# AE 410/CSE 461 – Computational Aerodynamics – Syllabus

F. Evrard

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**Online platform** We will use Canvas for all course related content, communications, and submissions. You are encouraged to create Discussions in Canvas in order to raise questions about concepts or course assignments. The instructor and TA will moderate these discussions and answer questions in a timely manner. For personal communications with the instructor or TA, or to provide feedback on the course, please send us a direct message via the Canvas Inbox.

*Link to the course homepage:* https://canvas.illinois.edu/courses/53751

**Course information**

| | |
|---|---|
| Credit | 3 undergraduate hours, 3 or 4 graduate hours |
| Time | 11:00 am – 12:20 pm MW |
| Location | Engineering Hall 403B2 |
| Recordings | Available to online students on Mediaspace after each lecture. |

**Instructor** Prof. Fabien Evrard (AE)

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| Office | Talbot 317 |
| E-mail | fevrard@illinois.edu |
| Office hours | 4–5 pm Tuesdays [zoom link] |

**Teaching assistant** Farhad Hasanli (AE)

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| Office | Talbot 319N |
| E-mail | hasanli2@illinois.edu |
| Office hours | 5–6 pm Wednesdays [zoom link] & 1–2 pm Thursdays [zoom link] |

**Course description** We will introduce finite-difference and finite-volume methods for solving partial differential equations. Model equations closely related to the Navier-Stokes equations will be used to introduce the methods, prior to their application to compressible flow. Emphasis will be placed on developing techniques for programming and analyzing numerical schemes that can then be applied to more complex scenarios.

**Learning goals** At this end of this course, you will have:

- Gained a fundamental understanding of the numerical methods constituting the basis of academic and commercial aerodynamics codes.
- Gained hands-on experience by implementing these numerical methods in `Python`.
- Become aware of the many challenges associated with the development and use of computational methods for aerodynamics.

**Prerequisites** AE 311 (incompressible flow), AE 312 (compressible flow), or their equivalents; introduction to numerical methods.

**Necessary background** Calculus, differential equations, linear algebra, basic programming.

**Recommended textbooks** These books cover much of the course material and can be downloaded for free from the university network:

Lomax, Pulliam, & Zingg, *Fundamentals of computational fluid dynamics* [link]
LeVeque, *Finite volume methods for hyperbolic problems* [link]
Toro, *Riemann solvers and numerical methods for fluid dynamics* [link]

**Other recommended texts** These books can provide additional information/perspective on the course:

Hirsch, *Numerical computation of internal and external flows*, Volumes 1 & 2.
Tannehill, Anderson, & Pletcher, *Computational fluid mechanics and heat transfer*
Gustafsson, Kreiss, & Oliger, *Time dependent problems and difference methods* (advanced)

**Progamming language** All assignments must be coded in `Python`. Students needing general computational support are encouraged to attend the AE Computational Office Hours on Thursdays 12-6pm in the 2nd Floor AE Lounge, Talbot.

**Assignments** This course requires that you submit several `Assignments` through Canvas:

- 5 homework reports
  ↪ out of 5 homework grades, only the 4 best results will count towards your final course grade.
- 1 take-home midterm
- 1 final project report

Homeworks will be available on Canvas about one week before the submission deadline. Late submission of any assignment will incur a penalty of 10% per day past the submission deadline.

Submissions guidelines are provided in the Canvas `Syllabus`. Tentative submission deadlines are provided below. They may be subject to changes, which will be announced in class and on Canvas. Therefore, it is your responsibility to regularily check Canvas and look for course announcements.

*Tentative assignment submission deadlines:*

| | |
|---|---|
| Homework 1 | February 14 |
| Homework 2 | February 21 |
| Homework 3 | February 28 |
| Take-home midterm | March 14 |
| Homework 4 | April 11 |
| Homework 5 | April 18 |
| Project | May 14 |

*Fourth credit hour requirements:* Assignments will contain questions specifically written for 4-credit-hours students. They will have to completed by 4-credit-hours students in order to obtain a full grade, however they are not required to be completed by 3-credit-hours students.

**Grading scheme** We will employ the following grading scheme:

*Grade repartition:*

| | |
|---|---|
| Homework/mini-codes | 40% |
| Take-home midterm | 25% |
| Project | 35% |

*Grade conversion:*

| Total | Grade | Total | Grade | Total | Grade | Total | Grade |
|---|---|---|---|---|---|---|---|
| $\geq 98$ | A+ | $[88, 90)$ | B+ | $[78, 80)$ | C+ | $[68, 70)$ | D+ |
| $[92, 98)$ | A | $[82, 88)$ | B | $[72, 78)$ | C | $[62, 68)$ | D |
| $[90, 92)$ | A– | $[80, 82)$ | B– | $[70, 72)$ | C– | $[60, 62)$ | D– |
| | | | | | | $< 60$ | F |

*Dispute process:* Grade disputes on any assignment or exam will follow this process:

1. You must wait 24 hours after receiving your graded item before contacting us. During this time, please carefully consider what the dispute is and why you believe an error has been made. You will have no more than two weeks, starting from the day the item is returned, to bring any dispute to our attention. Disputes after the two week window will not be considered.
2. Contact your TA first and discuss the dispute with them. If you reach an agreement, then the dispute is resolved.
3. If you and the TA do not reach agreement, then the three of us (you, the TA, and the instructor) will meet face-to-face.

**Student code and academic integrity** The University of Illinois Urbana-Champaign Student Code will be followed at all times during this course. We invite you to read through Article 1, Part 4: Academic Integrity in particular. Every student is expected to review and abide by this academic integrity policy, and it is your responsibility to read it to avoid putting yourself in a position that may result in you failing this course. If you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity in the context of this course, do not hesitate to contact the instructor.

You are expected to produce your own work in all assignments. You may collaborate with a peer, but your assignment must be written by you only. Assignments will be checked for plagiarism. If your work closely matches someone else's, it will be flagged and investigated.

**Use of Generative AI Technology** Generative AI, such as OpenAI ChatGPT, Microsoft Copilot/Bing Chat, Google Gemini, and others, can answer questions and generate text, images, and code. The appropriate use of generative AI will vary from course to course. Guidelines for using generative AI in this course are as follows:

1. Follow only the specific permitted uses set by your instructor.
2. Document and attribute all AI contributions to your coursework.
3. Take full responsibility for AI contributions, ensuring the accuracy of facts and sources.

Permitted uses of generative AI in this course include:

- Shortening your own text and revising it for spelling and grammar.
- Testing and practicing your knowledge of course topics.
- Conducting basic research on course and assignment topics.

Additional allowed uses and restrictions may apply to specific assignments as specified in that assignment's instructions.

When using generative AI, keep a journal documenting prompts, AI responses, and your usage, or, if possible, share a link to your chat history. Your instructor may ask you to provide this documentation. Refer to the APA style guide for citing generative AI, including the text of your prompt to the AI. Remember, a generative AI conversation in and of itself is not a valid source for facts. Always work to find, verify, and cite the original source of ideas, rather than citing the AI directly. Review the University of Illinois System's Generative AI Guidance for Students. You are responsible for verifying sources and facts and attributing ideas generated by the AI. Generative AI tools sometimes invent facts and sources.

Failure to abide by these guidelines is a violation of academic integrity. We will investigate suspected uses of generative AI that do not follow these guidelines and apply sanctions as outlined in the Illinois Student Code.

**Absence policies**

*Feeling sick before class?* If you feel ill or are sick with a potentially contagious illness, you should not attend class and will be considered to have an excused absence. Please contact the instructor via Canvas about making up the work. We will do our best to accomodate such unfortunate instances and make sure you stay on track with the course.

*Other health-related issues:* Similarily, if you cannot attend class or complete assignments due to health-related issues, including but not limited to feeling ill, caring for a sick family member, or having unexpected child-care obligations, you should inform your instructor and are also encouraged to copy your academic advisor.

*Absence letters:* Conditions under which an absence letter from the Office of the Dean of Students may be requested are defined in Article 1, Part 5 of the Student Code.

**Anti-Racism and inclusivity** The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gende identity, sexuality, disability status, class, age, or religious beliefs. The College recognizes that we are learning together in the midst of the Black Lives Matter movement, that Black, Hispanic, and Indigenous voices and contributions have largely either been excluded from, or not recognized in, science and engineering, and that both overt racism and micro-aggressions threaten the well-being of our students and our university community.

The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain a environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can report these behaviors to the Bias Assessment and Response Team (BART). Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

**Disability-related accommodations** To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may:

- Visit 1207 S. Oak St., Champaign
- Call 333-4603
- E-mail `disability@illinois.edu`
- Go to `https://www.disability.illinois.edu`

If you are concerned you have a disability-related condition that is impacting your academic progress, there are academic screening appointments available that can help diagnosis a previously undiagnosed disability. You may access these by visiting the DRES website and selecting "Request an Academic Screening" at the bottom of the page.

**Family Educational Rights and Privacy Act (FERPA)** Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See `https://registrar.illinois.edu/academic-records/ferpa/` for more information on FERPA.

**Religious observances** Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. You should examine this syllabus at the beginning of the semester for potential conflicts between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at `https://odos.illinois.edu/community-of-care/resources/students/religious-observances/` to request appropriate accommodations. This should be done in the first two weeks of classes.

**Sexual misconduct reporting obligation** The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the Title IX Office will provide information

about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: https://wecare.illinois.edu/resources/students/#confidential.

Other information about resources and reporting is available at https://wecare.illinois.edu/.

**Mental health** Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and emotional wellbeing. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings which are covered through the Student Health Fee. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University's resources provided below. Getting help is a smart and courageous thing to do for yourself and for those who care about you.

- Counseling Center (217) 333-3704
- McKinley Health Center (217) 333-2700
- National Suicide Prevention Lifeline (800) 273-8255
- Rosecrance Crisis Line (217) 359-4141 (available 24/7, 365 days a year)

If you are in immediate danger, call 911.

**Community of care** As members of the Illinois community, we each have a responsibility to express care and concern for one another. If you come across a classmate whose behavior concerns you, whether in regards to their well-being or yours, we encourage you to refer this behavior to the Student Assistance Center (217-333-0050 or http://odos.illinois.edu/community-of-care/referral/). Based on your report, the staff in the Student Assistance Center reaches out to students to make sure they have the support they need to be healthy and safe. Further, as a Community of Care, we want to support you in your overall wellness. We know that students sometimes face challenges that can impact academic performance (examples include mental health concerns, food insecurity, homelessness, personal emergencies). Should you find that you are managing such a challenge and that it is interfering with your coursework, you are encouraged to contact the Student Assistance Center (SAC) in the Office of the Dean of Students for support and referrals to campus and/or community resources.