HDU-CT9

Seat No. _____

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

November / December – 2017

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: Unified mass unit.

(2) Define: Average binding energy of a nuclear particle.

(3) Calculate the Coulomb energy constant in MeV ($e = 4.8 \times 10^{-10}$ esu, $R_0 = 1.2$ fm)

(4) Write the condition for spontaneous emission of β^- decay.

(5) The decay constant of a β source is 0.001 sec^{-1}. Find its half life time.

(6) List the fissile nuclides.

(7) Complete the following decay mode.
$_2He^6 \rightarrow {}_3Li^6 + \ldots\ldots\ldots + \bar{\nu}$.

(8) What do you mean by transfer nuclear reaction? Give one example.

(9) What do you mean by fermions and bosons?

(10) Why the process $p \rightarrow e^+ + \gamma$ has never been observed to occur?

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

(1) Make a list of basic nuclear properties. Discuss time dependent nuclear properties in detail.

(2) Discuss the isotopes, isobars and isotones with at least two examples of each.

(3) What is nuclear binding energy? Define it. Calculate the total and average binding energy of ^{12}C nuclide

[$M_H = 1.007825$ u, $M_n = 1.008665$ u, $M(^{12}C) = 12.000000$ u].

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

(a) Write the essential assumptions of a liquid drop model. Derive the Von-Weizsacker's semi-empirical mass formula.

(b) Discuss the spin-orbit coupling model in detail. Find the nuclear spin and parity for the following nuclides. ^{1}H, ^{11}C, ^{12}C, ^{4}He.

OR

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

(a) Discuss a nuclear reaction in lab system with necessary figure and derive nuclear reaction Q equation. Mention its special case.

(b) Discuss in detail: Elementary particle quantum numbers.

4 Answer the following questions : (any two out of three) **14**

(1) Discuss neutrino hypothesis.

(2) Derive the conditions for spontaneous emission of β^- and β^+ decay.

(3) Discuss Compton Effect, when gamma radiations interact with matter.

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

(1) Fermi's theory of β decay.

(2) Critical energy for nuclear fission.

(3) Internal conversion process.

(4) Symmetry and conservation laws.