1. Solve Problem 4.5-11 with a linear polynomial for u(x) and a quadratic polynomial for v(x). Hint: After applying for PMPE, you may get the following relation: bi * (expression) = 0, where bi is the unknown coefficient of polynomial. In order to get non-zero coefficient, you need to set expression = 0, which will give you the expression of buckling load.

2. Solve Problem 3.3-3

3. The boundary value problem for a cantilevered beam can be written as

$$\frac{d^4 w}{dx^4} - p(x) = 0, \quad 0 < x < 1$$
$$w(0) = \frac{dw}{dx}(0) = 0, \ \frac{d^2 w}{dx^2}(1) = 1, \ \frac{d^3 w}{dx^3}(1) = -1\text{: boundary condtions}$$

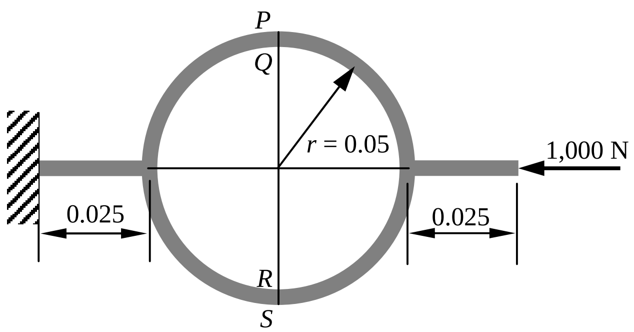
Assume $p(x) = x$. Assuming the approximate deflection in the form $\tilde{w}(x) = c_1 x^2 + c_2 x^3$. Solve for the boundary value problem using the Galerkin method. Compare the approximate solution to the exact solution by plotting the solutions on a graph.

4. Solve Problem 3.2-3

5. The figure shown below depicts a load cell made of aluminum. The ring and the stem both have square cross-section: 0.1×0.1 m^2. Assume the Young's modulus is 72 GPa. The mean radius of the ring is 0.05 m. In a load cell, the axial load is measured from the average of strains at points *P*, *Q*, *R* and *S* as shown in the figure. Points *P* and *S* are on the outside surface, and *Q* and *R* are on the inside surface of the ring. Model the load cell using plane frame elements. The step portions may be modeled using one element each. Use about 20 elements to model the entire ring. Compute the axial strain ε_{xx} at locations *P*, *Q*, *R* and *S* for a load of 1,000 N. Draw the axial force, shear force and bending moment diagrams for one quarter of the ring. The strain can be computed using the beam formula:

$$\sigma_{xx} = E\varepsilon_{xx} = \frac{P}{A} \pm \frac{Mc}{I}$$

where *P* is the axial force, *M* the bending moment, *A* the cross-sectional area, *I* the moment of inertia, and *c* the distance from the midplane.



6. In Problem 5, assume that load is applied eccentrically; i.e., the distance between the line of action of the applied force and the center line of load cell, e, is not equal to zero. Calculate the strain at *P*, *Q*, *R* and S for *e* = 0.002 m. What is the average of these strains? Comment on the results. Note: The eccentric load can be replaced by a central load and a couple of 1000×*e* N·m.