Course: ENPM 652 – APPLIED FINITE ELEMENT METHODS
Semester: Summer 2016
Day(s): MONDAYS; LECTURES JUNE 6 – AUGUST 15
Time: 5:30 PM – 8:45 PM
Location: TBA
Instructor: JOHN D. CLAYTON
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Course Description

Objectives: This class introduces basic concepts of the Finite Element Method (FEM) through a hands-on approach using commercial software ANSYS. Although no previous FEM experience is required, general familiarity with matrix algebra and physical concepts for elasticity and heat transfer are helpful but not mandatory. Students will learn fundamentals of the approach and how to set up and run problems for mechanical stress analysis and thermal analysis.

Topics Covered:
1. Fundamentals of finite element concepts
2. Familiarity with using ANSYS finite element software
3. Setting up, running, and analyzing a finite element model
4. Boundary value problems: variational methods, interpolation, numerical integration, stresses, error, post-processing
5. Truss and beam analysis using 2D and 3D FEM
6. 2D field problems: heat conduction/convection/radiation, plane stress, plane strain
7. 3D elastic stress analysis
8. Transient and dynamic analysis: initial value problems, modal analysis
9. Advanced topics: FE-aided design, improving accuracy and speed, the limitations of FEM

Grading:
☐ Homework assignments + project whitepaper (70%)
☐ Project (30%) All students will complete a project and submit an accompanying formal report which will be due on the day of the final lecture of the class. The purpose of the project is to reinforce topics covered in the course through exploration and tinkering. Project ideas will be self-defined for which a whitepaper (i.e., a brief project proposal/outline) will be due in the 3rd week of class. Projects’ grades will be defined by metrics you initially propose in your whitepaper that will be subsequently approved by the instructor. Further instructions regarding the project will follow in Week 2.

Computer Software Policy:
☐ This policy pertains only to the use of mathematical analysis and programming software other than ANSYS. Use of other software such as Matlab or Mathematica is permitted to assist development of handwritten or word-processed solutions. However, no verbatim computer input/output files will be accepted. The submitted assignment document must be prepared so as to give no impression that any such other software was used; over-reliance on such tools will result in point deductions.
Textbook(s)

There is no required textbook. Electronic lecture notes will be distributed.

Optional Supplementary Reading


Course Outline

Lecture Schedule*

- Week 1: Introduction to the course and the finite element method; the main components of a finite element code
- Weeks 2-4: Direct method, stiffness and force matrices, truss elements
- Weeks 4-6: 2D and 3D truss models, boundary conditions, matrix computing and assembly, internal forces/stresses
- Weeks 6-7: Elasticity and heat transfer
- Weeks 7-8: 2D geometric modeling, planar and axisymmetric elements, meshing, field problems
- Weeks 8-9: 3D geometric modeling, model building
- Weeks 9-10: Modal analysis, dynamics, and transients
- Week 10: Optimization, design, and error analysis

*Precise weekly schedule may vary as course progresses, depending on student interests.

Code of Academic Integrity

The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity of the Student Honor Council, please visit http://shc.umd.edu/SHC/HonorPledgeInformation.aspx.