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Reg. No. : .....

Name : .....

Fifth Semester B.Sc. Degree Examination, December 2017
First Degree Programme under CBCSS
PHYSICS
Core Course – VI
PY 1542 : Quantum Mechanics
(2013 Admission Onwards)

Time : 3 Hours Max. Marks : 80

SECTION – A

Answer **all** questions in a word or **one** or **two** sentences. **Each** question carries **one** mark.

1. Explain deBroglie relation.
2. Explain Hamiltonian function.
3. Write a note on statistical interpretation of probability.
4. Explain expansion theorem.
5. State correspondence principle.
6. What is discrete and continuous spectrum ?
7. What is co-ordinate representation ?
8. Explain the principle of super position.
9. When do you say two functions are orthonormal ?
10. Write down any two applications of uncertainty relation. (10x1=10 Marks)

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SECTION – B

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

11. Prove that commuting operators have common set of eigen functions.

12. Explain quantum theory of specific heat.

13. Define a Hermitian operator. Show that any two eigen functions of a Hermitian operator that belong to different eigenvalues are orthogonal.

14. Write a note on expectation value.

15. What are stationary states ? In stationary states, show that the probability of current density is constant in time.

16. Show that the velocity of a particle and the group velocity of the corresponding wave packet are the same.

17. How particle nature of radiation was confirmed by the photoelectric effect and Compton effect ?

18. Write a note on wave packet.

19. What is a linear operator ?

20. Explain photoelectric effect and its conclusions.

21. Explain Wilson-Sommerfeld quantization rule.

22. Outline Dirac's bra and ket notations. **(8×2=16 Marks)**

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SECTION – C

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

23. Calculate the maximum wavelength that hydrogen in its ground state can absorb. What would be the next maximum wavelength ?

24. What potential difference must be applied to stop the fastest photoelectrons emitted by a surface when electromagnetic radiation of frequency 1.5×10^{15} Hz is allowed to fall on it. The work function of the surface is 5 eV.

25. Show that the phase velocity of relativistic electron is $Vp = c\left[1 + m_0^2 C^2\lambda^2/h^2\right]$ where λ is its de Broglie wavelength.

26. Show that Cartesian coordinates (r_1, r_2, r_3) and the Cartesian components of angular momentum (L_1, L_2, L_3) obey the commutation relation. $[L_k, r_1] = i\hbar r_m$.

27. If A and B are Hermitian operators, show that (AB + BA) is Hermitian and (AB – BA) is not Hermitian.

28. Show that the linear momentum is not quantised.

29. Write the time dependent Schrodinger equation for a free particle in the momentum space and obtain the form of the wave function.

30. Show that the energy and wave function of a particle in a square well of infinite depth V_0 reduces to the energy and wave function of square well with rigid walls in the limit $V_0 \to \infty$.

31. A harmonic oscillator is in the ground state i) where is the probability density maximum ? What is the value of maximum probability density ? **(6×4=24 Marks)**

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SECTION – D

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

32. Discuss Bohr atom model. Derive an expression hydrogen spectrum.

33. Deduce time dependent Schrödinger equation for a free particle.

34. Outline the different postulates of quantum theory.

35. Define the uncertainty (ΔA) in the measurement of dynamical variable. State and explain the general uncertainty relation. **(2×15=30 Marks)**
