

Total No. of Questions :7]

SEAT No. :

P1924

[4922]-24

[Total No. of Pages :2

M.Sc.

PHYSICS

**PHY UT-604: Quantum Mechanics - II
(2008 Pattern) (Semester - II)**

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) Question No.1 is compulsory. Attempt any four from remaining.*
- 2) Draw neat diagrams wherever necessary.*
- 3) Figures to the right indicate full marks.*
- 4) Use of logarithmic table and calculators is allowed.*

Q1) Attempt any four of the following:

- a) Show that there is no first order stark effect in the ground state of atom. **[4]**
- b) Find the eigen value of exchange operator P_{12} for identical particles 1 and 2. **[4]**
- c) Determine the form of antisymmetric total eigen function for a system of three particles in which the interaction between the particles can be ignored. **[4]**
- d) Show that total energies in laboratory and centre of mass system are related by **[4]**

$$E_{\text{lab}} = \left(\frac{m_1 + m_2}{m_2} \right) E_{\text{cm}} .$$

- e) Use perturbation theory to obtain the first order correction to n^{th} energy level of an anharmonic oscillator with Hamiltonian **[4]**

$$H = \frac{P^2}{2m} + \frac{1}{2} kx^2 + bx^4 \text{ for very small } b.$$

- f) Using variation principle obtain expression for ground state energy of hydrogen atom. **[4]**

P.T.O.

- Q2)** a) Discuss classical and quantum mechanical picture of collision between identical particles. [8]
- b) Develop time dependent perturbation theory to obtain first order correction to amplitude $a_m^{(1)}(t)$. [8]
- Q3)** a) Obtain the Slater's determinant for a system of N particles. [8]
- b) Obtain an expression for the Fermi golden rule (transition probability) for harmonic perturbation. [8]
- Q4)** a) Using Born approximation obtain expression for differential cross section for a screened coulomb field. [8]
- b) What is dipole approximation in time dependent perturbation theory? Discuss selection rule for electric dipole transition. [8]
- Q5)** a) Using Green's function obtain an expression for scattering amplitude. [8]
- b) Use WKB theory to obtain transmission coefficient for α particle. [8]
- Q6)** a) Using method of partial waves, obtain an expression for the cross section for scattering by a perfectly rigid sphere. [8]
- b) What is Zeeman effect? Obtain expression for change in energy value of ground state when second order effect is considered. [8]
- Q7)** a) Obtain Bohr's quantization condition that bound state satisfy. [4]
- b) Describe vectors and pseudovectors in terms of intrinsic parity. [4]
- c) State conditions for validity of WKB approximation. [4]
- d) Discuss concept of symmetry in quantum mechanics. [4]

EEE