Bago University
Department of Physics
Second Semester Examination, September 2019

Third Year (BSc)
(Physics Specialization)

Phys 3104
Nuclear Physics
Time Allowed: (3) Hours

Answer any Six questions.

1 (a) What is the Q-value of a nuclear reaction and explain its significance? Give one example each of (α, n), (p, α) and (d, α).

(b) ^{12}C (d, α) ^{10}B has a Q-value of -1.35 MeV. (i) What is the minimum energy of the deuterons required for this reaction? (ii) If the deuterium gas is bombarded with ^{12}C nuclei, find the minimum energy of ^{12}C required for the reaction.

2 (a) What is meant by nuclear reaction? What are the conservation laws to occur a nuclear reaction and explain any two?

(b) Find the threshold energy for the reaction $_7N^{14}$ (n, α) $_5B^{11}$.
M(^{11}B) =11.009305u, M(^{14}Na) = 14.003074u, M (^4He) = 4.002604u

3 (a) What are the particle accelerator, the linear accelerator and the cyclic accelerator?

(b) In a linear accelerator, proton accelerated thrice by a potential of 40kV leaves a tube and enters an accelerating space of length 30 cm before entering the next tube. Calculate the frequency of the r.f voltage and the length of the tube entered by the proton.

4 (a) Describe the construction and action of a cyclotron.

(b) Deuterons in a cyclotron describe a circle of radius 0.32m just before emerging from the dees. The frequency of the applied e.m.f is 10 MHz. Find the flux density of the magnetic field and the velocity of deuterons emerging out of the cyclotron.

5 (a) Name the four kinds of interactions between elementary particles. State what particles are affected and what particles are exchanged in each interaction.

(b) When an antiproton of energy 72MeV comes to rest in a nuclear emulsion, it is annihilated by a proton to form two pairs of positive and negative pions and a neutral pion. Calculate the average K.E. of each pion, assuming they all have the same energy.
(rest energy for each p^+ & p^- is 938.3MeV, rest energy for each π^+ & π^- is 139.6MeV, rest energy for π^0 is 135MeV)

6 (a) Discuss quark model, colored quarks and gluons of elementary particle.

(b) Using the law of conservation of lepton numbers, find which of the following reactions is possible: (i) $p + \bar{\nu}_e \rightarrow n + \mu^+$ (ii) $p + \bar{\nu}_e \rightarrow n + e^+$

7 (a) Write a short count for gamma radiation and neutron particle with material.

(b) A particle is given and X ray exposure X of 5.16×10^{-5} coulombs per kg. Convert this exposure into roentgens (R), given that $1R = 2.58\times10^{-4}$ coulombs per kg.

8 (a) How do you protect alpha, beta and gamma radiation?

(b) A 2.0mCi source of Au-198 is permanently implanted into a patient. Determine the emitted radiation (1 day= 8.64×10^4s, $T_{1/2}$=2.69d).