



Introduction to Computational Fluid Dynamics AE 427

CHAPTER 0

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Course Objectives and Syllabus

by

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Instructor

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Lecture webpage:

<http://www1.gantep.edu.tr/~emrekara/index.php/ae427/>

FIRST OF ALL

TO ATTEND AE 427 INTRO TO CFD

Minimum requirement to become an
AE 427 student is:

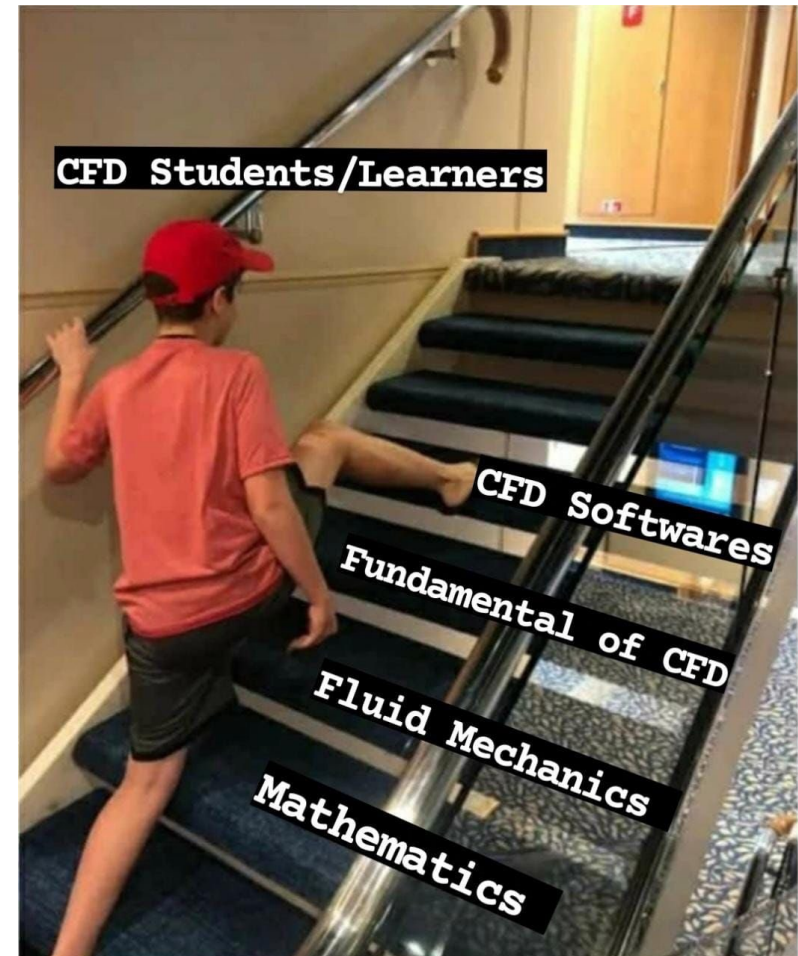
- To take and **pass** AE204 Fluid Mechanics and AE209 Thermodynamics in the previous semesters.
- **AE204 and AE209 GRADES OF FF/FD ARE NOT ACCEPTABLE. IF SO, PLEASE DROP THE COURSE.**

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Figure source: twitter @Jousefm2

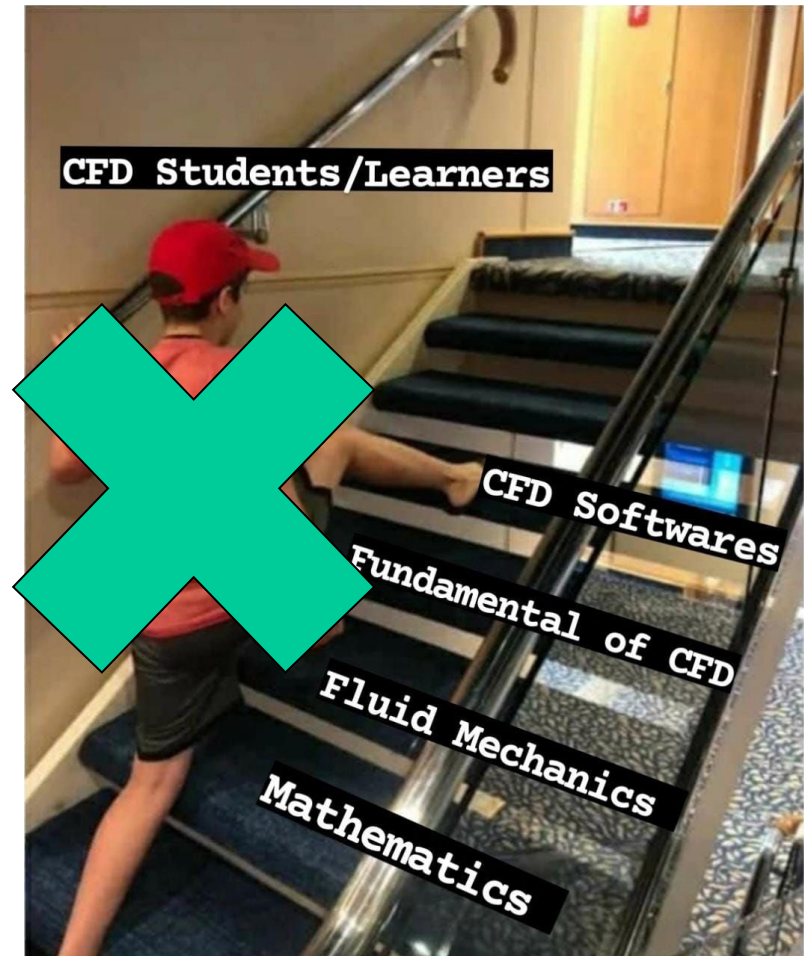


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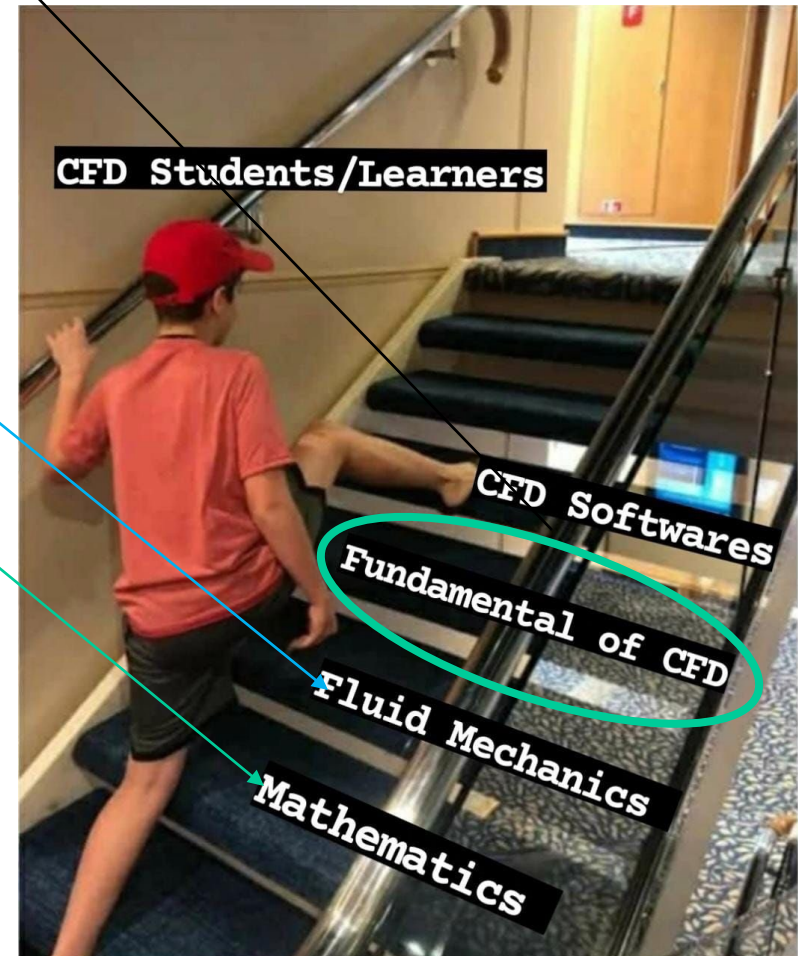


Figure source: twitter @Jousefm2

Course Information

Class Hours

Friday

08:30-11:05

(COMLAB)

3-0 Credit



Course Information

During the course, Computational Fluid Dynamics (CFD) fundamentals will be covered and a commercial CFD software (licensed by the department) will be used to solve engineering problems. This lecture is designed for aerospace engineering students new to CFD. Combining an appropriate level of mathematical background, worked examples and step-by-step processes, students will walk through modeling and computing, as well as interpreting CFD results.

Objective

- The main objective of the course is to give the students a thorough knowledge of CFD from the theoretical and practical points of view.
- Other objectives of the course are to provide junior and senior year students with,
 - 1. basic CFD design skills,
 - 2. experience on CFD applications.
- During the course, we will cover CFD fundamentals and will use commercial CFD software to solve engineering problems parallel to the lecture. The class will be taught using Tu et al.'s textbook, Computational Fluid Dynamics A Practical Approach.

Teaching Policy

- The course teaching policy involves lectures, simulation examples (tutorials), two midterms and a **final project**.



Compulsory Textbooks

Computational Fluid Dynamics

A Practical Approach

3rd Edition

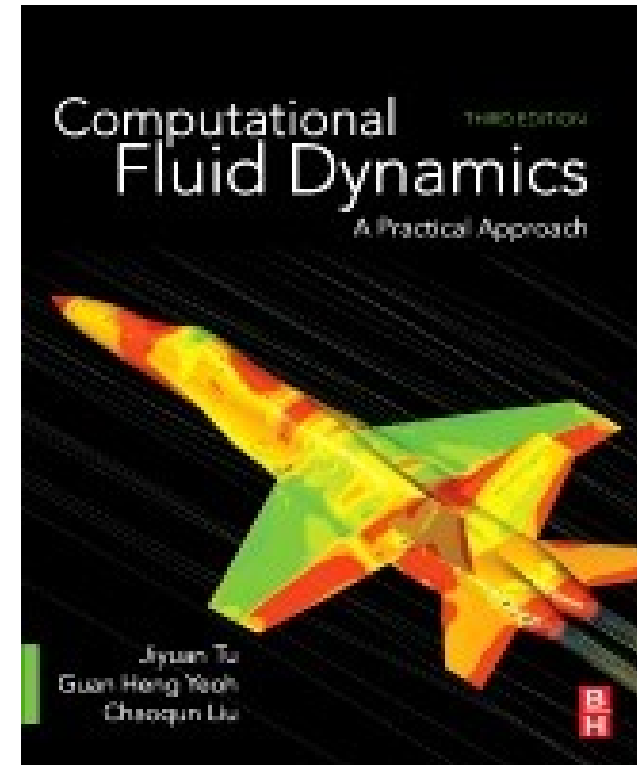
Jiyuan Tu

Guan Heng Yeoh

Chaoqun Liu

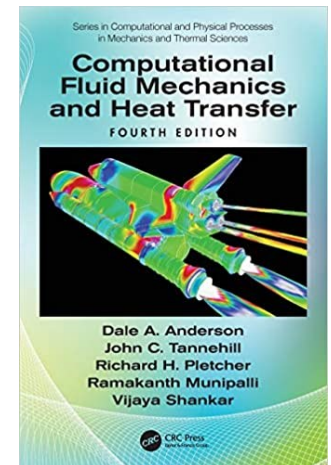
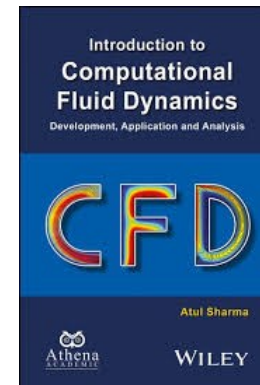
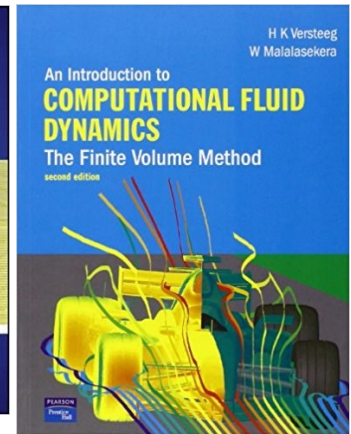
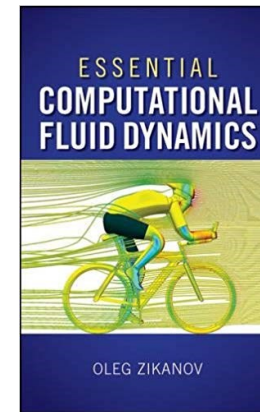
You can find the previous edition (2008) of textbook in our university library. New version is also available in bookstores.

Library number: TA 357 T835 2008



Recommended Texts

- An introduction to computational fluid dynamics: the finite volume method by Versteeg, and Malalasekera
- Computational Methods for Fluid Dynamics, Ferziger and Peric
- Computational Fluid Mechanics and Heat Transfer, by Pletcher, Tannehill and Anderson
- Introduction to Computational Fluid Dynamics: Development, Application and Analysis, by Sharma.
- Essential Computational Fluid Dynamics, by Zikanov



Internet Sources

1. <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/>

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>

Platform to publish, share, collaborate, discover & download simulations also in 3D/VR/AR.

4. <https://www.youtube.com>

Many video are available beginning with examples.

5. <https://cfd2012.com/index.html>

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

6. <https://www.learncax.com/>

Useful source site for FREE CFD Training : Courses, Projects, Career ...

Software and Resources

- CFD software are built upon physics, modeling, numerics.
- Three types of available software
 - Commercial (e.g., ANSYS, Star-CCM, COMSOL)
 - Open source (OpenFOAM, Su2)
 - Research (e.g., CFDShip-IOWA, U²RANS)
- More information on CFD can be got on the following website:
 - CFD Online: <http://www.cfd-online.com/>
 - Some CFD workbenches (Each include preprocessor, grid generator, flow solver and visualization softwares in them) :
 - ANSYS: <http://www.ansys.com/>
 - COMSOL <http://www.comsol.com/>
 - Star-CCM
<https://www.plm.automation.siemens.com/global/en/products/simcenter/STAR-CCM.html>
 - Some stand-alone grid generation softwares:
 - Cadence - Gridgen: <http://www.pointwise.com>
 - GridPro: <http://www.gridpro.com/>
 - Some stand-alone visualization softwares:
 - Tecplot: <http://www.tecplot.com/>
 - Paraview: <https://www.paraview.org/>

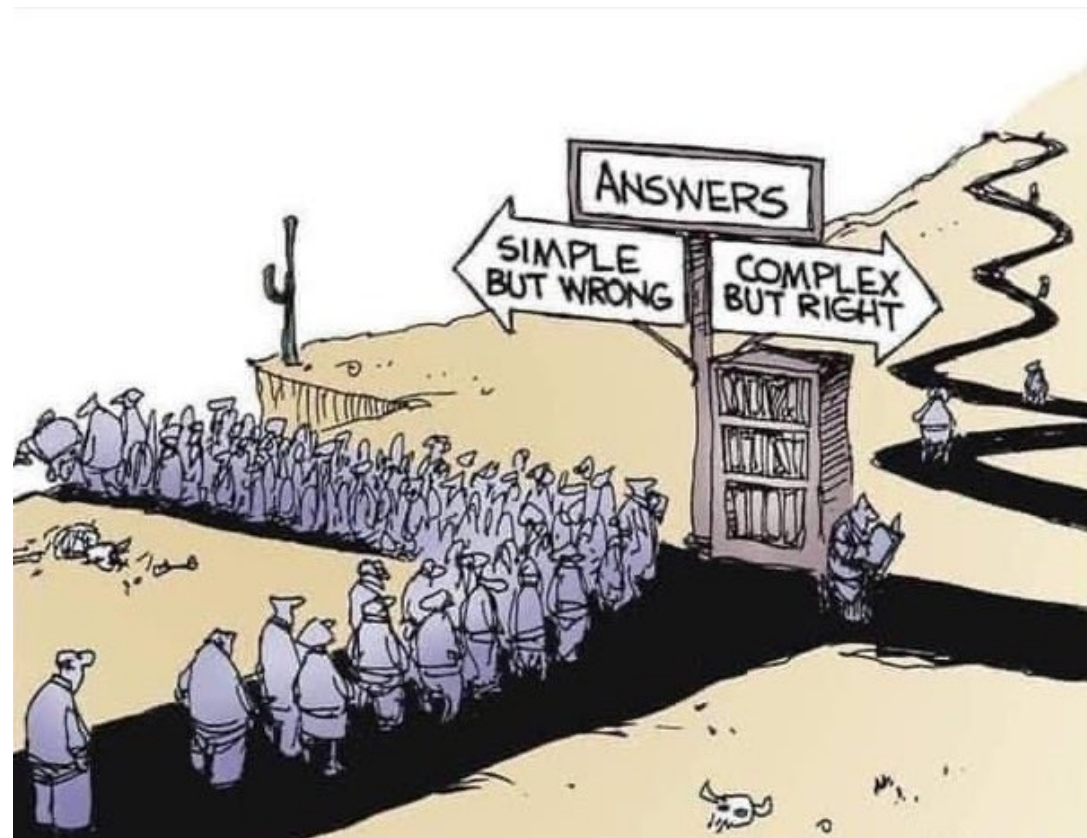
Software and Resources



- You can download and install ANSYS Fluent Student 2026 R1 edition to your computer to practice in your free time. In COMLAB class, we will use pre-installed student versions intended exclusively for personal learning in class and your projects and are strictly not for commercial use, industrial R&D, or large-scale production modeling.

Assessment (LOOK OUT !)

- Attendance
- CFD Applications
- Examinations
- Final Grades

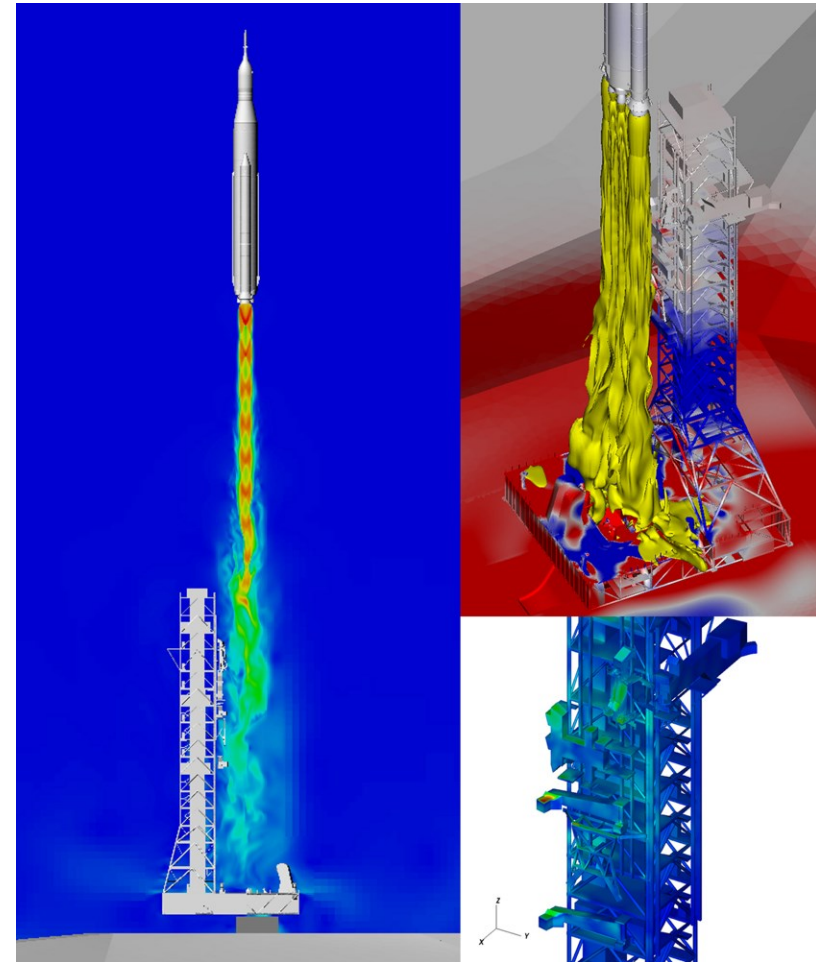


Assessment (LOOK OUT !)

- Attendance:

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 tests, etc.

If you encounter difficulties of any kind, feel free to come and see me in my office.



Assessment (LOOK OUT !)

- CFD Applications:

Previous semesters' tutorials can be found in:

https://www.youtube.com/playlist?list=PLwwnJlIl3v08-Y7AktjbgukL26L7tQmj_

Different from previous semesters, the students need to finish the tutorials given above, parallel to the lecture. At the end of each lecture, they will be given as homeworks (not to be submitted).

After week 2, there will be CFD sessions in ANSYS Fluent will be used for applications (CFD applications). All students should keep the same pace up during the applications, there will be seven CFD applications and students can try them after class at home, to get prepared for the midterms.

Assessment (LOOK OUT !)

- Examinations:
- One week before the midterms, there will be «midterm practice» sessions in which the instructor will tutor a similar study to midterm.

Assessment (LOOK OUT !)

- Examinations:
- **Midterm-1:**

Correct geometry definition and mesh generation of the problem (geometry will be given for the mesh generation).

The exam will be box-filling type, no partials. Students will fill the blanks on the question sheet, no USB submission.

Students will use only COMLAB computers, no personal laptops are allowed in exams.

Assessment (LOOK OUT !)

- Examinations:
- **Midterm-2** will be two parts:
 1. A simple computational problem (**HAND WRITTEN solution**) connected to thermodynamics and/or fluid mechanics.
 2. CFD solution of the problem (Mesh will be given) This part of the exam will be box-filling type, no partials. Students will fill the blanks on the question sheet, no USB submission.

Students will use only COMLAB computers, no personal laptops are allowed in exams.

Assessment (LOOK OUT !)

- Examinations:

Final exam will be two parts:

1st Part: CFD concepts, definitions (10-15 min, **multiple choice**)

2nd Part: Reports will be submitted. Oral presentations will be done in COMLAB about the projects in max. 10 minutes, each student will have 2-3 minutes of talk.

The most successful student group will have the opportunity to submit the project outcome to a conference or a journal.

IMPORTANT NOTE: 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. THE MAKEUP EXAMS WILL BE HANDWRITTEN, REGULAR, CLASSICAL PROBLEM SOLVING TYPE EXAMS, NO PRESENTATIONS, NO TESTS.

Assessment (LOOK OUT !)

- FINAL (Term Project):

A multiple choice test will be given prior to presentations.

Each CFD project will be performed by **a group of three student.**

Project topics will be given on week 13.

Assessment (LOOK OUT !)

- FINAL (Term Project):

PROJECT OUTLINE AND RULES WILL BE SHARED ON WEEK 13.

Gradings:

A multiple choice test before the presentations (10 pts)	final exam date
Presentation (15 pts)	final exam date
Report (15 pts)	final exam date

Final project report will include:

- Literature survey
- Project realization
- Selecting experimental study correctly
- Computational study
- Comparison of numerical results with experimental study

Assessment (LOOK OUT !)

- Final Grades:

Midterm 1	30	%
Midterm 2	30	%
Final	40	%

Total	100	%
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Tentative Schedule

Lecture	Lecture Title	Class
Week-1	Chapter-0: Course Objectives and Syllabus	COMLAB
Week-2	Chapter 1: Introduction CFD Application-1	COMLAB
Week-3	Chapter 2: CFD Solution Procedure – A Beginning CFD Application-2	COMLAB
Week-4	Chapter 2: CFD Solution Procedure – A Beginning (Continues) CFD Application-3	COMLAB
Week-5	Practice session for midterm-1	COMLAB
Week-6	Midterm-1: October 30th 2026 Friday at 9.00	COMLAB
Week-7	Midterm-1 solution lecture	COMLAB
Week-8	Chapter 4: CFD Mesh Generation – A Practical Guideline CFD Application-4	COMLAB
Week-9	Chapter 4: CFD Mesh Generation – A Practical Guideline (Continues) CFD Application-5	COMLAB
Week-10	Chapter 3: Governing Equations for CFD – Fundamentals CFD Application-6	COMLAB
Week-11	Practice session for midterm-2	COMLAB
Week-12	Midterm-2: December 11th 2026 Friday at 9.00	COMLAB
Week-13	Midterm-2 solution lecture and Final topics will be given - Final topic discussions.	COMLAB
Week-14	Chapter 3: Governing Equations for CFD – Fundamentals (Continues) CFD Application-7	COMLAB

I strongly recommend you to take a look at CFD from «your» perspective:

Gordon L.Y. So (3rd Year Mechanical Engineering Student (Aerospace Option) at UBC) explains CFD in his own words:

[Presentation PDF](#)

[Presentation video](#)

We will continue with Chapter-1: Introduction in the next lecture.

Homework-1 (not to be submitted)

Step by step apply Tutorial-1 from

https://www.youtube.com/playlist?list=PLwwnJlI13v08-Y7AktjbgukL26L7tQmj_