HW 7: Due Thurday April 2

1. Consider a linear elastic bar with cross-sectional properties $AE = 450 \times 10^6$ lbf and length 5 ft which is built-in at both ends. The bar is loaded with a axial point-force in its center of magnitude 450 kips. Solve for the displacement and strain fields in the bar using the method of Ritz and the basis functions $f_n(x) = \sin(n\pi x/L)$ for $n = 1, 2, 3, \ldots$. How many terms in the expansion are required to reduce the pointwise error in the displacements to 1% (use the exact answer for the error computation)? how many terms are need to do the same for the strains?

2. Consider a cantilever beam (built-in at $x = 0$) of length $L = 2$ m carrying a distributed load of 5000 N/m. The flexural rigidity of the beam is $EI(x) = (EI)_1 + (EI)_2(1 - \frac{x}{L})$, where $(EI)_1 = 30 \times 10^6$ MN $\cdot$ mm^2 and $(EI)_2 = 60 \times 10^6$ MN $\cdot$ mm^2. Solve for the displacement field in the beam using the method of Ritz and the basis functions

   (a) $f_n(x) = (x/L)^{n+1}$ for $n = 1, 2, 3, \ldots$

   (b) $f_n(x) = (1 - \cos(n\pi x/L))$ for $n = 1, 2, 3, \ldots$

   What are the pros and cons associated with these two choices?