NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES

DEPARTMENT OF PURE AND APPLIED SCIENCE

SEPTEMBER 2020_1 EXAMINATION

COURSE CODE: PHY 456
COURSE TITLE: NUCLEAR REACTOR PHYSICS
CREDIT UNIT: 3
TIME ALLOWED: (2½ HRS)

INSTRUCTION: *Answer question 1 and any other four questions*

QUESTION 1

a. List and explain six different ways by which neutron can interact with nuclei of an atom.

(9 marks)

b. Discuss the continuity equation. **(4 marks)**

c. What is meant by a reactor poison? **(3 mark**s)
d. Consider the nuclear reaction below:
$n + \ ^{16}_{8}O \rightarrow X + \ ^{2}_{1}H.$ What is X? **(3 marks)**
e. Define the Thermal utilization factor in a nuclear reactor. **(3 marks)**

QUESTION 2
a. What is a Cross Section in nuclear physics? **(6 marks)**
b. Show that macroscopic collision density F is given by $F = I \sum t$ **(6 marks)**

QUESTION 3
a. Define neutron moderation, and list two examples of good moderators. **(6 marks)**

b. With the aid of a suitable diagram, explain two frames of reference considered for neutron thermalization. **(6 marks)**

QUESTION 4

a. List two types of frames of references considered for neutron moderation.　　**(6 marks)**

b. Show that fractional energy, $\dfrac{E_1}{E_0} = \dfrac{[1+A^2+2ACos\theta]}{[1+A]^2}$　　**(6 marks)**

QUESTION 5

a. What happens to fractional energy during neutron moderation when there is:
- (i) glancing of collision　　**(3 marks)**
- (ii) head on collision　　**(3 marks)**

b. Consider Rutherford's reaction $^4_2He + ^{14}_7N \rightarrow ^{17}_8O + ^1_1H$, calculate the $Q\ value$.

　　(3 marks)

Suppose $\alpha\ (^4_2He)$ has K.E. = 7.68Mev, find the total kinetic energy of the products.

　　(3 marks)

$^4_2He = 4.002603u,\ ^{14}_7N = 14.003074u,\ ^{17}_8O = 16.99913u,\ ^1_1H = 1.007825u$

QUESTION 6

a. State Fick's law.　　**(3 marks)**

b. Write the boundary conditions upon which the Fick's law is not valid.　　**(3 marks)**

c. State the diffusion equation and explain what each term stands for in the equation. **(6 marks)**