



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

DEPARTMENT OF PURE AND APPLIED SCIENCE

POP 2021_2 EXAMINATIONS

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 marks)
- d. Consider the nuclear reaction below:
 $n + {}^{16}_8\text{O} \rightarrow X + {}^2_1\text{H}$. 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, $\frac{E_1}{E_0} = \frac{[1+A^2+2ACos\theta]}{[1+A]^2}$ (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 ${}^4_2\text{He} + {}^{14}_7\text{N} \rightarrow {}^{17}_8\text{O} + {}^1_1\text{H}$, calculate the Q value.

(3 marks)

Suppose α (${}^4_2\text{He}$) has K.E. = 7.68 Mev, find the total kinetic energy of the products.

(3 marks)

$${}^4_2\text{He} = 4.002603u, {}^{14}_7\text{N} = 14.003074u, {}^{17}_8\text{O} = 16.99913u, {}^1_1\text{H} = 1.007825u$$

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)