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

Code No. : 20040 E **Sub. Code : CMPH 61**

B.Sc. (CBCS) DEGREE EXAMINATION, NOVEMBER 2025.

Sixth Semester

Physics — Core

QUANTUM MECHANICS

(For those who joined in July 2021 and 2022 only)

Time : Three hours Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. Wein's radiation law account for which region of black body spectrum

(a) long wavelength region

(b) middle region

(c) short wavelength region

(d) entire region

2. Momentum of photon of frequency 'γ' is _____

(a) zero (b) $h\gamma$

(c) $\frac{h\gamma}{c}$ (d) $\frac{c}{h\gamma}$

3. The wave propagation constant 'K' is _____

(a) $\frac{h}{\lambda}$ (b) $\frac{\lambda}{h}$

(c) $h\lambda$ (d) $\frac{2\pi}{\lambda}$

4. The De-Broglie wavelength is _____

(a) $\frac{p}{h}$ (b) $\frac{h}{p}$

(c) hp (d) $\frac{h}{2\pi}$

5. Which of the following is not Heisenberg uncertainty principle?

(a) $\Delta x\ \Delta p \geq \hbar$ (b) $\Delta E\ \Delta t \geq \hbar$

(c) $\Delta x\ \Delta p_y \geq \hbar$ (d) both (a) and (b)

6. The uncertainty on the position of a moving particle represented by a wave packet is equal to _____

(a) amplitude of the wave packet
(b) width of wave packet
(c) frequency of wave packet
(d) group velocity

7. The momentum eigen value is _____

(a) $p = \frac{\hbar}{k}$ (b) $p = \hbar k$

(c) $p = \frac{\hbar}{2k}$ (d) $p = 2k$

8. Quantum operator of angular momentum is _____

(a) $-i\hbar (r \times \nabla)$ (b) $i\hbar (r \times \nabla)$

(c) $i\hbar \nabla$ (d) $-i\hbar \nabla$

9. For a particle bound in one dimensional box, its energy is

(a) entirely potential (b) thermal
(c) entirely kinetic (d) very small

10. In a region of infinite potential, the wave junction _____

(a) becomes infinity (b) becomes real
(c) becomes complex (d) vanishes

PART B — (5 × 5 = 25 marks)

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

Each answer should not exceed 250 words.

11. (a) Explain Einstein's theory of photo electric effect.

Or

(b) Define photo electric effect and state the laws of photo electric effect.

12. (a) Derive the expression for the De-Broglie wavelength of a particle moving with velocity 'V'.

Or

(b) Define group velocity and phase velocity and hence find the relation between them.

13. (a) State and explain Heisenberg uncertainty principle.

Or

(b) Applying uncertainty principle, prove that electrons do not exist inside the nucleus of an atom.

14. (a) Write the postulates of quantum mechanics.

Or

(b) What are the properties of wave function?

15. (a) Obtain the normalised wave function for the motion of a particle in one dimensional box.

Or

(b) Calculate the permitted energy levels of an electron in a box of $1 \times 10^{-10} m$ wide.

PART C — ($5 \times 8 = 40$ marks)

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

Each answer should not exceed 600 words.

16. (a) State the postulates of Bohrs theory of hydrogen atom based on these postulates derive an expression for (i) radius of n^{th} orbit (ii) energy of electron in n^{th} orbit.

Or

(b) Explain the experiment to determine the energy distribution in the black body radiation spectrum.

17. (a) Explain the consequences of De-Broglie concept of matter waves.

Or

(b) Describe an experiment on electron diffraction.

18. (a) Discuss any four consequences of Heisenberg uncertainty principle.

Or

(b) Give an elementary proof of Heisenberg uncertainty principle connection (i) position and momentum and (ii) energy and time.

19. (a) Derive time dependent schrodinger wave equation on three dimension.

Or

(b) Define eigen function and eigen value and prove that the energy eigen values are real.

20. (a) Determine the energy levels of a linear harmonic oscillator.

Or

(b) Discuss the transmission of a particle across a potential barrier.
