

Enrollment No: \_\_\_\_\_

Exam Seat No: \_\_\_\_\_

# C. U. SHAH UNIVERSITY

## Summer Examination-2020

Subject Name : Quantum Mechanics-I

Subject Code : 5SC01QUM1

Branch: M.Sc. (Physics)

Semester : 1

Date : 28/02/2020

Time : 02:30 To 05:30

Marks : 70

**Instructions:**

- (1) Use of Programmable calculator and 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.

**SECTION – I**

**Q-1                      Attempt the Following questions                      (07)**

- |  |   |   |
|--|---|---|
|  | a. Write laplacian $\nabla^2$ in terms of spherical coordinate. | 1 |
|  | b. Give Rodrigues formula.                                      | 1 |
|  | c. Give values of $P_0(x)$ , $P_1(x)$                           | 1 |
|  | d. Write Radial Equation  | 1 |
|  | e. Write Angular equation for $\theta$ .                        | 1 |
|  | f. Define perturbation.   | 1 |
|  | g. Write Schrodinger equation in three dimension.               | 1 |

**Q-2                      Attempt all questions                      (14)**

- |  |   |    |
|--|---|----|
|  | 1. Obtain Schrodinger equation in three dimensions. | 07 |
|  | 2. Explain Perturbation theory.                     | 07 |

**OR**

**Q-2                      Attempt all questions                      (14)**

- |  |  |    |
|--|--|----|
|  | 1. Explain separation of variables in Spherical Polar coordinates. | 14 |
|--|--|----|

**Q-3                      Attempt all questions                      (14)**

- |  |   |    |
|--|---|----|
|  | 1. Explain 1 <sup>st</sup> order correction of energy in perturbation theory. | 07 |
|  | 2. Explain first order correction of wavefunction in perturbation theory.     |    |

**OR**

**Q-3    1.                      Explain Two Fold degeneracy in detail.                      14**



## SECTION – II

- Q-4 Attempt the Following questions (07)**
- a. Write the Hamiltonian for the ground state of the helium. 1
  - b. Give the Hamiltonian for the Hydrogen molecule ion. 1
  - c. State Variational Principle. 1
  - d. Why WKB approximation is useful? 1
  - e. Define Tunneling. 1
  - f. Give condition for validity of WKB approximation. 1
  - g. What is the role of connecting formulas? 1
- Q-5 Attempt all questions (14)**
1. Write a note on Zeeman Effect. 07
  2. Explain stark effect. 07
- OR**
- Q-5**
1. Explain Linear Harmonic Oscillator. 07
  2. Write a note on Semi-classical treatment in WKB approximation. 07
- Q-6 Attempt all questions (14)**
1. Derive equation of Hamiltonian for Hydrogen molecule ion. 07
  2. Explain Gamow's theory of Alpha decay. 07
- OR**
- Q-6 Attempt all Questions**
1. Write a note on Tunneling. 07
  2. Write a note on zero order WKB approximation solution. 07

