

October 9th, 2009

The purpose of this project is to give you the opportunity to address a **technical problem of your interest** using the finite element method as one of the main analyses and design tools. The problem of interest can be motivated by your activities in other team or research projects, an application that you study in other courses (e.g. composites, fluids, dynamical systems, etc.).

Your 6 page report should be written and typed carefully (in Word or LaTeX format) as a scientific report (can follow the format of any engineering or science journal: Abstract, Introduction, Problem Definition, Technical approach, Implementation, Numerical Examples, Results, Conclusions, References **with links**). Don't use the 6 pages for little details – provide Appendices for anything that you think is necessary to demonstrate your quality of work (derivations, plots, drawings, etc). However, Appendices are not needed. The report should be submitted as a zipped directory to MAE4700@gmail.com together with all Appendices, all programs developed (input files, main codes developed), your ppt presentation, etc. **Please send us the original files and not just the PDF versions of your work.**

Below find a brief summary of what needs to be emphasized in your projects (these items are in some relative order of significance).

- a) **Problem definition** – if you cannot define this clearly, then don't attempt to solve it! Please also discuss the motivation for your project selection.
- b) Clear demonstration of your **understanding of FEM concepts and implementation**. Remember that **this is a project in a FEM class**. You should emphasize in a direct manner what FEM knowledge beyond the one covered in class did you acquire while working in your project (new FEM formulations for problems **beyond** those covered in HWs, new elements, new algorithms, etc.)
- c) **The level of sophistication and detail put in addressing your project topic**
 - Did you develop/write any new FEM libraries?
 - What is your level of competence with commercial codes (ANSYS, etc.)
 - Did you validate in some way your results? (error calculations, adaptivity/remeshing, comparisons with analytical solutions for particular subcases of your problem, etc.)
 - Is your project a major departure from the HW problems?

- d) Your power point presentation should be clearly and nicely prepared with the essentials of your work – problem definition, formulation, algorithms, results, comparisons, validation, figures, movies, etc.
- e) The presentation of your work can be done by one of the team members or in pieces by everyone in the team. **Total time for presentation 15 minutes including questions and answers. Your presentation should be given with a lots of respect for the audience – not everyone will know the fundamentals of your project. Use your presentation to educate everyone on something interesting and new.**

DESIGN PROJECTS

Those who take the class for design credit need to devote part of their paper and presentation in emphasizing [why their work qualifies for design credit](#). Things that you will need to incorporate include but are not limited to the following:

- ✓ Clear definition of your design problem (objective, design variables, constraints, etc.)
- ✓ What engineering approximations have you introduced and why in your engineering system analysis?
- ✓ Optimization integration in your work
- ✓ Sensitivity analysis to investigate how your solution varies with input parameters that you may not have direct knowledge (sensitivity on material model/properties, geometry, etc.) or input parameters you want to optimize.
- ✓ Iterative solution process to account for mechanical/thermal/etc or environmental/economical constraints
- ✓ Integration of multi-physics codes, mesh generators, CAD, etc.
- ✓ Addressing a problem with multiple solutions (materials design/selection, unknown geometry, etc.)
- ✓ Address issues of system performance (parametric representation of the system response - response surface techniques)
- ✓ Your conclusions should include recommendations based on the obtained results – what have you learned from your system analysis/design?
- ✓ Etc.