NPRE 560 Fall 2024
HW 2 Due 2024.09.30

- Show your work.
- This work must be submitted online as a `.pdf` through Canvas.
- Work completed with LaTeX or Jupyter earns 1 extra point. Submit source file (e.g. `.tex` or `.ipynb`) along with the `.pdf` file.
- If this work is completed with the aid of a numerical program (such as Python, Wolfram Alpha, or MATLAB) all scripts and data must be submitted in addition to the `.pdf`.
- If you work with anyone else, document what you worked on together.

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1. (Ott Problem 3.3)
   (a) (5 points) Define a one-group $\nu\Sigma_f$ based on the two group values $\nu\Sigma_{f1} = 0.015\left[\frac{1}{cm}\right]$ and $\nu\Sigma_{f2} = 0.3\left[\frac{1}{cm}\right]$.
   (b) (5 points) Calculate Λ with $\bar{v}$ and with $\overline{\frac{1}{v}}$.
   (c) (5 points) Discuss the results.
2. (Ott Review 3.8)
   (a) (5 points) Give the formula for β_{eff} in the one group approximation.
   (b) (10 points) Which physical fact is described by β_{eff} in this approximation?
3. (10 points) (Ott Review 3.10) Why is the diffusion equation a reasonable approximation for kinetics in large reactors?
4. (Ott 4.4) Consider a perturbation of $+\delta\Sigma_a$ for $r < r_a$ in a critical sphere. Assume r_a is much less than the critical radius, R. Find the corresponding change in the reactivity using the unperturbed flux
   (a) (5 points) from reaction rates
   (b) (5 points) from the first-order perturbation formula for the one-group approximation.
5. (5 points) (Ott Review 5.4) What does "exact" mean in the context of exact point kinetics equations?
6. (Ott Problem 6.1) Inhour equation.
   (a) (10 points) Find the stable and prompt-period branches for ^{235}U fuel with $\Lambda = 10^{-4}$s, $\Lambda = 10^{-5}$s, and $\Lambda = 4 \times 10^{-7}$s. Data is given in Table 2-III.
   (b) (10 points) Find $\rho(\alpha)$ in the one-delay-group approximation with $\lambda = \bar{\lambda}$.
7. (5 points) (Ott Review 6.13) Which conditions have to be fulfilled to yield an asymptotic transient with a "stable" period?
8. (10 points) (Ott Review 6.18b) Estimate the stable period for an asymptotic transient following a reactivity insertion of $\rho = 1.25¢$.
9. (10 points) (Ott Review 6.19) Give a list of six to seven kinetics equations with decreasing sophistication of the description of delayed neutrons.