FIFTH SEMESTER B.Sc. DEGREEE EXAMINATION, NOVEMBER 2021

(CUCBCSS-UG)

CC15U PH5 B07 - QUANTUM MECHANICS

(Physics – Core Course)

(2015 to 2018 Admissions - Supplementary/Improvement)

Time: Three Hours   Maximum: 80 Marks

Section A

Answer *all* question in a word or phrase. Each question carries 1 mark.

1. The maximum Compton shift possible is ………….

2. Write down the de-Broglie equation

3. Which spectral series of hydrogen falls in the visible region of the electromagnetic spectrum.

4. The principle of STM is based on ………….

5. For $l = 1$, What are the possible values of L_z.

Write true or False:

6. The phenomenon of photoelectric effect confirms the quantum nature of light.

7. When the uncertainty in the position measurement increases, the uncertainty in momentum measurement increases.

8. The energy required to knock out the electron in the innermost orbit is 13.6 eV.

9. The correspondence principle is enunciated by Heisenberg.

10. The ratio of magnetic moment to the orbital angular momentum is called gyromagnetic ratio.

(10 × 1 = 10 Marks)

Section B

Answer *all* questions in two or three sentences each. Each question carries 2 marks.

11. Explain Ultraviolet catastrophe.

12. Write down Einstein photoelectric equation. What are the terms involved?

13. What are de-Broglie waves? Give an expression?

14. Explain Bohr's correspondence principle.

15. Explain the significance of wave function.

16. What is meant by expectation value of an observable?

17. Illustrate Pauli's exclusion principle

(7 × 2 = 14 Marks)

Section C

Answer any *five* questions in a paragraph. Each question carries 4 marks.

18. Explain the pair production phenomenon. Is it possible for pair production to occur in free space?

19. Derive an expression for gravitational red shift?

20. Write a short note on Davisson-Germer experiment.

21. What is the effect on the wavelengths emitted by a hydrogen atom when nuclear motion is taken into account?

22. Write down the postulates of quantum mechanics.

23. What are eigen values, eigen functions and eigen value equations.

24. Explain Zeeman effect.

(5 × 4 = 20 Marks)

Section D
Answer any *four* questions. Each question carries 4 marks.

25. Light of wavelength 5000A ^{0} falls on a sensitive plate with photoelectric work function 1.9 eV. Find (i) energy of the photon (ii) kinetic energy of photoelectrons emitted and (iii) stopping potential.

26. Estimate the de Broglie wavelength of an electron which is accelerated through a potential difference of 100V.

27. An electron has a speed of 500m/s with accuracy of 0.004%. Calculate the certainty with which we can locate the position of the electron.

28. Calculate the excitation energy for n= 3 of He $^+$ atom.

29. Calculate the expectation value of position of a particle in one dimensional box of length L.

30. Electron with energy 1 eV is incident on a barrier of height 10 eV ad width 0.5 nm. Find the transmission probability.

31. Find the percentage difference between L and maximum value of Lz for an atomic electron in p, d and f states.

(4 × 4 = 16 Marks)

Section E
Answer any *two* questions. Each question carries 10 marks.

32. What is the importance of Compton effect? Obtain an expression for the change in wavelength of a Compton scattered electron?

33. Explain the Bohr postulates of the atomic structure. Derive the expression for Bohr orbit and total energy of the Hydrogen atom.

34. Develop time dependent Schrodinger equation.

35. Write down the Schrodinger equation for hydrogen atom in spherical polar coordinates and separate the variables.

(2 × 10 = 20 Marks)

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