ES 128

Computational Solid and Structural Mechanics

Harvard John A. Paulson School of Engineering and Applied Sciences

Course Agenda

Lecture	Date	Topic	Homework
1	January 24^{th}	Introduction to ES128	-
2	January 26^{th}	Trusses in 1D - Stiffness Matrix	-
3	January 31^{st}	Trusses in 1D - Boundary Conditions	-
4	February 2^{nd}	Trusses in 2D + Introduction to Abaqus Input Files	**HW1 is assigned**
5	February 7^{th}	Strong and Weak Forms in 1D	-
6	February 9^{th}	Introduction to Abaqus CAE & Scripting	**HW1 is due** / **HW2 is assigned**
7	February 14^{th}	Strong and Weak Forms in 1D	-
8	February 16^{th}	**Project Proposals**	**HW2 is due** / **HW3 is assigned**
9	February 21^{st}	Finite Element Formulation for 1D problems	-
10	February 23^{rd}	Abaqus Scripting - Automating Pre and Post processing	**HW3 is due** / **HW4 is assigned**
11	February 28^{th}	Review & Exercises	-
12	March 2^{nd}	**Midterm 1**	-
13	March 7^{th}	Elements of Linear Elasticity	-
14	March 9^{th}	Elements of Linear Elasticity	**HW4 is due**
15	March 14^{th}	**Spring Break**	-
16	March 16^{th}	**Spring Break**	-
17	March 21^{st}	Finite Element Formulation for 2D Elasticity	-
18	March 23^{rd}	More on Abaqus Scripting	**HW5 is assigned**
19	March 28^{th}	**Intermediate Project Presentation**	**Project Report is due**
20	March 30^{th}	Finite Element formulation for 2D Elasticity	**HW5 is due** / **HW6 is assigned**
21	April 4^{th}	Finite Element formulation for 2D large strain problems	-
22	April 6^{th}	Finite Element formulation for dynamic problems	**HW6 is due** / **HW7 is assigned**
23	April 11^{th}	Introduction to Abaqus Explicit	-
24	April 13^{th}	More on Abaqus Explicit	**HW7 is due**/**HW8 is assigned**
25	April 18^{th}	Abaqus Review	-
26	April 20^{th}	Review & Exercises	**HW8 is due**
27	April 25^{th}	**Midterm 2**	-
28	TBD	**Final Project Presentation**	**Final Report is due**

Syllabus

Tuesday - Thursday : 1:00 - 2:30 pm at Pierce 209

Instructor: Katia Bertoldi - Pierce 311 - bertoldi@seas.harvard.edu

Teaching Fellow: Nick Vasios - Pierce 327 - vasios@g.harvard.edu

Office Hours: Katia Bertoldi - Tuesday **3:00 - 4:00 pm** / Nick Vasios - Wednesday **4:00 - 5:30pm**

Textbook: A First Course in Finite Elements (Jacob Fish, Ted Belytschko)

ES128 is an introduction to computational techniques for the simulation of a large variety of engineered systems. The applicability to real-world engineering problems is stressed throughout. The course provides an introduction to finite element methods for analysis of steady-state and transient problems in solid, structural, fluid mechanics, and heat transfer. Modeling of problems and interpretation of numerical results. Implementation of simple MATLAB codes and use of existing general-purpose programs (ABAQUS). Final project addressing a significant problem arising in engineered systems.

Prerequisites: Engineering Sciences 120 and 123 or equivalent introduction to the mechanics of deformable materials and fluids.

Grading

- Homework (25%)
- Two Mid-Term Exams (25% each)
- Project (25%)

Homework

- Homework is mandatory in order to pass the course
- No late homework can be accepted, as the solutions will be distributed and posted on the day that homework is due
- All homework assignments will be posted on Thursdays and are due on the following Thursday (one week - unless other instructions are provided)
- All homework will be posted on the Canvas website
- Homework will consist of a combination of Paper, Matlab and Abaqus problems.
- Discussion and the exchange of ideas are essential to doing academic work. For assignments in this course, you are encouraged to consult with your classmates as you work on problem sets. However, after discussing with peers, make sure that you can work through the problem yourself and ensure that any answers you submit for evaluation are the result of your own efforts. In addition, you must cite any books, articles, websites, lectures, etc that have helped you with your work using appropriate citation practices. Similarly, you must list the names of students with whom you have collaborated on problem sets

Final Project

- A 5 minute report to the class regarding the plan of the project
- Groups of 2-3 people
- Projects should involve "serious" computation using ABAQUS
- Intermediate presentation + Report
- A final presentation (15 minutes) + Report