

Syllabus

MAE 560/460 Applied Computational Fluid Dynamics

Fall 2020 Tu/Th 1:30-2:45 PM, ASU Sync/In-Person, Classroom: LIB C12

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 in-person and remote 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. ASU Sync/In-Person Courses

This is an ASU Sync/In-Person course. Students may attend lectures in-person subject to guideline of social distancing, or participate in class remotely using Sync. ASU Sync is a technology-enhanced approach, designed to meet the dynamic needs of the class. During Sync classes, students learn remotely through live class lectures, discussions, study groups and/or tutoring. More information about ASU Sync for students can be found at <https://provost.asu.edu/sync/students> and <https://www.asu.edu/about/fall-2020>.

To participate in class by ASU Sync, log on to MyASU and click open MAE 560 or MAE 460. Click on **Attend via Sync**. This will establish connection to instructor's personal zoom link by which the lectures will be streamed.

8. 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.

9. 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) ASU Sync/In-Person attendance

Instructor does not plan to take attendance for ASU Sync or In-person 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.

(c) Classroom capacity and social distancing

Students who choose to attend lectures in-person must follow ASU guideline on social distancing. Observing the posted (50%) capacity of classroom, the class is divided into

two groups, A and B. On Tuesdays, students in Group A will meet in-person while the other half of the class participates in the live class on Zoom via ASU Sync. On Thursdays, students in Group B will meet in-person while the other half of the class participates in the live class on Zoom via ASU Sync. Students will receive their group designation before the first class of the semester.

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

(a) 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 detail of the individual project is subject to further 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.

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.

(b) ASU Sync Requirements

A personal computer (laptop, desktop, tablet) equipped with a web browser and with internet connection is required to participate in class remotely by ASU Sync. The internet connection should be of sufficient speed to properly carry live streaming by zoom. To participate in class interactively by zoom, student's computer should be equipped with a webcam and a microphone (built-in or external).

For students who are not able to personally finance the equipment needed to attend class via ASU Sync, ASU has a laptop and WiFi hotspot checkout program available through [ASU Library](#).

11. Policy regarding expected classroom behavior (e.g., use of pagers, cell phones, recording devices)

Until further notified, per ASU policy, faculty, staff, students and visitors, are required to wear face coverings in classrooms, labs, offices and community spaces.

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 both the ASU Academic Integrity [Honor Code](#) and the 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 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.

13. Copyright

All course content and materials, including lectures (Zoom recorded lectures included), 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.

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. 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, instructor is obligated to report any information that 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 students wish discuss any concerns confidentially and privately.

18. Update of Syllabus

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