



Avinashilingam Institute for Home Science and Higher Education for Women

(Deemed to be University Estd. u/s 3 of UGC Act 1956, Category 'A' by MHRD)
Re-accredited with 'A++' Grade by NAAC. Recognised by UGC Under Section 12B
Coimbatore - 641 043, Tamil Nadu, India

Continuous Internal Assessment Test II – April 2025 II SEMESTER

Class : I PG
Major : Physics

Time: 2 hours
Max Marks: 60

23MPHC07 QUANTUM MECHANICS I

Course Outcomes:

- CO1: Explain the evolution of quantum theory
- CO2: Enumerate properties of operators in quantum mechanics.
- CO3: Describe about linear vector spaces, Hilbert space, concepts of basis and operators
- CO4: Solve Schrödinger equations for various potentials and apply to hydrogen atom
- CO5: Analyze orbital and spin angular momentum matrices and calculate Clebsch-Gordan Coefficient

Part A

6 x 1 = 6

Choose the correct answer

1. The eigen value of an operator $\frac{d}{dx}$ operated on the function $x^2 - x$ is CO2K1
a. 0 b. 1 c. 2 d. $2x-1$
2. If $\hat{A} \Psi = a\Psi$, the eigen value of the inverse of an operator is CO2K2
a. a b. $\frac{1}{a}$ c. 0 d. 1
3. In Dirac's picture CO3K1
a. Operator is time-frozen b. State vector and operator is time-independent
c. Operator is time-frozen d. State vector is independent
4. Which of the following phenomena can be explained by quantum mechanical tunneling through the barrier? CO4K2
a. α -decay b. emission of electron from the cold metal surface
c. switching action of tunnel d. all the above
5. Role of linear harmonic oscillator is to link CO4K1
a. Fermions b. Kaons c. pions d. bosons
6. The determinants and trace of pauli matrices σ are CO5K1
a. 1,0 b. -1,0 c. -1,1 d. 1,1

Part B

3 x 6 = 18

Answer ALL questions

Each answer should not exceed 400 words or two pages

7.a. What is meant by Hermitian operator? Show that Hermitian operators have real eigen values. CO2K1

OR

7b. Explain what is the relation between simultaneity and commutativity by stating and proving the theorems. CO2K2

8a. Explain about various quantum mechanical pictures CO3K2

OR

8b. Deduce the time dependent Schrodinger's equation CO4K2

9a. Show that (i) $[L_x, L_y] = i\hbar L_z$ (ii) $[L_z, L_+] = \hbar[L_x + iL_y]$. CO5 K2

OR

9b. What are Eigen values of J^2 and J_z ? CO5 K2

Part C 3 x 12 = 36

Answer ALL questions

Each answer should not exceed 800 words or four pages

10a. What is the relation between commutator and Poisson's Bracket? CO2K2

OR

10b. Prove the following relations (i) $[A_1 A_2, B] = [A, B] A_2 + A_1 [A_2, B]$ and

(ii) $[A, [B, C]] + [B, [C, A]] + [C, [A, B]] = 0$ CO2K2

11a. Explain Unitary transformation and its properties. CO3K2

OR

11b. Obtain the solution for the Hydrogen atom using the Schrodinger equation. CO4K2

12a. Using the analytic method, obtain the eigen value and eigen function for the linear harmonic oscillator

OR

12b. Derive Clebsch-Gordon coefficients and obtain the selection rule and recursion relations.

CO5K2

Number of Copies: 20

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