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Reg. No. :

Code No. : 30307 E Sub. Code : AMPH 61

B.Sc. (CBCS) DEGREE EXAMINATION,
NOVEMBER 2024.

Sixth Semester

Physics — Core

QUANTUM MECHANICS

(For those who joined in July 2020 only)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. Black body radiation consists of wavelength from _____ to _____.
(a) $-\infty, \infty$ (b) $0, \infty$
(c) $-\infty, 0$ (d) none of these
2. Photoelectric current depends on _____ of the incident light.
(a) frequency (b) intensity
(c) nature (d) applied voltage

3. de Broglie wavelength of a particle is _____ its velocity.
(a) independent of
(b) directly proportional to
(c) inversely proportional to
(d) none of these
4. Group velocity is given by
(a) $d\omega/d\lambda$ (b) $d\lambda/d\omega$
(c) $dk/d\omega$ (d) $d\omega/dk$
5. Uncertainty principle was proposed by
(a) Einstein (b) Bohr
(c) Heisenberg (d) Schrodinger
6. Energy of electron in first Bohr orbit is
(a) 13.6 eV (b) -13.6 eV
(c) 0.529 eV (d) 1.36 eV
7. The schrodinger wave equation is
(a) partial differential equation
(b) algebraic equation
(c) simultaneous equation
(d) nonlinear equation

8. Two operators A and B is said to be commuting if

- (a) $A = B$ (b) $AB = BA$
(c) $AB < BA$ (d) $AB > BA$

9. Energy levels of a particle in a box

- (a) are equally spaced
(b) unequally spaced
(c) increases with principal quantum number is
(d) none of these

10. For a free particle ———— energy is zero.

- (a) vibrational (b) kinetic
(c) potential (d) rotational

MARKS — (5 × 5 = 25 marks)

Answer All questions choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) List out the postulates of classical mechanics.

Or

(b) Describe the combination principles.

12. (a) Calculate the momentum of x-ray photon of wavelength $0.5 \text{ \AA}$.

Or

(b) Write short notes on wave particle duality.

13. (a) State and explain the uncertainty relations between position and momentum.

Or

(b) The uncertainty in position of electron along x axis is 10^{-10} m . What is the uncertainty in momentum of electron along the same axis?

14. (a) What is wave function? Give its physical significance.

Or

(b) Show that eigen functions of Hermitian operators are orthogonal.

15. (a) Write the energy eigen values and eigen functions for the first three states of particle in a box.

Or

(b) What do you understand by the terms potential well and potential barrier?

PART C — ($5 \times 8 = 40$ marks)

Answer ALL questions, choosing either (a) or (b)
Each answer should not exceed 600 words.

16. (a) What are the main features of energy distribution over various wavelengths of black body radiation?

Or

- (b) Describe Einstein's theory of photoelectric effect.

17. (a) Obtain an expression for de Broglie wavelength of matter waves.

Or

- (b) Obtain expression for wave velocity and group velocity and also the relation between them.

18. (a) State and prove uncertainty relation between energy and time.

Or

- (b) Derive an expression for energy of electron in Bohr orbit of hydrogen atom on the basis of uncertainty principles.

19. (a) Obtain three - dimensional Schrodinger wave equation in time dependent form.

Or

- (b) Derive time independent Schrodinger wave equation.

20. (a) Solve the Schrodinger equation for a particle confined in a one-dimensional infinite potential well.

Or

- (b) Set up and solve the Schrodinger equation for linear harmonic oscillator.