Nuclear Engineering 150 – Discussion Section
Team Exercises #2

Problem 1

Compute the atomic densities of ^{235}U, ^{238}U, and O in UO_2 when its density is 10.41 g/cm^3 and the uranium is enriched to 5 wt% in ^{235}U.

Problem 2

Free neutrons undergo β^- decay with a half-life of 10.4 minutes. Determine the probability that a neutron will decay before being absorbed in an infinite absorbing material (assume no scattering). Estimate this probability for a thermal neutron ($v = 2200$ m/s) in water.

Problem 3

A reactor is operating for a long time at some known power density P_0. Then, it instantaneously changes power to some power density P_1. One fission product of interest is ^{135}Xe, though it has a neglible yield from the initial fission reaction. ^{135}Xe precursors ^{135}Te and ^{135}I are produced with a combined yield of approximately 6%, before decaying via β^- decay to ^{135}I and ^{135}Xe respectively. Find the number density of ^{135}Xe as a function of time after the power change. (Your solution may be left as variables)

Nucleus	Half-life	Thermal σ_a
^{135}Te	19.0 s	~ 0
^{135}I	6.6 hr	~ 0
^{135}Xe	9.2 hr	2.6×10^6 barns

Problem 4

Given UO_2 with 2.5×10^{21} atoms/cm^3 of ^{235}U and 2.0×10^{22} atoms/cm^3 of ^{238}U, find the partial densities of ^{235}U, ^{238}U, and O, and determine the enrichment.