

DUE: Thursday, December 4 at 3 a.m.

I Consider the boundary value problem:

$$\frac{d^2\psi_n}{dx^2} + [100n(x) - \beta_n]\psi_n = 0. \quad (1)$$

The function $n(x)$ is given by

$$n(x) = \begin{cases} 1 - |x|^2 & 0 \leq |x| \leq 1 \\ 0 & |x| > 1 \end{cases} \quad (2)$$

with boundary conditions: $\psi(\pm L) = 0$. Use $L = 2$ and solve for $x = -L : 0.1 : L$.

(a) Calculate the absolute value of the first five *normalized* eigenfunctions (ψ_n) and eigenvalues (β_n) using a shooting scheme and `ode45`. (NOTE: normalization $\int_{-L}^L |\psi_n|^2 dx = 1$)

ANSWER: Eigenvectors should be written out in a matrix with five columns A1.dat

ANSWER: Eigenvalues should be in a row vector with five components A2.dat

(b) Calculate the absolute value of the first five *normalized* eigenfunctions (ψ_n) and eigenvalues (β_n) using the direct solve scheme outlined in class. (NOTE: normalization $\int_{-L}^L |\psi_n|^2 dx = 1$). You will need the EIGS command to solve this.

ANSWER: Eigenvectors should be written out in a matrix with five columns A3.dat

ANSWER: Eigenvalues should be in a row vector with five components A4.dat