(6 pages) **Reg. No. :** .....

Code No. : 7863 **Sub. Code : PPHM 31**

M.Sc. (CBCS) DEGREE EXAMINATION, NOVEMBER 2019.

Third Semester

Physics – Core

QUANTUM MECHANICS – I

(For those who joined in July 2017 onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. According to schrodinger, a particle is equivalent to a

(a) single wave (b) light wave

(c) wave packet (d) energy

2. An equation representing Ehrenfest relation is

(a) $\frac{d}{dx}\langle\vec{p}\rangle = -\langle\nabla v\rangle$ (b) $\frac{d}{dt}\langle\vec{p}\rangle = -\langle\nabla v\rangle$

(c) $\frac{d}{dt}\langle\vec{p}\rangle = -i\hbar\langle\nabla v\rangle$ (d) $\frac{d}{dt}\langle\vec{p}\rangle = i\hbar\langle\nabla v\rangle$

3. The duration of radar pulse is 10^{-6}S, the uncertainty in energy would be

(a) $6.62\times10^{-19}J$ (b) 0

(c) $10^{-35}J$ (d) $10^{-28}J$

4. Hermitian operator is one which has

(a) real eigen values only

(b) imaginary eigen values only

(c) real and imaginary eigen values

(d) no eigen values

5. The ground state energy of linear harmonic oscillator is

(a) $\frac{-e^2}{2a_0}$ (b) Zero

(c) $\hbar w$ (d) $\frac{1}{2}\hbar w$

6. The eigen functions for a particle in a box is _____.

(a) $\psi_n(x) = \sqrt{\left(\frac{2}{L}\right)} \sin\left(\frac{n\pi x}{L}\right)$

(b) $\psi_n{}^*(x) = \sqrt{\left(\frac{2}{\pi}\right)} \sin\left(\frac{n\theta x}{L}\right)$

(c) $\psi_n(x) = \sqrt{\left(\frac{2}{L}\right)} \cos\left(\frac{n\pi x}{L}\right)$

(d) $\psi^*(x) = \sqrt{\left(\frac{2}{\pi}\right)} \cos\left(\frac{n\theta x}{L}\right)$

7. The scalar product of the vector ϕ and ψ is

(a) $\langle\phi|\psi\rangle = \langle\phi|\psi\rangle^*$ (b) $\langle\phi|\psi\rangle = \langle\psi|\phi\rangle^*$

(c) $\langle\phi|\psi\rangle^* = \langle\phi|\psi^*\rangle$ (d) $\langle\phi|\psi\rangle^* = \langle\phi|\phi^*\rangle$

8. _____ is also known as canonical matrix transformation.

(a) Matrix transformation

(b) Unitary transformation

(c) Linear transformation

(d) None of the above

9. _____ picture both state vector and the operators are time-dependent.

(a) Schrodinger (b) Heisenberg

(c) Interaction (d) Both (a) and (b)

10. In the Heisenberg picture _____ opertator does not change with time.

(a) Hamiltonian (b) Linear

(c) Projection (d) Identity

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Describe the conditions on allowed wave functions.

Or

(b) Discuss conservation of probability.

12. (a) Write note on classical uncertainty principle.

Or

(b) Discuss about Hermittan Operator.

13. (a) Derive the eigen values and eigen functions of particle in box.

Or

(b) Describe the Poschl – Teller Potentials.

14. (a) Deduce the matrix representation of wave functions.

Or

(b) Describe the properties of bra and ket vectors.

15. (a) Discuss about Heisenberg picture.

Or

(b) Deduce the time evaluation of density operator.

PART C — (5 × 8 = 40 marks)

Answer ALL questions by choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Explain in detail about a particle in one dimensional, infinitely deep potential well.

Or

(b) Derive the solution of time dependent Schrodinger equation.

17. (a) Explain in detail about Heisenberg uncertainty relation.

Or

(b) Explain in detail about Heisenberg gamma ray microscope.

18. (a) Derive the Schrodinger equation for quantum pendulum.

Or

(b) Discuss about rigid rotator with free axis.

19. (a) Derive an expression for represent the matrix form of Interaction Picture.

Or

(b) Explain in detail about dirac notation.

20. (a) Deduce the expression for Ischrodinger Picture.

Or

(b) Describe in detail about Interaction Picture with Schrodinger equation of motion.

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