

(Pages : 3)

**M – 7125**

Reg. No. : .....

Name : .....

**Third Semester M.Sc. Degree Examination, March 2022**

**Physics**

**PH 231 : ADVANCED QUANTUM MECHANICS**

**(2018 - 2019 Admission)**

Time : 3 Hours

Max. Marks : 75

**SECTION – A**

Answer **any five** questions. **Each** question carries **3** marks.

1. (a) A conservation law implies the existence of a symmetry transformation for the system. Comment.
- (b) What are ladder operators? Why are they called so?
- (c) For s electron, the spin — orbit interaction is zero. Why?
- (d) Explain the validity conditions of WKB approximation
- (e) Explain what is dipole approximation
- (f) What are singlet and triplet states?
- (g) What are partial waves?
- (h) The dimension of Dirac matrices has to be even. Why?

**(5 × 3 = 15 Marks)**

P.T.O.



## SECTION – B

Answer **all** questions. **Each** question carries **15** marks.

2. (a) Discuss the variation method as applied to the ground state of Helium.

OR

- (b) Discuss the barrier penetration problem based on the WKB method

3. (a) Describe the scattering by a central potential on the basis of partial wave analysis.

OR

- (b) What are Pauli's spin matrices and explain their properties. Using Pauli's spin matrix representation, reduce the operators  $S_x^2, S_y^2$  and  $S_z^2$

4. (a) Obtain the eigen values of  $J^2$  and  $J_z$  where  $J^2$  and  $J_z$  have the usual meaning.

OR

- (b) Set up Dirac equation for an electron in an electromagnetic field and obtain an expression for the electron spin magnetic moment.

**(3 × 15 = 45 Marks)**

## SECTION – C

Answer any **three** questions. **Each** question carries **5** marks.

5. (a) Prove that the conservation of total angular momentum is a consequence of the rotational invariance of a system.
- (b) Show that  $[L^2, L_x] = 0$
- (c) For Pauli spin matrices show that  $\sigma_x \sigma_y \sigma_z = i$ .



- (d) Explain dipole approximation and dipole moment. Comment on the transitions  $1s \rightarrow 2s$  and  $1s \rightarrow 2p$
- (e) List out the Boson states and Fermion states with spatial and spin part included
- (f) Write down the Dirac matrices in the standard notation. What are the conditions applied to Dirac matrices.

**(3 × 5 = 15 Marks)**

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