JAX-CT-9 Seat No. _____

M. Sc. (Sem. III) (CBCS) Examination

December – 2019

Physics : CT - 09

(Nuclear & Particle Physics)

Time : $2\frac{1}{2}$ Hours] [Total Marks : **70**

Instructions :

1. Attempt all questions.
2. All questions carry equal marks.

1 Answer in brief any seven : **14**

1. Define the term: Nucleon
2. Calculate the separation energy of $^{2^{\circ}7}$Pb nuclide. [M(^{207}Pb) = 206.9759 u, M(^{206}Pb) = 205.9744 u and M_n =1.008665 u]
3. Write the three different β decay processes.
4. Write the essential assumptions of Liquid Drop Model.
5. Write the conditions for spontaneous emission of β^- and β^+ decay.
6. What are the different mechanisms that take place when γ radiations interact with matter?
7. Mention two main features of linear attenuation coefficient. What is its unit?
8. Define: Endothermic reaction and exothermic reaction.
9. Why particle physics is called high energy physics?
10. In which groups the elementary particles can be classified ?

2 Answer the following questions : any two out of three **14**

1. List the various properties of nuclides. Discuss time independent nuclear properties in detail.
2. Explain the abundance systematic of stable nuclides in detail.
3. What is nuclear binding energy ? Define it. Calculate the total and average binding energy of ^{4}He nuclide. [M_H = 1.007825 u, M_n = 1.008665 u, M(^{4}He) = 4.002606 u].

3 Answer the following questions : (all are compulsory) 14

(a) Discuss the various terms in semi empirical mass formula. Write the equation of a mass parabola.

(b) Discuss the spin orbit coupling model in detail. Find the nuclear spin and parity for the ^{15}N, ^{15}O, ^{13}C and ^{27}Si nuclides.

OR

3 Answer the following questions : (all are compulsory) 14

(a) Discuss the Compton Effect in detail when γ radiation interacts with matter.

(b) Discuss the interaction of charged particle with matter and derive an equation of Kinetic energy lost by the heavy particle per unit path.

4 Answer the following questions : Any TWO out of THREE : 14

1. A reaction between $\left(\pi^{-}\right)$ and (p) is given as $\pi^{-} + p \rightarrow n + \pi^{\circ}$,

   Given $M(\pi^{-} + p) = 1077.85$ MeV and $M(n + \pi^{\circ}) = 1074.53$ MeV. Show that the reaction falls under the category of strong interaction.
2. By considering the nuclear reaction in a lab system, derive the Q equation of a nuclear reaction with its special case.
3. With necessary examples, show that strangeness is conserved in strong and electromagnetic interaction but not in weak interaction.

5 Write any **two** short notes : 14

1. Neutrino hypothesis
2. Conservation of baryon number
3. Cross section for a nuclear reaction
4. Internal conversion.
