Avinashilingam Institute for Home Science and Higher Education for Women
(Deemed to be University under Category 'A' by MHRD, Estd. u/s 3 of UGC Act 1956)
Re-accredited with A++ Grade by NAAC. Recognised by UGC Under Section 12B
Coimbatore - 641 043, Tamil Nadu, India

Continuous Internal Assessment – II (October 2025)
V Semester

Class: III B.Sc., **Duration: 2 hours**
Major: Physics **Max. Marks: 60 Marks**

23BPHC09 – Quantum Mechanics and Applications

Course Outcome:
1. Understand the quantum theory formulation through Schrodinger equation.
2. Understanding the behavior of quantum particle encountering a barrier potential
3. Applications of Schrodinger equation to hydrogen atom
4. Learn the concept of electric and magnetic fields on atoms and understand the Stark effect and Zeeman Effect respectively.
5. Understand the basic concepts of quantum many body problems

Part A **6x1 =6 Marks**

Answer all questions

1. Potential energy of 1D simple harmonic oscillator CO2K1
   a. $\frac{m\omega^2x^2}{2}$ b. $\frac{m\omega^2x^2}{4}$ c. $\frac{\omega^2x^2}{4}$ d. $m\omega^2x^2$
2. In 1D linear Harmonic oscillator separation between two adjacent energy level is CO2K2
   a. $\frac{\hbar\omega}{2}$ b. $\hbar\omega$ c. $2\hbar\omega$ d. $\frac{\hbar\omega}{4}$
3. Ground state energy of a hydrogen atom is CO3K2
   a. -13.6 eV b. 13.6 eV c. -3.4 eV d. ∞
4. $P_0^0(\cos\theta) =$ CO3K2
   a. 1 b. 0 c. $\sin\theta$ d. $\cos\theta$
5. According to Pauli's exclusion principle, how many electrons can occupy an orbital? CO5K1
   a. 1 b. 2 c. 3 d. 4
6. The total number of allowed values for the total magnetic quantum number for a given J are ____ CO5K1
   a. J b. 2J c. 2J-1 d. 2J+1

Part B **3 x 6 = 18 Marks**

Answer ALL questions

Each answer should not exceed 400 words or two pages

7a. Describe zero point energy CO2K3

OR

7b. Compare classical and quantum probability of linear harmonic oscillator CO2 K2

8a. Obtain Schrodinger equation in spherical polar coordinates CO3K3

OR

8b. How the Legendre functions are useful in the case of hydrogen atom to obtain solution of wave equation CO3 K1

9a. Explain optical spectral rule and explain fine structure of the sodium D-line CO5K1

OR

9b. Write a note on spin orbit coupling CO5K2

Part C **3 x 12 = 36 Marks**

Answer ALL questions

Each answer should not exceed 800 words or two pages

10a. Obtain wave equation for the simple harmonic oscillator CO2K2

OR

10b. Obtain energy eigen function of 1D SHO using Frobenius method CO2K2

11a. Obtain the solution of the azimuthal wave equation for the hydrogen atom. CO3K3

OR

11b. Derive radial wave equation and the total wave function of the hydrogen atom and its allowed energy levels CO3K4.

12 a. Describe the vector model of the atom and explain the different quantum numbers associated with it.

OR CO5K2

12 b. Explain Pauli's exclusion principle as applied to electrons in atoms. Describe how this principle assists in the interpretation of the periodic system of the elements CO5K2

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No.of Copies: 16 **Staff in-Charge: Dr.V.Sasirekha, & Ms.V.Bhuvaneswari**