ME 498CM · Tools of Computational Mechanics · Fall 2015

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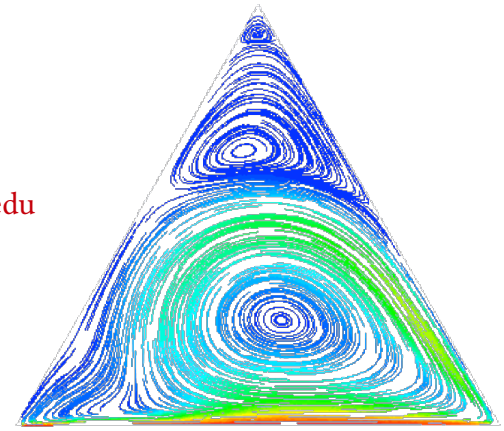
URL uiuc-cse.github.io/me498cm-fa15

Lecture MEL 1001 · 2:00–3:20 · Tue/Thu

Office Hours MEL 1001 · 3:30–4:30 · Tue/Thu (TA)
2102B NCSA · 2:00–4:00 · Wed (Davis)



Summary

This course will provide an opportunity for students who have been introduced to principles of finite element analysis and computational fluid dynamics (by taking ME 412, ATMS 502, ME 554, etc.) to learn the basic and intermediate functionality of widely used commercial mechanics packages. Two finite element analysis packages, ANSYS Mechanical APDL and Abaqus FEA, and one computational fluid dynamics package, Fluent CFD, will be covered.

The course will be taught Tuesdays and Thursdays in 1h20m applied lecture sections, with other lab hours available for consulting and exercise help. Applied lectures will introduce modeling methods and software capabilities as well as feature the hands-on demonstration of fundamental principles and techniques. Students will be expected to follow along and then apply the principles to short exercises and four projects for each package.

The course will be broken into three discrete units, one credit hour being available for each software package. The class will be taught in sequential five-week units devoted to each package (see *Course Outline & Schedule* for more details).

ANSYS	25 Aug–22 Sep	(9 lectures)
Fluent	24 Sep–27 Oct	(10 lectures)
Abaqus	29 Oct–8 Dec	(10 lectures)

Prerequisites

Familiarity with computational methods; exposure to underlying principles of fluid dynamics and structural mechanics. Essentially, the standard set of 300-level courses in fluid flow, heat transfer, and continuum mechanics offered within AE, CEE, MatSE, MechSE, and NPRE.

Required Text

None.

Auxiliary Texts

ANSYS ANSYS 15.0 Mechanical APDL documentation

X. Chen, Y. Liu (2014) *Finite Element Modeling and Simulation with ANSYS Workbench*. Boca Raton, Florida: CRC Press.

E. Madenci, I. Guven (2015) *The Finite Element Method and Applications in Engineering using ANSYS®*. Heidelberg: Springer-Verlag. DOI:10.1007/978-1-4899-7550-8.
☞Available for free to UIUC students through SpringerLink.

S. Moaveni (2007) *Finite Element Analysis: Theory and Application with ANSYS* (3rd ed.). Upper Saddle River, New Jersey: Pearson Prentice-Hall.

Y. Nakasone, S. Yoshimoto, T. A. Stolarski (2006) *Engineering Analysis with ANSYS Software*. Amsterdam: Elsevier.
☞Available for free to UIUC students through ScienceDirect.

Fluent ANSYS 15.0 Fluent CFD documentation

Abaqus 3DS Simulia Abaqus 6 FEA documentation (requires login) (hard copy available)

3DS Academy learning materials

A. Khennane (2013) *Introduction to Finite Element Analysis Using MATLAB and Abaqus*. Boca Raton, Florida: CRC Press.

 Illinois Compass 2g will be used for students to privately monitor grades and course progress.

Attendance

Lectures The primary class meetings will consist of applied lectures, in which the instructor will introduce software features, discuss algorithmic underpinnings as appropriate, and guide students through exercises designed to illustrate features and applications in engineering modeling.

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The EWS lab will be reserved for students to work on their projects using the required software. Teaching assistants will be present to answer questions. The lab block may occasionally be used to make up lectures missed due to instructor travel or class cancellation. Dr Davis will be available for consultation about course topics as well.

Assessment

Exercises Students will be tested through four exercise sets for each software package, intended to elicit insight and understanding into the application's design and operation.

Examinations None.

Grading

Participation	5%
Homework 1	25%
Homework 2	25%
Homework 3	25%
Homework 4	20%

Letter grades will be assigned based on student performance within each credit hour of the course (*i.e.*, one credit hour each for each software package). Each credit hour will be graded independently of the others. Grade cutoffs may be adjusted based on clusters in aggregate student performance; however, students with a percentage score above 90% are guaranteed an A or A-, those above 80% guaranteed a B+, B, or B-, etc. The participation grade will use attendance as an index of student engagement.

Homework should be submitted in hard copy at the beginning of class on the due date. (It is recommended students list their name and total number of pages on each page.) Late submissions will be automatically penalized 10% of total project score per day.

Citation Policy

Students are responsible for their own work, although collaboration is encouraged. Each student must carry out all calculations him- or herself and write and compose his or her own report. Plagiarism will not be tolerated, and may result in academic sanctions and in all parties receiving no credit on the exercise. Although you may share work or utilize online resources, *citations are required* for any outside resources with a strong influence on your work, and you *may not copy* work. If you have any questions, review the University policy on academic integrity.

Software

The software products required for this course are available in Engineering WorkStation (EWS) computer laboratories, and no purchase is required to complete any element of this class. If you are interested in acquiring a copy of the software for personal use or as part of your research group, you can enquire about academic licenses through the UIUC Webstore. EWS also supports remote access via the command line or Citrix.

ANSYS (Webstore)
☞ANSYS includes the Workbench, Mechanical APDL, and Fluent.

Abaqus (Webstore) (Student Edition)
☞EWS machines use 6.13, so for compatibility please install this version instead of 6.14.

Course Outline & Schedule

The course is decomposed into three logical units, one addressing each software package exclusively. (This outline and schedule are subject to revision.)

ANSYS Mechanical APDL *for Structural Analysis* · TA: Smruthi Murali

1	Finite element analysis workflow	Tue, Aug 25	Homework 1	Thu, Sep 3
2	Meshing, elements, & geometry	Thu, Aug 27	Homework 2	Thu, Sep 10
3	Postprocessing	Tue, Sep 1	Homework 3	Thu, Sep 17
4	Solution methods	Thu, Sep 3	Homework 4	Thu, Sep 24
5	Boundary conditions	Tue, Sep 8		
6	Geometry importing	Thu, Sep 10		
7	Batch programming & scripting	Tue, Sep 15		
8	Thermal coupling	Thu, Sep 17		
9	Nonlinear & contact FEA	Tue, Sep 22		

ANSYS Fluent CFD *for Computational Fluid Dynamics* · TA: Zhongzhong Zhang

1	Finite volume method workflow	Thu, Sep 24	Homework 1	Thu, Oct 8
2	Postprocessing	Tue, Sep 29	Homework 2	Thu, Oct 15
3	Composite geometry construction	Thu, Oct 1	Homework 3	Thu, Oct 22
4	Convective flow	Tue, Oct 6	Homework 4	Thu, Oct 29
5	Boundary conditions & UDFs	Thu, Oct 8		
6	Transient solution	Tue, Oct 13		
7	Compressible flow/Thermal coupling	Thu, Oct 15		
8	Turbulent flow	Tue, Oct 20		
9	Chemical reactivity	Thu, Oct 22		
10	Applications	Tue, Oct 27		

3DS Abaqus FEA *for Structural Analysis* · TA: Masoud Safdari

1	Finite element analysis workflow	Thu, Oct 29	Homework 1	Thu, Nov 12
2	Loading & analysis	Tue, Nov 3	Homework 2	Thu, Nov 19
3	Thermal coupling	Thu, Nov 5	Homework 3	Thu, Dec 3
4	Meshing	Tue, Nov 10	Homework 4	Wed, Dec 9
5	Transient solution	Thu, Nov 12		
6	Material & yield models	Tue, Nov 17		
7	Dynamic & contact FEA	Thu, Nov 19		
8	Batch programming & scripting	Tue, Dec 1		
9	Applications	Thu, Dec 3		
10	Applications	Tue, Dec 8		