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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^2_x, S^2_y and S^2_z

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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