ME 712, Finite Element Method Applications Final Exam, Spring 2002

Open book, open notes. Problems must be in order in the blue books. 10% will be deducted from each problem done out of order.

1. Obtain the mass matrix of a rod (extension) using 1 quadratic element. Use Gauss integration to derive the element matrices. Explain any differences in results. Assume a length l, density ρ, cross sectional area of A, and a modulus of E. Print out any code that you may write to solve this problem.

2. Find the maximum direct strain in the beam from project 1 at the root for the problem as shown in the book. Print out the section of code corresponding to the solution for the strain (no more than 1 page)

3. Start a diary of this problem (type *diary problem3*). This will log your solution to a file named problem3 in your current working directory. When you are done with the problem, type *diary off*. Print out this file **after** editing out erroneous lines. Apply Guyan Reduction to the system below to reduce the size of the system to two degrees of freedom. Choose your reduced coordinate to cause the least amount of error in the reduced model.

$$K = \begin{bmatrix} 7 & -3 & 0 & 0 \\ -3 & 5 & -2 & 0 \\ 0 & -2 & 3 & -1 \\ 0 & 0 & -1 & 1 \end{bmatrix}, M = I$$

4. Start a diary of this problem (type *diary problem4*). This will log your solution to a file named problem4 in your current working directory. When you are done with the problem, type *diary off*. Print out this file **after** editing out erroneous lines. Given that the coordinates for the model shown above are x_1 through x_4, apply the boundary condition to the system such that $x_1 = x_4$.

Turn in:

1. Your blue book

2. Any code used for problem 1

3. The segment of code from problem

4. The diaries from problems 3 and 4 **-10% off each if they are not on clearly marked and separate pages**