ME 712, Finite Element Method Applications Final Exam, Spring 2010

One formula sheet to be turned in. Open book. **Problems must be done in order in the blue books.**

1. To find the mass moment of inertia of a finite element model, one possible method is to constrain the motion of each node to a plane perpendicular to the radius from the origin to the node. If a node is at x, y, z, wright the necessary constraints for this node.

2. Apply the power method to obtain the largest eigenvalue and its corresponding eigenvector. Write the calculated eigenvector after each step in your blue book. Your initial guess for the eigenvector **is**

$$\mathbf{v} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$$

$$A = \begin{bmatrix} 1 & -1 & 0 \\ -1 & 1 & -1 \\ 0 & -1 & 1 \end{bmatrix}$$

3. Obtain first row of the stiffness matrix of a rod (extension: 1-D) using 1 quadratic element with a mid-node located at $3L/4$. Use Gauss integration to derive the element matrices. Assume a length l, density ρ, cross sectional area of A, and a modulus of E. *Use 3 Gauss points.*

4. Find the strain at (x, y)=(-1,0) of a bilinear quadrilateral (Q4) element with nodes 1-4 at (1,0), (0,1), (-1,0), and (0,-1) in terms of u_3 and v_3 (presume all other nodal displacements are zero). *This is not the same problem you saw on the first exam.*