K23U 2374

V Semester B.Sc. Degree (CBCSS – OBE – Regular/Supplementary/ Improvement) Examination, November 2023
(2019 – 2021 Admissions)
CORE COURSE IN PHYSICS
5B06 PHY : Quantum Mechanics

Time : 3 Hours

Max. Marks : 40

PART – A

(Short answer questions. Answer **all** questions. **Each** carries **1** mark.)   (6×1=6)

1. What is pair production ?

2. Discuss the Bohr's correspondence principle.

3. Write down the energy-time uncertainty principle and explain the terms involved.

4. What does the amplitude of the de Broglie wave represent ?

5. Explain the term degeneracy of eigen states.

6. What is Pauli's exclusion principle ?

PART – B

(Short essay questions. Answer **any 6** questions. **Each** carries **2** marks.) (6×2=12)

7. Draw the spectrum of a blackbody for two different temperatures. Explain Wien's displacement law.

8. Using a suitable schematic, explain the Bragg's law.

9. Discuss the assumptions of Thomson's model. Explain the failures of this model.

10. What do you mean by a wavepacket ? Explain the terms phase and group velocities.

11. Discuss the schematic and the results of the Davisson-Germer experiment.

12. Explain the concept of normalizing a wave function.

13. Using a suitable figure, explain qualitatively the phenomenon of quantum mechanical tunneling.

14. Explain normal Zeeman effect.

PART – C

(Problems. Answer **any 4** questions. **Each** carries **3** marks.)   **(4×3=12)**

15. X-rays of wavelength 0.24 nm are Compton-scattered and the scattered beam is observed at an angle 60 degree relative to the incident beam. Determine (a) the wavelength of the scattered X-rays and (b) energy of the scattered X-rays.

16. Calculate the two longest wavelengths of the Balmer series of triply ionized beryllium (Z = 4).

17. Calculate the de Broglie wavelength of an electron having a kinetic energy 1000 eV.

18. A particle is confined to a box of width 40Å. Determine the probability that the particle is found in an interval of 4Å at the centre of the box. Assume that the particle is in its lowest energy state.

19. What are the possible z components of the angular momentum vector L which represents the orbital angular momentum of a state with orbital angular momentum quantum number $l = 2$? What is the length of the angular momentum vector ?

20. What are the possible values of the total angular momentum quantum number under LS coupling of two atomic electrons whose orbital quantum numbers are $l_1 = 1$ and $l_2 = 2$?

PART – D

(Long essay. Answer **any 2** questions. **Each** carries **5** marks.)   **(2×5=10)**

21. List the experimental results of photoelectric effect. Give Einstein's explanations for the same.

22. Explain Franck-Hertz experiment. Discuss the result of the experiment.

23. Setup the time-independent Schrödinger equation for a particle moving in a potential in one dimension.

24. Explain the fine structure splitting in hydrogen.