**EML 6067 Finite Elements I**

**Scope:**
Use a finite element analysis program (you may use NASTRAN/PATRAN available in ENG II, RM 304 – Front Row Computers and Harris Lab or any other software you may prefer) to analyze a particular problem of engineering interest to you. The apparent difficulty of the task that you undertake is of course dependent on your choice of problem. Scoring will consider the problem difficulty, but the grade will also strongly depend on you convincing me that your analysis is **accurate** and **valid**. Thus the supporting documentation might include a convergence study and perhaps some simpler related problems in which you have compared the finite element results to theoretical solutions (or experimental data) available in the literature, or have derived analytically. Else, you might choose a problem that has been solved previously and compare your FEM solution to the previous solution.

**Teaming:**
Work together in teams of two. There are the modeling aspects as well as the supporting closed-form analyses, or other means of model validation, and background research that can be shared responsibilities.

**Project Milestones:**

| | |
|---|---|
| 1/24, 1/26 | Meet with me, as a group, to discuss project topics during office hours |
| 2/7 | Progress Report 1: (i) list team members, (ii) describe project and approach (**1 page**) |
| 3/13 | Progress Report 2: Brief report describing progress on: (i) FEA results, (ii) supporting validation of the FEA results, (iii) and any technical problems you are having (**2 pages max**) |
| 04/12 | Final Report – see below. |
| 04/17, 04/19 | Project Presentations – short 5 min presentation describing your problem & results. |

**Final Report Content:**
Your report should include: (i) an abstract, (ii) an introduction that clearly describes the problem, (iii) a description of your FEA model and results (e.g., stress contour plots, results plotted along key paths of interest), (iv) a discussion on the validation of the FEA results (e.g., comparison with closed-form solutions or experimental measurements available in the literature or even done yourself), and (v) conclusions. In an appendix, identify the project responsibilities of each team member. 12 pages max.

**Grading (Tentative):**
Submit Progress Report 1 **10%**
Submit Progress Report 2 **30%**
· Actual Progress – e.g., prelim. FEA results
· General Technical Content
Project Presentation **10%**
Submit Final Report (**04/12**) **50%**
· General Technical Content (10%)
· Difficulty of Topic (10%)
· Demonstrate Solution Accuracy/Validity (30%)

**Term Project** **Final Report due by Apr 12**

**The following page contains a list of project ideas. You are not limited to these problems, and are in fact encouraged to come up with one yourself.**

**Some Project Topic Ideas:**

• elasticity, stress analysis
  o punch problems, contact, indentation
  o demonstrations of St. Venant's principle
  o wedge/crack tip solution – compare with Williams' elasticity solution

• structural mechanics
  o torsion of open sections – thin bars, thick bar, C, T, and I shaped cross-sections
  o shear flow in multi-cell wing box loaded in torsion
  o modeling of sandwich structures

• dynamics
  o impact of beam or plate – e.g., FEA compared to modal analysis or published data
  o vibration modes of plates
  o vibration modes of thin and/or thick-walled cylinders
  o acoustic problems – natural frequency of bell, drum

• composites
  o predicting coupling behavior of composite structures having unbalanced, unsymmetric layup
  o tapered composites – ply drop-off's
  o homogeneous vs. heterogeneous modeling of composite laminates
  o thermal distortion in curved composite laminates
  o elliptical hole in an orthotropic composite plate
  o analysis of shear test specimen as function of orthoropy – Iosipescu, rail shear

• joints
  o adhesive bonded joint analysis – butt, lap, tubular, scarf, composite scarf, Tee
  o bolted joint in metal or composite joints – perhaps account for screw threads

• shells
  o stresses in thick-walled pressure vessel
  o boundary layer stresses in shell transitions/end caps
  o behavior of inflated thin-wall or membrane structures

• nonlinear mechanics
  o beams or trusses (e.g., a mast) with very large deformations
  o warping of thin-walled cross-sections under bending or torsion loads (e.g., Brazier Moment in thin-walled cylinders)
  o beam-column behavior

• stability/bifurcation
  o buckling of thin-walled cylinder or cone or hemispherical dome
  o snap-through of juice cap or carpenter's tape – can do experiments to verify!

• analysis of an experiment conducted in previous lab courses
• projects motivated by your own research/other coursework are encouraged
• projects motivated by previous work experience