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2020

PHE-11 : QUANTUM MECHANICS AND APPLICATION

F.M - 70

TIME - 3 hours

Answer from all the section as per instructions.

Section 1

Compulsory multiple choice questions $10 \times 2 = 20$

1. (a) The concept of matter wave was suggested by
(i) Heisenberg (ii) debroglie (iii) Schrodinger (iv) Laplace

Ans. (ii) debroglie

(b) The total probability of finding the particle in space must be
(i) zero (ii) unity (iii) Infinity (iv) double

Ans (ii) unity

(c) The limit of a region-II for a square well potential is
(i) $-\infty < x < 0$ (ii) $a < \infty < \infty$ (iii) $-a < x < a$
(iv) $-\infty < x < -a$

Ans. (iii) $-a < x < a$

(d) Any wavefunction having symmetry property is said to be ——— parity
(i) zero (ii) Even (iii) Odd (iv) Infinite

Ans. (ii) Even

(e) If A and B are canonically conjugate pair of operator then $[A, B]$ is
(i) $i\hbar/2$ (ii) $\vec{L}$ (iii) $\hbar$ (iv) $\vec{\nabla}$

Ans (iii) $\hbar$

(P.T.O) (1)

(f) The ground state energy for simple harmonic oscillator is

(i) $\hbar\omega$ (ii) $\frac{1}{2}\hbar\omega$ (iii) $\frac{3}{2}\hbar\omega$ (iv) $\frac{5}{2}\hbar\omega$

Ans. $\frac{1}{2}\hbar\omega$

(g) Time dependent Schrodinger equation in shorter form is given by $H\psi = ?$

(i) $E\psi^2$ (ii) E (iii) EH (iv) $E\psi$

Ans (iv) $E\psi$

(h) The set of eigen functions $(C_1\psi_1 + C_2\psi_2)$ forms a space is known as

(i) Configuration (ii) eigen (iii) phase (iv) Imaginary, ~~Imaginary~~

Ans: (ii) eigen

(i) If there exist only one eigenfunction ~~Corresponding~~ corresponding to a given eigen value, then the eigen value is called

(i) Nondegenerate (ii) degenerate (iii) discrete
(iv) Continuum.

Ans. degenerate

(j) The Square of the magnitude of the wave function is called

(i) Current density (ii) probability density
(iii) Zero density (iv) volume density

Ans. (ii) probability density

PART - B.

(Short answer Type Questions)

Answer any four in brief $4 \times 5 = 20$

2. Derive one dimensional Schrodinger equation for a free particle

(2)

(P.T.O)

3. What do you mean by $|\psi|^2$

4. Define Expectation value of position and Momentum.

5. Define stationary state of wave function

6. Derive Bohr's angular momentum quantisation condition for the Bohr atom from de Broglie relation.

7. The unnormalised wavefunction of a system is given by $xe^{-x^2/2}$. obtain the value of its normalisation constant.

8. Show that the average value of x for a simple harmonic oscillator in the nth quantum state is zero.

9. Show that $[x, p_x] = i\hbar$.

PART C

Long answer Type Questions

Answer any two questions $15 \times 2 = 30$

10. Discuss Heisenberg Uncertainty principle and show how it is introduced in the process of measurement.

11. State quantum mechanical postulates.

12. Discuss the motion of wavepacket and derive the expression of group velocity of wave packet

13. Set up Hamiltonian for Simple Harmonic Oscillator and draw the energy level diagram of simple harmonic Oscillator.
