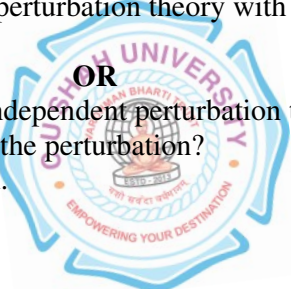
OR

- Q.5 A. Explain Matrix representation of an operator. 5
B. Discuss the Unitary Transformation. 5
C. Explain the Interaction of Electromagnetic Field with atom. 4

- Q.6 A. Explain the Fermi-Golden Rule 7
B. Explain the Time dependent perturbation theory with general formulation and first order theory. 7

OR

- Q.6 A. Discuss the first order time independent perturbation theory. What is the criterion for the smallness of the perturbation? 7
B. Explain WKB approximation. 7



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