

Roll No. ...203112300064

Exam Code : M-23

Subject Code—59357

B.Sc. EXAMINATION

(Main/Reappear)

(Batch 2018 Onwards)

(Sixth Semester)

PHYSICS

CPL-602

Quantum Mechanics (Course-III)

Time : 3 Hours

Maximum Marks : 80

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. 1 is compulsory. All questions carry equal marks.

(Compulsory Question)

1. (a) Find the expectation value $\langle x \rangle$ of the position of a particle trapped in a box L wide. 4

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- (b) What is Tunnel Effect ? How does it explain alpha decay ? 4
- (c) Show that the excited states of helium can have total spin of zero or unity, but the ground state can have a spin of zero only. 4
- (d) Why do all molecules not show rotational spectra ? 4

Unit I

2. (a) Calculate the energy of a particle in one-dimensional infinite potential well. 8
- (b) Derive the commutation relation between position and momentum. 8
3. (a) Derive three-dimensional time independent Schrödinger equation from Schrödinger time dependent equation. 12

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- (b) The wave function of a particle is given by $\psi(x) = e^{7x}$. Find the probability of finding the particle between $x = 0$ and $x = 5$. 4

Unit II

4. (a) Obtain energy levels for a particle inside a box of finite width. 12
- (b) An electron has a speed of 600 m/s with an accuracy of 0.005%. Calculate the certainty with which we can locate the position of the electron. 4
5. (a) A particle of mass m and total energy E moves from the region of zero potential to the region of constant potential V_0 . Given that $E > V_0$, derive expression for reflection coefficient R and transmission coefficient T . Prove that $R + T = 1$. 12

- (b) Calculate the value of lowest energy of an electron moving in a one-dimensional force free region of length $4 \text{ \AA}$. 4

Unit III

6. (a) Explain Zeeman effect. What is the quantum theory of anomalous Zeeman effect ? 10
- (b) Explain J-J coupling in case of two electron spectra. 6
7. (a) What is Larmor's Precession and derive Larmor's Theorem ? 10
- (b) Determine the normal Zeeman splitting of the Cadmium red line of $6438 \text{ \AA}$ when the atoms are placed in a magnetic field of 0.009 T . 6

Unit IV

8. What is Raman effect ? What are Stokes' and antiStokes' line in Raman spectrum ? Give experimental setup to study Raman effect with the help of a neat diagram. 16
9. (a) State and explain electromagnetic spectrum. 8
- (b) Explain the probability distribution for molecular orbits. 8