**AE-675/AE-675A: Introduction to Finite Element Methods**

**Assignment No. 1**

In problems 1- 6, construct the weak forms and, whenever possible, quadratic functionals.

1. One directional heat conduction/ convection:

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where *a* and *q* are functions of *x*, and *β*, *c*, *u∞*and *Qo*are constants.

1. Beam on elastic foundations:

where *b=EI* and *f* are functions of *x*, and *k* is a constant (foundation modulus).

1. Longitudinal Elongation of a bar with an end spring:

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where *a* and *q* are functions of *x*, and *k* and *P* are constants.

1. The Timoshenko (shear-deformable) beam theory

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1. A non- linear equation:
2. The Euler- Bernoulli- von Karman nonlinear theory of beams:

where *a*, *b*, *q* and *f* are functions of *x*, and *Mo* is a constant. Here, *u* denotes the axial displacement and *w* the transverse deflection of the beam.

1. Compute the coefficient matrix and the right hand side of the N- parameter Rayleigh- Ritz approximation of the equation

Use algebraic polynomials for the approximate functions. Specialize your results for N=2 and compute the Ritz coefficient.

1. Use trigonometric functions for the two- parameter approximation of the equation in problem 7, and compute the Ritz coefficient.
2. Set up the equation for the N-parameter Rayleigh- Ritz approximation of the following equations associated with a simply supported beam and subjected to a uniform transverse load *f = f0*:
3. Use algebraic polynomials
4. Use trigonometric functions

Compare the two parameter Rayleigh- Ritz solution with the exact solution.

1. Consider the (Neuman) boundary value problem

Find a two parameter Galerkin approximation of the problem using trigonometric approximation functions, when (a) *f=focos(πx/L)*  and (b) *f= fo*