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P – 2502

Reg. No. : .....

Name : .....

**Fifth Semester B.Sc. Degree Examination, December 2022**

**First Degree Programme under CBCSS**

**Physics**

**Core Course V**

**PY 1541 – QUANTUM MECHANICS**

**(2018 Admission onwards)**

Time : 3 Hours

Max. Marks : 80

SECTION – A

Answer **all** questions, each question carries **1** mark.

1. What is 'Ether'?
2. Write down Planck's expression for quantized energy.
3. Explain dual nature.
4. What is threshold frequency?
5. Write down the expression for quantized angular momentum.
6. Write down the expressions for operators of energy and momentum.

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7. Define wave function.

8. What is Hermitian operator?

9. What is Hilbert space?

10. What are Eigen values of an operator?

**(10 × 1 = 10 Marks)**

## SECTION – B

Answer any **eight** questions, each question carries **2** marks.

11. How black body radiation spectra lead to quantum mechanics?

12. Explain photo electric effect and its features.

13. Explain Dulong and Petit's law of specific heats.

14. What are matter waves?

15. Explain Compton Effect?

16. Explain admissibility conditions of the wave function.

17. What are the major inadequacies in quantum theory?

18. Explain about position momentum uncertainty.

19. Briefly explain about the uncertainty in energy and time.

20. Explain the principle of superposition in quantum mechanics.

21. Give a brief explanation about wave packets.

22. Explain about expectation values of an operator.

23. Write a brief note on linear vector space.

24. Give the expressions for nature of potentials in different regions of square well potential with finite walls.

25. Explain quantum mechanical tunnelling.

26. Does the concept of Bohr radius violate the uncertainty principle.

**(8 × 2 = 16 Marks)**

## SECTION – C

Answer any **six** questions, each question carries **4** marks.

27. Explain correspondence principle.

28. The work function of barium and tungsten are 2.5 eV and 4.2 eV respectively. Check whether these materials are useful in photocells which is to be used to detect visible light.

29. Calculate the De Broglie wavelength of an electron having kinetic energy of 1000 eV. Compare the result with the wavelength of X rays having same energy.

30. Evaluate the ratio of De Broglie wavelength of an electron and proton if both have same kinetic energy.

31. Calculate the separation between two lowest energy levels of an electron in a one dimensional infinite potential well of width $1A^0$.

32. Find the value of maximum probability density for a one dimensional harmonic oscillator in its ground state.

33. Obtain the energy Eigen values for a particle in infinite square well potential with rigid walls.

34. Obtain the expression for position operator in momentum representation.

35. Prove that Eigen values of Hermitian operators are real.

36. Obtain the equation of motion for interaction picture.

37. If the position of a 5 KeV electron is located in $2A^0$, then what is its uncertainty in momentum?

38. Calculate the velocity and frequency of revolution of the electron of the Bohr hydrogen atom in its ground state.

**(6 × 4 = 24 Marks)**

## SECTION – D

Answer any **two** questions, each question carries **15** marks.

39. Explain Bohr model of hydrogen atom and derive necessary equations.

40. Obtain time independent Schrodinger equation and explain stationary states.

41. Explain the interpretation for the wave function and derive equation of continuity by defining probability current density.

42. Explain all postulates of quantum mechanics.

43. Obtain equations of motion by Schrodinger and Heisenberg representations.

44. Explain the square potential barrier and obtain relationship for transmission probability.

**(2 × 15 = 30 Marks)**

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