

# Syllabus

## MAE 598/494 Topic: Applied Computational Fluid Dynamics

Fall 2019 Tu/Th 1:30-2:45 PM, Classroom: SCOB 152

Instructor: Huei-Ping Huang (hp.huang@asu.edu), ERC 359

Office hours: Monday 3-5 PM, Tuesday 3-5 PM, or by appointment

Course website <http://www.public.asu.edu/~hhuang38/ACFD2019.html>

*Note: Items 4-10 in this syllabus are modified from a template provided by FSE to aid compliance with the syllabus requirements of ACD 304-10.*

### 1. Course Objectives and Expected Learning Outcomes

Course description: Numerical techniques for solving incompressible and compressible flow equations using industrial solvers; Computer-aided analysis of thermofluid systems; Applications to fluid system engineering.

Expected outcome: Understanding of basic principles for computer simulation of fluid systems; Familiarity with computational fluid dynamics solvers in engineering applications.

### 2. Readings, Assignments, Examinations, Special Materials, Required Activities

Course Outline: We will run two threads concurrently through the semester. One of them ("Lectures") fills the background knowledge on computational fluid dynamics. The other ("Projects") focuses on the execution and analysis of specific projects using Ansys-Fluent.

#### *Lectures*

1. Survey of basic fluid mechanics and thermodynamics as preparation for the projects (4 weeks)
2. Survey of numerical methods to deepen the understanding of the functionality of Ansys-Fluent and similar industrial software (6 weeks)
3. Discussion on more advanced topics in CFD (e.g., turbulence modeling) (3 weeks)

#### *Projects*

1. Tutorials for Ansys-Fluent (2 weeks)
2. Main projects (12 weeks)

At least four of the following projects (3 weeks each) will be chosen for this semester. The list is tentative and the detail of the individual project is subject to further adjustments.

Project 1: Fluid system with heat transfer

Project 2: External flow (calculation of drag and lift; Reynolds number dependence)

Project 3: Compressible flow system

Project 4: Low Reynolds number flow; Microfluidics

Project 5: Moving boundary and moving grid

Project 6: Flow with an interface (two-phase or multi-phase)

The required work for the projects will be different for participants of MAE598 and MAE494. Typically, each project has one extra task for MAE 598 participants. Details will be given in the individual assignments.

In addition to projects, one short homework assignment will be given to supplement related tutorials for Ansys-Fluent.

Textbook: No required textbook. Instructor will provide tutorials, slides, and lecture notes as needed.

Attendance is mandatory for this class. Excessive absence without a proper reason may result in a failing grade.

*Programming using Matlab or equivalent:* The CFD solver (Ansys-Fluent) used in this class already comes with a post-processing module with graphic functions. Most of the figures for the reports of projects can be produced within the software. Nevertheless, occasionally it is advantageous to export the data of the simulation by Ansys-Fluent and process it using Matlab (or other programming languages/tools such as Fortran, C++, Python, Java, R, Excel). A beginner's guide for Matlab will be posted to the class website. No tutorial will be given on programming languages/tools. The uses of those tools are optional.

### **3. Grading Policies**

Grade will be based on performances in homework and projects, and a final exam, as weighted in the following: Projects & homework 90%, Final exam (in-class test) 10%

Specific rules for collaboration on homework and projects will be released separately in the beginning of the semester. A violation of the rule(s) may lead to lowering of the score for the assignment, in addition to consequences of a violation of ASU's Academic Integrity Policy.

The typical thresholds for letter grades are: A = 90%, B = 80%, C = 70%, and D = 60%. These thresholds are subject to adjustments depending on the distribution of the total scores for the class.

### **4. Absence & Make-Up Policies**

Instructor will arrange make-up exams, extension of deadline for projects, and/or assignment of alternative projects for students who are excused from class with proper reasons. This policy will accommodate students who have **(a)** Excused absences due to an emergency, illness, or other unforeseeable events that prevent students from attending class or completing a project within the regularly allocated time ; **(b)** Excused absences related to religious observance/practices that are in accord with ACD 304-04, "Accommodation for Religious Practices"; **(c)** Excused absences related to university sanctioned events/activities that are in accord with ACD 304-02, "Missed Classes Due to University-Sanctioned Activities"

Students who expect to miss class due to officially university-sanctioned activities should inform the instructor early in the semester. Alternative arrangements will generally be made for any examinations and other graded in-class work affected by such absences. The preceding policies are based on ACD 304-04, "Accommodation for Religious Practices" and ACD 304-02, "Missed Classes Due to University-Sanctioned Activities."

## **5. Classroom Behavior**

Note-taking using electronic devices such as laptops is permitted as long as the activity does not cause disruption to the lecture or disturbance to other participants in the class. Cellphone and similar communication devices should be turned off or set to silent mode when class is in session. Any violent or threatening conduct by an ASU student in this class will be reported to the ASU Police Department and the Office of the Dean of Students.

## **6. Academic Integrity**

All Students in this class must adhere to ASU's academic integrity policy, which can be found at <https://provost.asu.edu/academic-integrity/policy>). Students are responsible for reviewing this policy and understanding each of the areas in which academic dishonesty can occur. In addition, all engineering students are expected to adhere to both the ASU Academic Integrity Honor Code (<https://provost.asu.edu/academic-integrity/honor-code/>) and the Fulton Schools of Engineering Honor Code (<https://engineering.asu.edu/ira-a-fulton-schools-of-engineering-honor-code/>). All academic integrity violations will be reported to the Fulton Schools of Engineering Academic Integrity Office (AIO). The AIO maintains record of all violations and has access to academic integrity violations committed in all other ASU college/schools.

Specific to this class, limited collaboration is allowed for homework and projects. Specific rules for collaboration on homework and projects will be given in the individual assignments.

## **7. Copyright**

Course content, including lectures, are copyrighted materials and students may not share outside the class, upload to online websites not approved by the instructor, sell, or distribute course content or notes taken during the conduct of the course (see ACD 304–06, “Commercial Note Taking Services” and ABOR Policy 5-308 F.14 for more information).

You must refrain from uploading to any course shell, discussion board, or website used by the course instructor or other course forum, material that is not the student's original work, unless the students first comply with all applicable copyright laws; faculty members reserve the right to delete materials on the grounds of suspected copyright infringement.

## **8. Disability Accommodations.**

Suitable accommodations will be made for students having disabilities and students should notify the instructor as early as possible if they will require same. Such students must be registered with the Disability Resource Center and provide documentation to that effect.

## **9. Offensive Materials**

Participants of this class who find any course material objectionable may consult with the instructor or MAE Program Chair to identify appropriate accommodations.

## **10. Sexual Discrimination**

Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at <https://sexualviolenceprevention.asu.edu/faqs>.

As a mandated reporter, the instructor is obligated to report any information upon becoming aware of alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, <https://eoss.asu.edu/counseling>, is available for students who wish discuss any concerns confidentially and privately.

***Notice: Any information in this syllabus may be subject to change with reasonable advance notice.***