

Syllabus
MAE560/MAE460 Applied Computational Fluid Dynamics
Fall 2022 Tu/Th 1:30-2:45 PM, In-Person, Classroom: SCOB 152

1. Contact Information

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

2. Office Hours

Monday 3-5 PM, Tuesday 3-5 PM, or by appointment. The office hours will provide opportunities of discussion with instructor. Detailed format will be announced separately by instructor.

3. 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.

4. Enrollment Requirements

Familiarity with elementary fluid mechanics, thermodynamics, heat transfer, and numerical methods.

5. Course Objectives

This course will define the principles of computer simulation for fluid flows and explore applications to the analysis and design of fluid systems in engineering.

6. Expected Learning Outcomes

- Analyze fluid systems in engineering using computer software
- Formulate numerical procedures for computer simulation
- Design and evaluate fluid systems in engineering using principles of computational fluid dynamics

7. Grade 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 10%

The expected thresholds for letter grades are: A = 90%, B = 80%, C = 70%, D = 60%, E = Below 60%. These thresholds are subject to adjustments depending on the distribution of the total scores for the class. Students in the MAE 560 and MAE 460 sections are graded separately.

8. Absence and Attendance Policies

(a) General Policy

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 with the following circumstances:

- a. Excused absences related to religious observances/practices that are in accord with [ACD 304-04](#), "Accommodation for Religious Practices"
- b. Excused absences related to university sanctioned events/activities that are in accord with [ACD 304-02](#), "Missed Classes Due to University-Sanctioned Activities"
- c. Excused absences related to missed class due to military line-of-duty activities that are in accord with [ACD 304-11](#), "Missed Class Due to Military Line-of-Duty Activities," and SSM 201-18, "Accommodating Active Duty Military"

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.

(b) Attendance

Instructor does not plan to take attendance for class participation on a regular basis. Students are strongly encouraged to attend all classes to acquire the knowledge and skills that are needed to succeed in this class.

9. Faculty recording of class sessions

Faculty may record class meetings to make an archived recording available to enrolled students, instructors, or support personnel. Creation of recordings for groups beyond these requires consent from students who are recorded.

For this class, lectures will not be streamed or recorded on a regular basis. Archived recording might be produced only for selected special sessions such as in-class demonstrations of computer software.

10. Readings, Assignments, Examinations, Special Materials, Required Activities

Outline of class activity

The main class activity consists of two threads that will run 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 details of individual projects are subject to adjustments.

Project 1: Fluid system with heat transfer

Project 2: External flow (lift and 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 MAE560 and MAE460. Typically, each project has one extra task for MAE 560 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.

CFD solver: The major projects in this class requires the use of a computational fluid dynamics (CFD) solver, ANSYS-Fluent. Running the software requires a personal computer (laptop, desktop, tablet) with sufficient computing power and memory, details of which will be disseminated to class. For students who are not able to personally finance the equipment, ASU has a laptop checkout program available through ASU Library.

Programming using Matlab or equivalent: The CFD solver (Ansys-Fluent) used in this class is equipped 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. Matlab is available to ASU students under MyASU/MyApps. No tutorial will be given on programming languages/tools. The uses of those tools are optional.

11. Policy regarding expected classroom behavior

Adhering to ASU guideline, any violent or threatening conduct by a student in this class will be reported to the Office of the Dean of Students.

12. Academic Integrity

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 the ASU Academic Integrity Honor Code (<https://provost.asu.edu/academic-integrity/honor-code>). All academic integrity violations are 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 rules for collaboration on individual 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.

13. Copyright

Students 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.

The contents of this course, including lectures and other instructional materials, are copyrighted materials. Students may not share outside the class, including uploading, selling or distributing course content or notes taken during the conduct of the course. Any recording of class sessions is authorized only for the use of students enrolled in this course during their enrollment in this course. Recordings and excerpts of recordings may not be distributed to others. (see [ACD 304-06](#), "Commercial Note Taking Services" and ABOR Policy [5-308 F.14](#) for more information).

14. Policy against threatening behavior, per the Student Services Manual, [SSM 104-02](#)

Students, faculty, staff, and other individuals do not have an unqualified right of access to university grounds, property, or services (see SSM 104-02,

<https://www.asu.edu/aad/manuals/ssm/ssm104-02.html>). Interfering with the peaceful conduct of university-related business or activities or remaining on campus grounds after a request to leave may be considered a crime. All incidents and allegations of violent or threatening conduct by an ASU student (whether on-or off-campus) must be reported to the ASU Police Department (ASU PD) and the Office of the Dean of Students

15. Warning of Offensive Class Materials

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

16. Disability Accommodations

Suitable accommodations will be made for students having disabilities. Students needing accommodations must register with the ASU Disabilities Resource Center and provide documentation of that registration to the instructor. Students should communicate the need for an accommodation in sufficient time for it to be properly arranged. See [ACD 304-08](#) Classroom and Testing Accommodations for Students with Disabilities.

17. Harassment and Sexual Discrimination

Arizona State University is committed to providing an environment free of discrimination, harassment, or retaliation for the entire university community, including all students, faculty members, staff employees, and guests. ASU expressly prohibits discrimination, harassment, and retaliation by employees, students, contractors, or agents of the university based on any protected status: race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, and genetic information.

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 that the instructor becomes aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, <https://eoss.asu.edu/counseling> is available if you wish to discuss any concerns confidentially and privately. ASU online students may access 360 Life Services, <https://goto.asuonline.asu.edu/success/online-resources.html>.

18. Update of Syllabus

Any information in this syllabus may be subject to changes with reasonable advance notices.