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Reg. No : .....

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Fifth Semester B.Sc. Degree Examination, December 2019

First Degree Programme under CBCSS

Physics

Core Course VI

PY 1542 : QUANTUM MECHANICS

(2014 Admission onwards)

Time : 3 Hours Max. Marks : 80

SECTION – A

Answer **all** the questions in **one** or **two** sentences. Each question carries **1** mark.

1. What is Compton shift?
2. What is Wein's displacement law?
3. What is de Broglie hypothesis?
4. Define expectation value.
5. Explain Born's statistical interpretation of the wave function.
6. State the uncertainity principle.
7. Define Hilbert space.

8. What are the characteristics of a wave function?

9. Define tunneling.

10. What are Hermitian operators?

(10 × 1 = 10 Marks)

SECTION – B

Answer **any eight** questions, not exceeding a paragraph. Each question carries **2** marks.

11. Explain the Rutherford planetary model.

12. Briefly discuss correspondence principle.

13. Briefly outline the mechanism by which photoelectrons are emitted.

14. Write down the momentum and energy operators in quantum mechanics.

15. Discuss the eigen functions and eigen values of Harmonic oscillator.

16. Discuss generalized statistical interpretation.

17. Solve the Schrodinger equation of a free particle.

18. Discuss the concept of normalization.

19. Why observables in quantum mechanics need to be Hermitian?

20. Define bound states and scattering states.

21. Explain the conditions for admissible wave functions.

22. Briefly discuss the stationary states of the free particle.

(8 × 2 = 16 Marks)

SECTION – C

Answer **any six** questions. Each question carries **4** marks.

23. The photoelectric threshold wavelength of silver is 2762 Å. Calculate the maximum kinetic energy of the ejected electrons when the silver surface is illuminated with ultraviolet light of wavelength 2000 Å.

24. X-rays of wavelength 1.4 Å are scattered from a block of carbon. What will be the wavelength of scattered X-rays at 180° and 0°?

25. Calculate the maximum wavelength that hydrogen in its ground state can absorb where the ground state energy is -13.6 eV.

26. Find the frequency of revolution of electrons in n = 1 and n = 2 orbits.

27. Determine the de Broglie wavelength of an electron that has been accelerated through a potential difference of 100 V.

28. Calculate the expectation value of momentum of a particle trapped in a one dimensional box of width L.

29. Calculate the probability of finding the particle in the region $0 < x < a$ where the wave function of the particle confined in a box of length $-a$ to $+a$ is $\psi(x) = \{1/\sqrt{a}\}\sin(\pi x/2a)$.

30. An operator A defined by $A\psi(x) = \frac{d^{\psi}(x)}{dx} + 2\psi(x)$. Check whether the operator is linear or not.

31. The uncertainity in the velocity of a particle is equal to its velocity. If $\Delta p \cdot \Delta x = h$, show that the uncertainity in its location is its de Broglie wavelength.

(6 × 4 = 24 Marks)

SECTION – D

Answer **any two** questions. Each question carries **15** marks.

32. Obtain the eigen functions and eigen values of a particle in an infinite square potential well.

33. Derive steady state form of Schrodinger equation from time dependent form.

34. Obtain the general uncertainity principle.

35. Derive the transmission and reflection coefficients of a particle approaching a delta function potential.

(2 × 15 = 30 Marks)
