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D5BPH2002 (PAGES 2) **Reg.No.....**

Name: .....

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2022

(Regular/Improvement/Supplementary)

PHYSICS

GPHY5B07T: QUANTUM MECHANICS

Time: 2 Hours **Maximum Marks: 60**

SECTION A: Answer the following questions. Each carries 2 marks.

(Ceiling 20 Marks)

1. Show graphically the variation of intensity of spectral line distribution with frequency for a black body.
2. Draw a graph showing the variation of photoelectric current with frequency and intensity of incident radiation.
3. Write down Heisenberg's uncertainty principle.
4. Write down the names of spectral lines emitted by hydrogen atom.
5. What was the conclusion of Frank-Hertz experiment?
6. What is meant by expectation value of a dynamical variable?
7. Write down the Schrodinger equation for a free particle and explain its solution.
8. Distinguish between free and confined particle.
9. What is zero point energy?
10. What is potential energy step penetration?
11. Write dimensional formula for spin. Explain spin of an electron.
12. Can a hydrogen atom in its ground state absorb a photon (of the proper energy) and end up in the $3d$ state?

SECTION B: Answer the following questions. Each carries 5 marks.

(Ceiling 30 Marks)

13. In an experiment on Compton scattering the incident radiation has wavelength 2 A^0. The wavelength of radiation scattered through 180^0 is 2.048 A^0. Calculate
    (i) the wavelength of scattered radiation if they are viewed at an angle of 60^0 to the direction of incidence
    (ii) the energy of recoil electron which scatters radiation through 60^0.
14. Write and explain postulates of Quantum mechanics.
15. Normalize the wave function $\Psi = A\,cosx$ for $0<x<\pi/2$.
16. The wave function of a particle confined to a one-dimensional box of length L with rigid walls is given by $\psi_n(x) = \sqrt{\frac{2}{L}}\sin\left(\frac{n\pi x}{L}\right)$; $n = 1,2,3$ ... ...Determine the energy eigen values.

(PTO)

17. Find the expectation value $< x^2 >$ of the position of the particle trapped in a box of L wide.

18. A particle moving in one-dimensional potential is given by:

$$U(x) = 0 \quad x < 0$$

$$U(x) = U_0 \quad x \geq 0$$

Let E be the energy of particle and)$E > U_0$. Write down the Schrodinger equation for the particle and its solutions.

19. A sample of a certain element is placed in a 0.2 T magnetic field and suitably excited. How far apart are the Zeeman components of 450 nm spectral lines of the element?

SECTION C: Answer any 1 question. Each carries 10 marks.

20. Discuss Bohr atomic model and its limitations.

21. Discuss the non-classical behavior of quantum harmonic oscillator.

(1 x 10 = 10 Marks)