

- N.B. (1) Figures to the right indicate full marks.
(2) All questions are compulsory.
(3) Neat diagrams should be drawn wherever necessary.
(4) Use of non-programmable calculators /log tables is allowed.
(5) Symbols have their usual meaning unless otherwise stated.

- Q.1 Attempt **any TWO**:
- i) Write down steady state Schrodinger equation for 1-D harmonic oscillator. Solve it by operator method. 10
 - ii) Set up the steady state Schrodinger's equation for H atom in spherical polar coordinates. Solve it by the method of separation of variables. Explain how magnetic quantum number m_l arises in solving φ equation. 10
 - iii) Discuss the Stern-Gerlach experiment to demonstrate space quantization of electron spin. 10
- Q.2 Attempt **any TWO**:
- i) What is normal Zeeman effect? Give the quantum mechanical mathematical theory of the normal Zeeman effect. 10
 - ii) State Frank-Condon principle. Discuss the electronic spectra of a diatomic molecule with the help of suitable diagrams. 10
 - iii) What is Paschen Back effect? Give mathematical theory. 10
- Q.3 Attempt **any TWO**:
- i) Discuss Rutherford's alpha scattering experiment to determine nuclear radius. 10
 - ii) Explain the nature of beta ray spectrum. Discuss the energetics of beta decay and electron capture. 10
 - iii) What is Mossbauer effect? Describe Mossbauer's experimental arrangement. 10
- Q.4 Attempt **any TWO**:
- i) Derive Weizsaeker semi empirical formula for binding energy of atomic nucleus of atomic number Z and atomic mass A. 10
 - ii) Explain construction and working of GM counter. 10
 - iii) Describe neutron cycle in thermal nuclear reactor and also derive four factor formula. 10

- Q.5 a) Attempt **any FOUR**:
- i) What is zero point energy? Find zero point energy in electron-volt of an oscillator having period of 0.001 second. 5
 - ii) Describe space quantization of electron spin. 5
 - iii) What is Raman effect? Give energy level diagram explaining origin of stokes and anti-stokes lines. 5
 - iv) Explain ionisation by alpha particles. An alpha particle is stopped in an ionisation chamber in which it produces 2×10^5 ion pairs. Production of one ion pair results in the alpha particle losing 35 eV of energy. Calculate the kinetic energy of alpha particle in MeV. 5
 - v) ^{232}Th decays from ground state emitting four groups of alpha particles with energies 6.33, 6.22, 6.10 and 6.03 MeV. Draw a diagram showing energy levels of daughter nucleus. 5
 - vi) What is Breedor reactor? State it's advantages 5
