Computational Fluid Dynamics
AE 433

CHAPTER 0

Course Objectives and Syllabus

by
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Instructor

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Course Information

Class Hours:  Fri – 14:25-17:00 (Location: A03)
Number of Credit Hours: 3 hr credit
ME and CFD

Master’s Thesis: Design of an Alternative Glaucoma Drainage Device Using CFD Tools (USE OF GAMBIT & FLUENT SOFTWARES)

Papers, proceedings and projects from master’s thesis:

ME and CFD

Doctoral Thesis: Development of a Navier Stokes Solver for Compressible Flows on Cartesian Grids with Aerodynamics Applications (MY OWN CODES WRITTEN IN VISUAL FORTRAN !)

Papers, proceedings and projects from doctoral thesis (PART-1):


E. Kara, Preparation date: 12.09.2018

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Doctoral Thesis: Development of a Navier Stokes Solver for Compressible Flows on Cartesian Grids with Aerodynamics Applications (MY OWN CODES WRITTEN IN VISUAL FORTRAN !)

Papers, proceedings and projects from doctoral thesis (PART-2):


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Doctoral Thesis: Development of a Navier Stokes Solver for Compressible Flows on Cartesian Grids with Aerodynamics Applications (MY OWN CODES WRITTEN IN VISUAL FORTRAN!)

Papers, proceedings and projects from doctoral thesis (PART-2):


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NEW STUDIES

Papers, proceedings and projects AFTER doctoral thesis:


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Compulsory Texts

1. «An introduction to computational fluid dynamics: the finite volume method.»

2. «Introduction to Computational Fluid Dynamics: Development, Application and Analysis.»
Recommended Texts

- Essential Computational Fluid Dynamics, by Zikanov
- Computational Fluid Dynamics - A Practical Approach, by Tu, Yeoh and Liu
- Computational Methods for Fluid Dynamics, Ferziger and Peric
- Computational Fluid Mechanics and Heat Transfer, by Pletcher, Tannehill and Anderson
Internet Sources

1. [https://www.cfd-online.com/](https://www.cfd-online.com/)
   An online center for Computational Fluid Dynamics, largest CFD site on the net with services like discussion forums, jobs, links and a wiki

2. [https://cfd.ninja/](https://cfd.ninja/)
   Various free tutorials using ANSYS, OpenFOAM and more, with the goal learn, disseminate and share knowledge that is useful for the solution of current problems in engineering using tools of CFD

3. [https://www.fetchcfd.com](https://www.fetchcfd.com)
   Platform to publish, share, collaborate, discover & download simulations also in 3D/VR/AR.

4. [https://www.youtube.com](https://www.youtube.com)
   Many video are available beginning with examples.

   Useful source site by Dr. Ahmed Al Makky of Cardiff University.

6. [https://www.raefkobeissi.com/](https://www.raefkobeissi.com/)
   Useful source site by Raef Kobeissi.

7. [https://www.learncax.com/](https://www.learncax.com/)
   Useful source site for FREE CFD Training : Courses, Projects, Career ...
Software and Resources

- CFD software was built upon physics, modeling, numerics.
- Two types of available software
  - Commercial (e.g., FLUENT, CFX, Star-CCM, COMSOL)
  - Research (e.g., CFDSHIP-IOWA, U^2RANS)
- More information on CFD can be got on the following website:
  - CFD Online: http://www.cfd-online.com/
  - CFD software
    - FLUENT: http://www.fluent.com/
  - Grid generation software
    - Gridgen: http://www.pointwise.com
    - GridPro: http://www.gridpro.com/
  - Visualization software
    - Tecplot: http://www.amtec.com/
    - Fieldview: http://www.ilight.com/
Assessment (LOOK OUT !)

- Assignment (Term Project)
- Attendance
- Labs
- Examinations
- Final Grades
Assessment (LOOK OUT !)

- Assignment (Term Project):

It consists of a project presentation by each group of students to the full class and the instructor. Each CFD project will be performed by a group of two students. The CFD problem to be analyzed will be chosen by the students based upon their own interests and with advice from the instructor.
Assessment (LOOK OUT !)

- Attendance:

Regular attendance is **strictly required (at least 70 %)**.

In case you have to miss a class, **you are responsible for keeping up** with the class work and being informed of all announcements made in the class concerning homework, quizzes, tests, etc.

If you encounter difficulties of any kind, feel free to come and see me in my office.
Assessment (LOOK OUT !)

- Labs:

There will be CFD Lab sessions in the second half of the semester, after the first midterm.
Assessment (LOOK OUT !)

- Examinations:

  Two midterms are scheduled. First midterm will be about CFD concepts, definitions, and short exercises plus section with short computational problems (HAND WRITTEN). Second midterm will be in the PC lab. First part will be an open book computation of aerodynamics problem. Second part will be the CFD solution of it applied in PC lab.

  A final comprehensive examination will be given according to the school schedules. Make-up exams may be given for legitimate excuses if you contact the instructor as soon as you return to the school. It will be given for excused absences only and must be scheduled immediately upon returning to class. Excused absences require a medical excuse or notice of official school business by the V.P. of Academic Affairs.
Assessment (LOOK OUT !)

- Final Grades:

  Assignment (Term Project)   20 %
  Class Tests (Midterms)      2 × 20 %
  Final Exam                 40 %

Total                             100 %

Letter grades will be given relative to the average of the class!
Objective

- The objective of this class is to introduce students to applied computational fluid dynamics and to teach them how to solve a fluid flow problem using commercially available CFD software.
- The class will be taught using textbooks, lecture notes, and the commercial CFD package and its modules.
# Tentative Schedule

<table>
<thead>
<tr>
<th>Lecture 1</th>
<th>Introduction &amp; basic aspects of CFD</th>
<th>Week 1</th>
<th>Reading: Chapter 1</th>
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</thead>
<tbody>
<tr>
<td>Lecture 2</td>
<td>Conservation laws of fluid motion</td>
<td>Week 2</td>
<td>Reading: Chapter 2</td>
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<td>and boundary conditions</td>
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<tr>
<td>Lecture 3</td>
<td>Conservation laws of fluid motion</td>
<td>Week 3</td>
<td>Reading: Chapter 2</td>
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<td>Lecture 4</td>
<td>Turbulence and its modelling</td>
<td>Week 4</td>
<td>Reading: Chapter 3</td>
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<td>Lecture 5</td>
<td>The finite volume method (FVM)</td>
<td>Week 5</td>
<td>Reading: Chapter 4</td>
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<td>Lecture 6</td>
<td>FVM and Boundary Conditions</td>
<td>Week 6</td>
<td>Reading: Chapter 5-6</td>
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<td><strong>MIDTERM 1</strong></td>
<td><strong>November 9th, Friday, 14:30</strong></td>
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<tr>
<td>Lecture 7</td>
<td>Introduction to GUI &amp; Design Modeler</td>
<td>Week 8</td>
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<td>Lecture 8</td>
<td>Basics of Meshing Module</td>
<td>Week 9</td>
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<td>Lecture 9</td>
<td>Basics of the Solver Module</td>
<td>Week 10</td>
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<td>Lecture 10</td>
<td>Tutorials / Group &amp; Topic Selections</td>
<td>Week 11</td>
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<td>Lecture 11</td>
<td>Presentations of Term Projects</td>
<td>Week 12</td>
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<td><strong>MIDTERM 2</strong></td>
<td><strong>December 21th, Friday, 14:30</strong></td>
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**Last Lecture – Review**

E. Kara, Preparation date: 12.09.2018

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