ME EN 7540 **Advanced Finite Elements** **Class Project**

1) A list of possible project topics is listed below.
2) Please e-mail me the names of members of your team and the topic on which you will work for your class project.
3) A written progress report (2 page, single-spaced) on your project will be due on Tuesday, February 21, 2006. The progress report will contain:
    - The names of the teams members
    - The title of the project
    - An introduction to the topic.
    - Your approach.
    - What you intend to find, i.e., what results you expect to present in your final report.
    - A break-up of team duties, i.e., a time-task schedule and the assigned member of the team for each task.
    - I will read the report and decide whether the project is appropriate and will provide suggestions.
4) The final project report will be due on May 4, 2006.
    - The project report will contain a title page formatted in the University of Utah thesis format.
    - The contents will follow the format of a research paper with sections such as Introduction, Approach, Results, Discussion, and Conclusion.
    - Any ANSYS scripts or programs will be relegated to an Appendix.
    - Figures and tables will follow the University of Utah thesis format.
    - All references will be placed in a reference section following the appendix. References will be formatted according to the University of Utah thesis format.
5) Oral presentations will be held in the last two weeks of class. The exact dates will be decided based on the number of teams.
    - Each team will talk for 20 minutes. A 10 minute question session will follow each presentation.
    - Each team member is required to talk. The allotted 20 minutes should be divided among the team accordingly.
    - The presentation should be designed so that everyone in the audience can understand its contents and should be delivered in an organized manner.

Possible Project Topics:

1) Finite element modeling of **composite shells**
    - This will involve going into the research literature and finding what people do to model curved shells made of fiber-reinforced composites with finite elements. The team is also expected to use software to run simulations of composite shells and compare their results with experimental data.

2) Fracture mechanics simulations with **extended FEM**.
    - Read the literature on extended FEM (X-FEM). Find out whether ANSYS or the software you use can be used to run extended FEM simulations. If not you can either write your own 2-D code or compare extended FEM with the virtual crack closure technique (VCCT) and run simulations with VVCT in ANSYS.

3) Dynamic or Quasistatic fracture simulations with **cohesive zone methods**.
    - Read the literature on fracture using finite elements and cohesive zone models. See whether ANSYS/LS-DYNA can be used to run cohesive zone simulations. If not, write your own code.

4) Simulate the **forming of a soda can** using finite elements (dynamic or static).
    - This will include extruding the cylinder and forming the cap so that you can break it by applying a small pressure. You can use both ANSYS and LS-DYNA or any other tools. You have to choose the material, the plasticity model, and the failure criterion and discuss why you chose those.

5) **Stochastic** finite elements.
    - This will involve reading the literature on stochastic finite elements and explaining how the method works and what its drawbacks are. Simple 1-D simulations with your own code or 2-D simulations with ANSYS are acceptable.

6) Modeling the deformation of **viscoelastic tires**.
    - Read the literature on viscoelastic models of tire material and the deformation behavior of the steel belts inside the tires. Simulate static and dynamic deformations of tires and figure out why tires might burst under some circumstances.

7) Modeling **shape memory alloys** and stents.
    - This project will involve the study of the constitutive behavior of shape memory alloys used in medical devices. A stent made of these materials will have to be simulated.

8) Modeling **armor penetration**.
    - LS-DYNA will be required in these simulations. The project will involve the study of nonlinear material models for projectiles and armor and dynamic simulations.

9) **Fluid-Structure interaction**.
    - This project will involve the study of fluid-structure interaction. The structure should be deformable. Explore methods of solving this problem that involve finite elements. If ANSYS (or LS-DYNA) has the relevant features, perform simulations.

10) **Meshfree methods**.
    - Study Element-Free Galerkin methods or smoothed-particle hydrodynamics. You can use Tahoe or LS-DYNA to solve problems using some of these methods. Explore situations where meshfree methods are more appropriate than standard finite element methods.