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

DEPARTMENT OF PURE AND APPLIED SCIENCE

2020_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) Define nuclear cross section **(2 marks)**

(b) Define atom density and give its mathematical representation **(3 marks)**

(c)A block of aluminium has a density of 2.699 g/cm^3. If the gram atomic weight of aluminium is 26.9815 g, calculate the atom density of the aluminium **(3 marks)**.

(d) Define mean free path for a neutron and State the relationship between the mean free path λ of neutron and the macroscopic cross section **(4 marks)**

(e) Define average log energy decrement **(3 marks)**

(f) Define Slowing down power **(2 marks)**

(g) Mention three parameters that determine the effectiveness of a neutron moderating material **(3 marks)**.

(h) Define a nuclear reactor **(2 marks)**.

QUESTION 2

(a) List six ways by which neutrons may interact with nuclei. **(6 marks)**

(b) Briefly discuss any two. **(6 marks)**

QUESTION 3

(a)(i) Mention two ways through which to sustain chair reaction. **(2 marks)**
(ii) What are the factors that govern the probability of a neutron interacting with a nucleus for a particular reaction? **(4 marks)**

(b). Write a short note on thermalization and give two examples of good moderators **(6 marks)**.

QUESTION 4

(a) (i) Mention two ways by which a neutron interact with an atom of the material it enters.

(2 marks)

(ii) Write short note on the microscopic cross section of a nucleus for a particular reaction

(5 marks)

(b). Calculate the energy liberated when a helium nucleus is formed by the fusion of two deuterium nuclei. (mass of $_1H^2$ is 2.01478u, mass of $_2He^4$ is 4.00388u. 1u = 931 MeV)

(5 marks).

QUESTION 5

(a). Differentiate between macroscopic and microscopic cross sections. State the relationship between them **(5 marks)**

(b). How many collisions are required to slow a neutron from an energy of 2 MeV to a thermal energy of 0.025 eV, using water as the moderator? Average logarithmic energy decrement of water is 0.948. **(4 marks)**

(c). Calculate how far a neutron will go through a scattering material like water (H_2O) in the thermal energy range before it is absorbed. (Thermal diffusion length of water = 2.85 cm)

(3 marks)

QUESTION 6

Briefly discuss the two frames of reference that are usually common in the study of the dynamics of neutrons. **(12 marks)**