Roll No. : .....

Total No. of Questions : **11**] [Total No. of Printed Pages : **3**

BPG–1110

M.Sc. (Previous) Examination, 2021

PHYSICS

Paper–III

(Quantum Mechanics)

Time : 1½ Hours] [*Maximum Marks : 75*

Section–A **(Marks : 2 × 10 = 20)**

Note :– Answer all *ten* questions (Answer limit **50** words). Each question carries **2** marks.

Section–B **(Marks : 5 × 5 = 25)**

Note :– Answer all *five* questions. Each question has internal choice (Answer limit **200** words). Each question carries **5** marks.

Section–C **(Marks : 10 × 3 = 30)**

Note :– Answer any *three* questions out of five (Answer limit **500** words). Each question carries **10** marks.

Section–A 2 each

1. (i) Write the continuity equation.

   (ii) Show that :

$$\int_{-\infty}^{\infty} f(x)\,\delta(x-a)dx = f(a)$$

(iii) Explain bra and ket notation.

(iv) Define Hermitian operator.

(v) Explain Fermi's golden rule.

(vi) What do you understand by Stark effect ?

(vii) Explain Variational Method.

(viii) What are symmetric and antisymmetric wave functions ?

(ix) Discuss Born approximation.

(x) Define Partial Wave analysis.

Section–B 5 each

2. Write a brief note on the representation of states and dynamical variables.

Or

Discuss solution of Harmonic oscillator by Schrödinger equation.

3. Prove that the generators of unitary transformation for translation and rotation in space are momentum and angular momentum respectively.

Or

Show that :

$$J_+ | \psi_{l,m} > = \hbar [(j \mp m)\ (j \pm m + 1)]^{1/2}\ \psi_{l,m \pm 1} | >$$

4. Show that the ground state of hydrogen atom does not show Stark effect.

Or

Calculate the atomic polarizability of H-atom in ground state.

5. Use WKB method to explain α-decay.

Or

Discuss spin functions for a many-electron.

6. Establish the condition for validity of the Born approximation.

Or

Using the method of partial wave analysis, obtain optical theorem.

Section–C

10 each

7. State and prove the Ehrenfest's theorem.
8. State and prove Wigner-Eckart theorem and discuss its importance.
9. An atom is placed in a weak homogeneous magnetic field. Derive an expression for the change in energy levels of the atom due to field.
10. Obtain probability density and probability current density using Klein Gordon equation.
11. Obtain transformation of differential scattering cross-section from centre of mass to laboratory frame of reference. Also explain scattering amplitude.