SHAILABALA WOMEN'S (AUTO.) COLLEGE, CUTTACK

QUANTUM MECHANICS AND APPLICATIONS

SEMESTER - V

C C - XI

DEPARTMENT OF PHYSICS

Short Answer Questions

1. Why should the wave function f(x) be a single valued every where?
2. Explain the meaning of well behaved wave function.
3. What is a wave function associated with a free particle?
4. What is a free particle?
5. Explain Born's interpretation of wave function.
6. What are the conditions that a wave function must obey?
7. What do you mean by normalization of a wave function.
8. Write down time dependent Schrodinger wave function.
9. What are the properties of the wave function.
10. What do you mean by expectation value of an observable
11. What is probability current density.
12. What do you mean by linearity.
13. State superposition principle.
14. Show that probability density is always
15. What is the wave function for a free particle.
16. Write down the relation between linear momentum and propagation constant.
17. Discuss limitation of free particle wave function.
18. What is the de-Broglie's wave length of an electron travelling with a speed of 3x10^6m/sec.
19. What is the relation between linear momentum and propagation constant.
20. Define wave packet
21. Why material particle can not be represented by a single wave?
22. What is an operator.
23. What is eigen value and eigen function of an operator.
24. What are the conditions for a linear operator.
25. What is momentum operator.

26.What is energy operator.

27.What is Hamiltonian operator.

28.Define commutator.

29.What do you mean by Hermitian operator.

30.Write down the properties of Hermitian operator

31.Show that the momentum operator is Hermitian .

32.What do you mean by adjoint of an operator.

33.Explain eigen value spectrum.

34.Explain simultaneous eigen functions.

35.What do you mean by degeneracy.

36.Is sin x a linear operator?

37.Prove that the operator – is non-Hermitian

38.What are conjugate variables?

39.Find an expression for x-component of angular momentum operator in

Spherical polar co-ordinate.

40.Energy, time commutator is non-zero. Can they be determined simultaneously.

41.What is the significance of commutator in uncertainty principle?

42.Calculate the ground state energy of an electron in a one dimensional box of length 14°

43.A particle is in the ground state of an infinite square well of size a' what is the probability of finding the particle in a distance $\Delta x=0.01a$ at

(a)$X=a/2$

(b) $x=a/4$

44.In what factors allowed values of energy of a particle in rectangular well depends?

45.Show that sum of reflection and transmission co-efficient for a potential barrier is 1.

46.What is the condition for perfect transmission through a rectangular potential barrier.

47.How many minima and maxima are there in the 2^{nd} excited state wave function of the particle in infinite well.

48.What is stationary state.

49.What is ground state energy or zero energy.

50.What is reflection co-efficient.

51.What is transmission co-efficient.

52.The probability of occupation of a stationary state is

53.The minimum energy of a particle in a box is not zero but if finite is called.

54.Write the energy eigen values of a particle in a box.

55.Show that the wave function of two lowest states of a particle in an infinite well are orthogonal.

56.What does quantum no. for a particle 'n' in a box determines.

57.Define Gyromagnetic ratio.

58.What is Bohr magneton?

59.Define Larmor frequency.

60.What is the significance of Stern-Gerlach experimental result?

61.The vector atom model is based on which principle?

62.What are the limitations of Bohr's atom model?

63.What are the short comings of Bohr-Sommerfield theory.

64.What do you mean by parity of eigen functions.

65.Wilson-Sommerfild theory explain the origin of fine structure of spectral lines by assuming.

66.What is Zeeman effect.

67.What is longitudinal Zeeman effect.

68.What is transverse Zeeman effect?

69.What do you mean by anomalous Zeeman effect?

70.Anomalous Zeeman effect is observed if the source is placed in magnetic field.

71.Define Lorentz unit.

72.Define the Lande g-factor.

73.What is paschen-Back effect?

74.What is stark effect?

75.How many components are observed in Stark effect?

76.Does weak field Stark effect can be observed.

Long Answer Questions

1.Derive time dependent Schrodinger wave equation in one dimension and three dimension.

2. What are matter waves? What is their phase and group velocity?

3. Derive the expression of probability current density in three dimensions. discuss about the spread of Gaussian wave packet.

5. Explain time, position and momentum uncertainty of wave packet.

6. State and prove Ehrenfest theorem.

7. Discuss about commutation relation between Hamiltonian 'H' and components of orbital angular momentum.

8. Discuss about orthonormality of eigen function,

9. Discuss about commutation relations of angular momentum with linear momentum.

10. Discuss commutation relation between position and momentum.

11. Derive time independent Schrondinger wave equation and predict its solution.

12. What are stationary state solutions? Find them for time independent schrodinger wave equation.

13. Write Schrodinger equation for a particle in a box and determine expression for energy eigen values and eigen functions?

14. Obtain the normalized wave function for a particle in a box. Represent them graphically.

15. Consider a particle incident on a potential step of high Vo. Calculate the co- efficient of reflection and transmission.

16. What is quantum mechanical tunneling? Under what condition the transmission co-efficient is equal to one.

17. Describe an experimental set-up to study Zeeman effect.

18. What anamolous Zeeman effect? Discuss the Zeeman pattern of the resonance lines of sodium.

19. What is stark effect. Discuss about the weak field and strong field stark effect.

20. Describe Stern-Gerlach experiment.

21. Describe an expression for the Larmor precesional frequency. What is its importance.

22. Discuss Sommerfeld's extension of Bohr's model.

23. Discuss the quantum mechanical treatment of one electron atom.