Problem Set 5
Due SES #13

[EL] = Lewis, Elmer L. *Fundamentals of Nuclear Reactor Physics*. Burlington, MA: Academic Press, 2008. ISBN: 9780123706317.

Suggested Problems: [EL] Chapter 5, Problems 5.2, 5.10, 5.13, 5.17, 5.19

Question 1: Solve the point kinetics equations with a single precursor group for an initially critical reactor for the following scenarios (i.e. provide analytical solution). Plot both the reactor power and precursor concentration. Show the details of your calculations. Assume the following parameters:

$\beta = 0.007$
$\lambda = 0.1\ s^{-1}$
$\Lambda = 0.0001\ s$

a) From an initially critical reactor, a control rod bank that is worth 10mk drops instantly into the reactor.
b) From an initially critical reactor, an inserted control rod that is worth 2mk is ejected instantly from the core.
c) From an initially critical reactor, a set of 6 inserted control rods each worth 2mk are ejected instantly from the core.

For all cases, plot and discuss your results (you may use the Matlab code to produce your plots.

d) Using the six delayed group Matlab code, repeat parts a, b and c. Discuss the observed differences in using 6 delayed groups versus 1.

Question 2: Starting from the time-dependent diffusion equation (eq 3.1 from pdf) and the precursor equation (eq 3.2 from pdf), derive the point kinetic equation using the following assumptions:

- Assume that the flux shape is fixed (i.e. no time dependence)
- No external sources
- One delayed precursor group
- Use operator format (define your operators at the beginning

Question 3: If for a given fictitious material no delayed neutrons exist, solve the point kinetics equations for a reactivity change of 1 mk (assume $\Lambda = 0.0001$ s). Compute the reactor period.

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