SG – 263

VI Semester B.Sc. Examination, September/October 2021
(CBCS – Fresh + Repeaters – 2018 – 19 and Onwards)
PHYSICS – VII
Atomic, Molecular and Nuclear Physics

Time : 3 Hours Max. Marks : 70

Instructions : 1) *Answer* ***any five*** *questions from* ***each*** *Part.*
2) *Use of non-programmable scientific calculator are allowed.*

PART – A

Answer **any five** of the following questions. **Each** question carries **eight** marks. **(5×8=40)**

1. a) State and explain Pauli's exclusion principle.
   b) Obtain an expression for the maximum number of electrons in a shell. **(3+5)**

2. a) What are the two main features of the vector atom model ?
   b) Derive an expression for the Bohr magneton. **(2+6)**

3. a) What is anomalous Zeeman effect ?
   b) Explain the phenomenon of anomalous Zeeman effect on the basis of quantum theory and derive an expression for change in energy. **(2+6)**

4. a) State any two assumptions of Rutherford's alpha particle scattering experiment.
   b) Derive the relation between the impact parameter and angle of scattering in Rutherford's alpha particle scattering experiment. **(2+6)**

5. a) What is beta decay ?
   b) Explain the different types of beta decay with an example for each type. **(2+6)**

6. Describe the construction and working of a Geiger-Muller counter and explain the features of its characteristic curves. **8**

7. Derive an expression for the Q value of a nuclear reaction using Energy-Momentum conservation. **8**

P.T.O.

8. a) State any two properties of Quarks.

   b) Describe the four types of fundamental reactions. **(2+6)**

PART – B

Solve **any five** of the following problems. **Each** problem carries **four** marks. **(5×4=20)**

9. Find the wavelength of light emitted when a hydrogen atom undergoes transition from 5^{th} orbit to 2^{nd} orbit. Assume the ionisation potential for Hydrogen to be 13.6eV. Given e = 1.6×10^{-19} C and c = 3×10^{8} m/s.

10. Determine the value of rotational constant for HF molecule. Given the moment of inertia of the molecule is 1.38×10^{-47} Kgm^2.
    Assume h = 6.625×10^{-34} Js and
    c = 3×10^{8} m/s.

11. With an exciting radiation of wavelength 435.8 nm, a substance should Raman line of a wavelength of 462.4 nm. Calculate the frequency of the corresponding anti stokes line.

12. One gram of a radioactive substance takes 50 seconds to lose one centigram. Find the half-life period of the substance.

13. Neptunium $_{93}Np^{237}$ emits alpha particles of energy 4.19 MeV. Calculate the alpha disintegration energy.

14. Deutrons in a cyclotron describe a circle of radius 0.6 m before emerging from "dees". The oscillator frequency is 15MHz. Find the flux density of the magnetic field and the energy acquired by the deutrons.
    Given $m_d = 3.349 \times 10^{-27}$ Kg
    e = 1.6×10^{-19} C

15. Calculate the threshold energy required to initiate the reaction P^{31} (n.p)Si^{31}.
    Given
    Mass of proton = 1.00814 u
    Mass of neutron = 1.00898 u
    Mass of phosphorus = 30.93856 u
    Mass of Silicon = 30.98515 u

16. When target Lithium $\left(_3Li^7\right)$ of thickness 0.028 mm is bombarded with a beam of intensity 10^{15} protons/sec, 10^{9} neutrons are produced. Calculate the cross-section of the reaction. Given density of Lithium = $500kg/m^3$.

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10)**

17. a) Alkali metals have Hydrogen like spectra. Justify.

    b) Can principal quantum number be zero ? Explain.

    c) Are energy levels in pure rotational spectra equally spaced ? Explain.

    d) Why is that only α- particles are emitted by radioactive nuclei while protons and neutrons are not ? Explain.

    e) In Betatron, do electrons move in a fixed orbit of constant radius ? Explain.

    f) What is the significance of the negative sign of Q value of a nuclear reaction ? Explain.

    g) Does conservation of parity hold good in (i) strong interactions and (ii) weak interactions ?

    h) Is photon an elementary particle ? Explain.