23U509 (Pages: 2) Name: .....

Reg.No: .....

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2025

(CBCSS - UG)

(Regular/Supplementary/Improvement)

CC19UPHY5B07 / CC20UPHY5B07 - 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. What is Stefan's law?
2. How are X-rays produced?
3. Explain Thomsons model of atom.
4. What is distance of closest approach in Rutherford scattering?
5. What is the difference between excitation energy and ionization energy?
6. What is matter wave?What does it signify?
7. Explain the concept of randomness.
8. When does the energy of the particle become discrete? What is the nature of the energy of a quantum free particle?
9. What is degeneracy? Explain with an example.
10. Draw and mathematically define a finite one-dimensional potential barrier.
11. What is magnetic quantum number? What are its possible values?
12. Sketch the Zeeman effect splitting of an Electronic transition from l=2 to l=1 of the Hydrogen atom.

(Ceiling: 20 Marks)

Part B (Short essay questions - Paragraph)

Answer ***all*** questions. Each question carries 5 marks.

13. The cutoff wavelength for the photoelectric effect in a certain metal is 254 nm. (a) What is the work function for that metal? (b) Will the photoelectric effect be observed for $\lambda > 254$nm?
14. Demonstrate the correspondence principle by calculating frequency of emitted radiation emitted during electron transition.

15. Derive the uncertainty relation between position and wavelength for a classical wave.

16. The phase velocity of a wave is given by the expression $V_p = (10\lambda /2\pi)^{1/2}$. Find the group velocity of the corresponding wave packet.

17. A particle is restricted to move along the X-axis between x=0 and x=1. The wavefunction of the particle is $\Psi (x) = bx$. a) Find the normalisation constant b. b) Find the probability to find the particle between x = 0.5 and x = 0.6.

18. Normalise the wavefunction $\Psi(x)=A \exp(-kx^2)$ over the domain - ∞ to + ∞ where A and k are constants.

19. Write short note on intrinsic spin.

(Ceiling: 30 Marks)

Part C (Essay questions)

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

20. Obtain the Compton shift for a photon incident on a free electron.

21. Form the Schrodingers equation for a simple harmonic oscillator. Write down the expressions for energy eigen values and wavefunction.

(1 × 10 = 10 Marks)

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