

# Numerical Exercise #2

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## 1 Question #1

Numerical solution for the bare system

$k_{\text{eff}}$  (scientific format with 5 significant digits):  $k = 0.97511$

net current at the core boundary (scientific format with 5 significant digits):  $J = \frac{\phi_2 - \phi_1}{dx} = 0.07106$

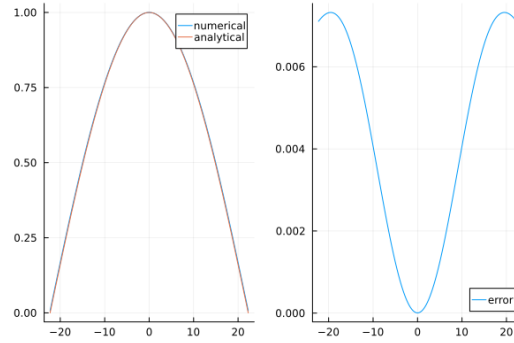


Figure 1: Flux in the bare reactor for a mesh size of 0.1 cm and Distance between numerical and algebraic solutions at each mesh point for a mesh size of 0.1 cm.

## 2 Question #2

Analytical solution for the bare system

For the bare reactor the Equation becomes

$$\frac{d^2\phi}{dz^2} + B_m^2\phi = 0$$

where  $B_m$  is the material Buckling. It is solved by  $\phi(z) = A \cos(Bz) + C \sin(Bz)$ . Due to the symmetric boundary conditions of the problem, we know that  $C = 0$ . The geometric buckling is  $B^2 = \left(\frac{\pi}{H+2d}\right)^2$ . A steady state is reached, when the material Buckling is equal to the numerical buckling, in this case,  $k_{\text{eff}}$  can be calculated by

$$k_{\text{eff}} = \frac{k_{\infty}}{1 + L^2 B^2}$$

$k_{\text{eff}}$  (scientific format with 5 significant digits): 0.97785

net current at the core boundary (scientific format with 5 significant digits): 0.1607 (left and right)

### 3 Question #3

Numerical solution for the reflected system

keff (scientific format with 5 significant digits):1.14649

net current at the core boundary (scientific format with 5 significant digits): 0.03285

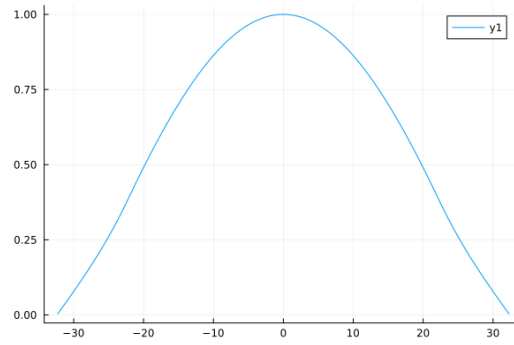


Figure 2: Flux in the reflected reactor for a mesh size of 0.1 cm.