15. When target lithium ($_3Li^7$) of thickness 0.01 mm is bombarded with a beam of intensity.

10^{13} protons per second. As a result 10^8 neutrons are produced calculate the cross-section of the reaction in barn. Given density of lithium = 500 kg m^{-3}. $m_p = 1.66 \times 10^{-27}$ kg.

16. Verify whether the following reaction are allowed or forbidden.

$P + P \rightarrow n + P + \Pi^+$ using conservation laws.

PART – C

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

17. a) Does Bohr Magneton have any physical significance ? Explain.
    b) Are doublets observed in alkali spectra ? Explain.
    c) Are rotational spectra observed in the microwave region ? Explain.
    d) Are most energetic α-emitters long lived ? Explain.
    e) Is quenching necessary in a GM counter ? Explain.
    f) Vacuum chamber in Betatron is coated with silver ? Comment.
    g) Does conservation of linear momentum in nuclear scattering imply conservation of kinetic energy ? Explain.
    h) Is photon an elementary particle ? Explain.

SE – 152

VI Semester B.Sc. Examination, September 2020
(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) Explain the concept of spinning electron.
   b) Write a brief note on spectral terms and their notations. **(3+5)**

2. a) Describe with relevant theory Stern-Gerlach experiment. Give its significance.
   b) Distinguish between normal and anomalous Zeeman effect. **(6+2)**

3. a) What are Molecular spectra ? Obtain an expression for energies of vibrational levels and show that they are equally spaced.
   b) Distinguish between Rayleigh scattering and Raman scattering. **(6+2)**

4. a) State any two assumptions of Rutherford's theory of α-particle scattering.
   b) Give the theory of successive disintegration of a radioactive substance and hence discuss the transient equilibrium. **(2+6)**

5. a) What is range of an alpha-particle ? Write the relation between the range and energy of α-particles.
   b) Explain the different types of beta-decay with an example for each. **(2+6)**

6. a) What is proportional counter ?
   b) Describe the working of a linear accelerator with a neat diagram and necessary theory. **(1+7)**

P.T.O.

7. a) Derive an expression for Q-value of nuclear reactions using the energy-momentum conservation.
   b) Distinguish between direct nuclear reactions and compound nuclear reactions. **(6+2)**

8. a) Write a brief note on exact conservation laws obeyed by elementary particles.
   b) Give any two properties of quarks. **(6+2)**

PART – B

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

9. Obtain $\vec{L} \cdot \vec{S}$ interms of L, S and J. Find the possible values of $\vec{L} \cdot \vec{S}$ for L = 1 and S = ½.

10. Calculate the frequencies of the adjacent lines in normal Zeeman effect, if the frequency of the central line is 4.30×10^{14} H_2 and the magnetic field applied is 5T. Given e/m = 1.76×10^{11} C kg^{-1} and c = 3×10^8 ms^{-1}.

11. In an experimental study of Raman effect using mercury green radiation of 546.1 nm, a stokes line of wavelength 554.6 nm was observed. Find Raman shift and wavelength corresponding to anti-stokes line. Given c = 3×10^8 ms^{-1}.

12. Calculate the distance of closet approach to a gold nucleus (Z = 79) of an α-particle of kinetic energy 7.8 meV and also find the impact parameter to produce scattering angles $\geq 90^\circ$. Given $\in_0 = 8.85 \times 10^{-12}$ Fm^{-1} and e = 1.6×10^{-19} C.

13. Calculate the α–particle potential barrier in MeV for $_{92}U^{238}$ nucleus. Given $R_0 = 1.2 \times 10^{-15}$ m $\in_0 = 8.85 \times 10^{-12}$ Fm^{-1} and e = 1.6×10^{-19} C.

14. Find the amount of energy in joules released during the process in which 0.001 kg of radium is converted into lead in the following reaction.
   $Ra^{226} \rightarrow Pb^{206} + 5\ He^4$
   Given masses Ra^{226} = 226.0955 amu
   Pb^{206} = 206.0386 amu
   and α-particle = 4.003 amu.