CHE 5834/6834 Nuclear Engineering

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Assignment #2

Question 4 (Includes Coding Component)

Coding Portion

(a) For the indirect production route of Lu-177, the analytical solution for the number of atoms of Lu-177 generated as a function of time, $N_{\text{Lu-177}}(t)$, is

$$N_C(t) = RN_{A,0}\lambda_B\left(\frac{e^{-Rt}}{(\lambda_2 - R)(\lambda_C - R)} + \frac{e^{-\lambda_B t}}{(R-\lambda_B)(\lambda_C - \lambda_B)} + \frac{e^{-\lambda_C t}}{(R-\lambda_C)(\lambda_B - \lambda_C)}\right),$$

where A = Yb-176, B = Yb-177, and C = Lu-177

Using Python, write a code that uses the trial and error (i.e., guess-and-check) method to determine the amount of time it takes (in days or weeks) to reach 90% of the maximum number of atoms of Lu-177. Your code must have the following features to receive full marks:

- A function that has time as an input argument and the number of atoms of Lu-177 as the return. You may choose to use additional functions or other input/output, but this is the minimum requirement. Use comments and docstrings as you see fit for clarity.

- A loop that iterates over time (time step of your choice, as makes sense for this scenario), where your main function is called at each iteration (time is “subbed in” to the function).

- A break in the loop once the appropriate time has been reached (90% of the maximum number of atoms of C is reached). It may be necessary to run your function initially to check what the maximum number of atoms is)

- A print statement that is issued once the loop ends that tells the user what you have calculated and its value, e.g., the sample console output is:

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Number of weeks:  ?? , Atoms of Lu-177 at 90% saturation:  ??
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