FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2023

(CBCSS - UG)

(Regular/Supplementary/Improvement)

CC19U PHY5 B07 / CC20U PHY5 B07 - QUANTUM MECHANICS

(Physics - Core Course)

(2019 Admission onwards)

Time : 2.00 Hours   Maximum : 60 Marks

Credit : 3

Part A (Short answer questions)
Answer *all* questions. Each question carries 2 marks.

1. List the conditions for (i) constructive interference (ii) destructive interference.

2. How are X-rays produced?

3. Thomson's atom model is called plum pudding model. Why?

4. Write down the names of the spectral lines emitted by a hydrogen atom.

5. Give any two deficiencies of Bohr model.

6. What is the physical interpretation of group velocity?

7. Define probabilty amplitude and probability density.

8. Express Schrodinger equation in one, two, and three dimensions.

9. Write down the mathematical expressions for the expectation value of position and momentum in quantum mechanics.

10. Explain the tunneling effect.

11. Normalise the azimuthal wave function $\varphi = Ae^{im\varphi}$

12. What is meant by the space quantisation of spin angular momentum?

(Ceiling: 20 Marks)

Part B (Short essay questions - Paragraph)
Answer *all* questions. Each question carries 5 marks.

13. A photon is Compton scattered off a stationary electron through an angle of 45^0 and its final energy is half its initial energy. Calculate the value of the initial energy.

14. Derive equation for wavelength of radiation in emission spectra of hydrogen atom. What difference should be introduced when dealing with other atoms with a single electron?

15. Calculate the de broglie wavelength of (i) a rifle bullet of mass 2 g moving with a speed of 400m/s and (ii) a 2000kg car moving along the highway at 30ms^{-1}

16. Derive the uncertainty relation between frequency and time for a classical wave.

17. A particle with mass 9.11×10^{-31}Kg is trapped in a 1-Dimensional region of length 1 A^0. Find the energies of the ground state, first excited state and second excited state.

18. Compare the Classical and Quantum mechanical results of simple harmonic oscillator.

19. Explain the term space quantisation with suitable example?

(Ceiling: 30 Marks)

Part C (Essay questions)

Answer any *one* question. The question carries 10 marks.

20. What is meant by ultraviolet catastrophe? How did Max Planck solve the same?

21. Explain the steps of solving a Schrodinger equation. Solve the Schrodingers equation for a free particle and obtain energy eigenvalues.

(1 × 10 = 10 Marks)

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