HW 9: Due April 7: 8:30 am

1. (20pts) Consider a column with length $L = 1.5$ m and a 1.2×1.2 cm^2 square cross-section. The column is pinned at $x = 0$ and is supported by a pin-roller at $x = L$ – i.e. it is simply supported. Further, it is supported at $x = L/4$ by a linear spring with spring constant $k = 0.5$ N/mm. The column is subjected to an axial compressive force P at the pin-roller support. Estimate the critical load using an approximate potential energy method with a single parameter. Assume $E = 200$ kN/mm^2.

2. (10pts) Consider the system in Problem 1 except that the axial compressive load is now applied at $x = 3L/4$ instead of at $x = L$. Find the critical load using an approximate potential energy method with a single parameter.

3. (20pts) Consider a beam supported by a Winkler foundation. The beam is 100 ft long with a Young's modulus of $E = 30 \times 10^6$ psi and a cross sectional area moment of inertia $I = 77.4$ in^4. Assume a (continuously distributed) foundation stiffness $k = 100$ lb/in^2 and find the axial buckling load (with small deformation assumptions) and buckling mode. To solve this problem assume an approximation of the form $v(x) = \sum_{i=1}^{n} c_i f_i(x)$ where $f_i = \sin(\frac{\pi i}{L} x)$.