Nuclear Reactor Physics : Neutronics

Homework 5: The Multigroup Equation

The number of stars gives the estimated difficulty of an exercise, though I must say they are not a very trustworthy notation system since I do not really know what you will find challenging or not.

You can either write your answer through :

- Google Docs document (insert > Equation... > type your question using LateX-like directives or select manually the formulas you want to introduce).
- Any word processor that supports equations (Word, LibreOffice,...)
- Good ol' paper and pencil, then scan your solutions.
- Virtually any other method you can think of, as long as I can read it

You can then send that to me by:

- Email at NuclearEngineer@ureddit.com
- Dropbox/Google docs link
- Use of the "send your answer" form (select the homework/quiz you are answering to, write your Ureddit username, upload your document and submit !)
- Virtually any other method you can think of, as long as I can receive it

I will acknowledge receipt of your email/message within two days or so, so that you don't worry that it did not reach me.

Please let me know at the end of your homework if you want a partial correction (i.e. hints toward the good answer if your answer is not correct, so that you can try it again if you want), or a total correction (complete solution to the problems).

Once again, I remind you about the discussion platform, if you have any trouble with the math or if you're thinking "how the hell do I answer that ? I'm stuck !"

Exercise n°1: k_∞ for a homogeneous medium (2 group diffusion) ✪

In the case of an infinite homogeneous medium, show that, **in two group diffusion**, we can write k_∞ as:

$$k_\infty = pf\eta$$

Where:

$$p = \frac{\Sigma_{s,1\to2}}{\Sigma_{r1}}$$

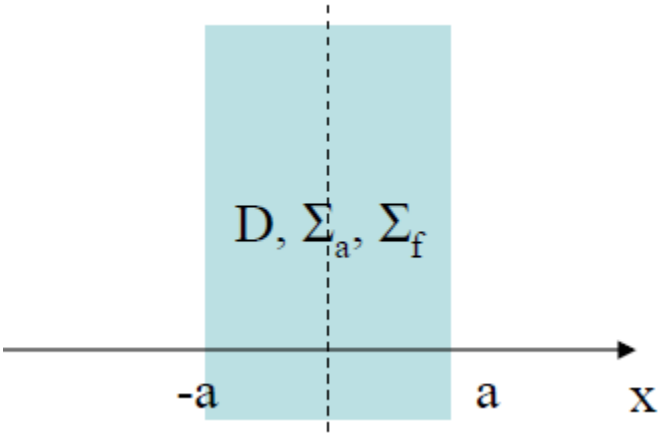
$$f = \frac{\Sigma_{a2}^{Fuel}}{\Sigma_{a,2}}$$

$$\eta = \frac{\nu\Sigma_{f2}}{\Sigma_{a2}^{Fuel}}$$

p is the resonance escape probability, f the thermal utilization factor, and η the reproduction factor.

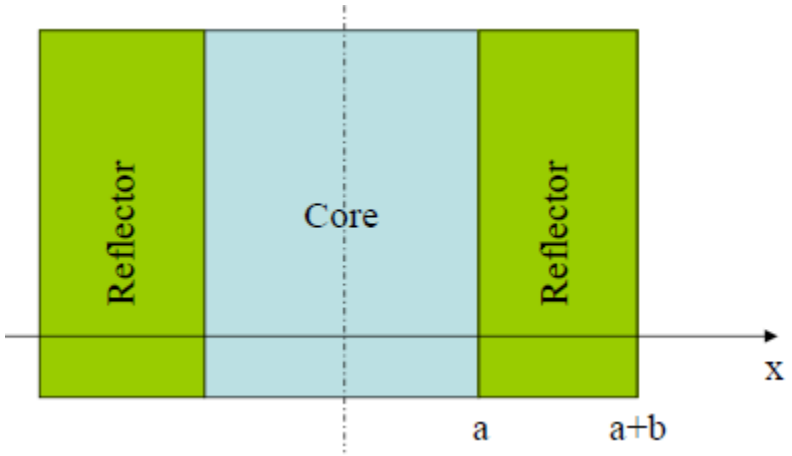
Exercise n°2: The critical slab ✪✪

In this exercise, we consider a homogeneous slab that we want to be critical.



Can you compute again the flux obtained in two group diffusion? This is the exact same exercise than in the lecture. The goal there is for you to be able to do it on your own.

Exercise n°3: The reflected critical slab ✪✪✪



Here, the reflector will limit neutron leakage, protect the vessel from fast neutrons, and flatten the thermal flux, hence the power shape.

You will of course only consider two groups in your calculation. It's difficult enough like that…! You do not have to solve for the integration constants.