21P206 (Pages: 2) Name: ....

Reg.No: ....

SECOND SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2022

(CBCSS - PG)

(Regular/Supplementary/Improvement)

CC19P PHY2 C05 - QUANTUM MECHANICS – I

(Physics)

(2019 Admission onwards)

Time : 3 HoursMaximum : 30 Weightage

Section A

Answer ***all*** questions. Each question carries 1 weightage.

1. Write a note on ket and bra spaces.
2. Prove that the eigenvalues of a Hermitian operators are real.
3. What is a Unitary operator? How can it be used for change of basis?
4. Write the time evolution operator for a spin half system.
5. Explain the importance of commutation of an operator with Hamiltonian using Heisenberg equation of r
6. Write the expressions for the application of annihilation, creation and number operator on a eigenket of harmonic oscillator.
7. Write the matrices which can be used to rotate the Cartesian coordinates by an angle equation (ϕ) (ϕ) v
8. Write an expression for probability flux. Write the continuity equation based on it.

Section B

Answer any ***two*** questions. Each question carries 5 weightage.

9. Discuss how measurement affects a system prepared in one of the base kets. Compare it with the case w a general state.
10. Discuss Schrodinger picture and Heisenberg picture.
11. Derive the equation for the energy of an isotropic harmonic oscillator using the radial equation for a cen
12. What is relation between symmetry and conservation laws? How are the translation in space and time co of linear momentum and energy respectively?

Section C

Answer any ***four*** questions. Each question carries 3 weightage.

13. Show that $([X,P_n]=i\hbar XP_{n-1})$ $([X,Pn]=i\hbar XPn-1)$
14. Consider an operator $(A=Xd/dx+2)$$(A=Xd/dx+2)$, where X is arbitrary operator and x is the position
    (a) Find the eigenfunction of $(A)$$(A)$ corresponding to the eigen value 0.

(b) Is the operator (A)(A) Hermitian.
(c) Calculate ([X,[A,X]]).([X,[A,X]]).

15. Consider a one-dimensional particle which is confined within the region(0≤x≤a)(0≤x≤a) and whose wa
is(ψ(x,t)=sin(πx/a)exp(−iωt))(ψ(x,t)=sin(πx/a)exp(−iωt)). Find the potential (V)(V).

16. A particle of mass (m)(m), which moves freely inside an infinite potential well of length (a)(a), has the
function
at (t=0);(t=0); (ψ(x,0)=Aa√sin(πx/a)+3√5asin(3πx/a)+15√asin(5πx/a))(ψ(x,0)=Aasin(πx/a)+35as
where (A)(A)is a real constant.
(a) Find (A)(A) so that (ψ)(ψ)is normalized.
(b) If measurements of the energy are carried out, what are the values that will be found and what are the corresponding probabilities?
(c) Find the wave function at a later time t.

17. Calculate the commutator between the x and y components of the orbital angular momentum operator.

18. Consider a system with total angular momentum (j=1)(j=1). Evaluate the angular momentum operators

19. Discuss indistinguishability principle.

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