

TAM 335-Introductory Fluid Mechanics

Spring 2024

Instructor: Md Abdul Hamid (mdabdul2@illinois.edu)

Classes: Day: MWF
Time: 11:00-11.50 AM
Location: 2310 Everitt Laboratory

Office Hour: Time: Thursday 5.00-6.00 PM
Location: 4100 Sidney Lu MEB

Website: hosted on <https://canvas.illinois.edu>

Course Overview:

This course is focused on the basic concepts of fluid mechanics. Students are expected to gather fundamental concepts and ideas on fluid, fluid properties, fluid statics and fluid dynamics. Fluid statics focuses on the analysis of fluid “not in motion”. Meanwhile, fluid dynamics is focused on Newtons 2nd law of motion along with conservation principles (i.e., mass, momentum, and energy). Students will gather ideas on how mathematics (differential calculus) defines fluid mechanics which should strengthen their analytical skills. Further, basic concepts of experimental fluid mechanics will be covered. Students will analyze their theoretical and experimental understanding in practical fluid mechanics applications.

Course topics: Fluid statics; continuity, momentum, and energy principles via control volumes; ideal and real fluid flow; introduction to the Navier-Stokes equation; similitude; laminar and turbulent boundary layers; closed conduit flow, open-channel flow, and turbomachinery.

** Credit is not given for “both” ME 310 and TAM 335.

Prerequisite:

Prior credit in TAM 212 Introductory Dynamics is required. The importance of some dexterity with calculus cannot be overstated. In this context, the material of MATH 241 Calculus III is important. If differential equations as well as symbols like ∂ and ∇ do not “ring a bell”, attendance of this course will, sooner or later, become problematic.

Textbook:

1. Munson, Young and Okiishi's *Fundamentals of Fluid Mechanics*, 8th edition, by Philip M. Gerhart, Andrew L. Gerhart, and John I. Hochstein, John Wiley & sons [Required]
2. Potter, Wiggert, Ramadan, *Mechanics of Fluids*, 4th edition, Cengage Learning [Recommended]
3. White, *Fluid Mechanics*, 7th edition, McGraw-Hill [Recommended]

Grading:

Laboratory:	15%	
Class Participation:	5%	(Interactive discussion: <i>bonus points</i> available in each class)
Homework:	20%	(Electronically submitted before class starts on due date(s))
Mid Term-1:	15%	(Detail will be discussed in class prior to Exam date)
Mid Term-2:	15%	(Detail will be discussed in class prior to Exam date)
Final Exam:	30%	(Detail will be discussed in class prior to Exam date)

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HomeWorks:

- HomeWorks will be published on canvas. All homework must be submitted as a single PDF file electronically on canvas before the scheduled class time on the due date.
- Homework solutions will be published after the due date is over (some may be discussed in class).
- Late homework submission(s) will not be accepted without prior arrangement and without good reasoning (as outlined in UIUC rules).

Exams:

These Exams are meant to assess student's understanding of the basic, fundamental concepts presented in class and illustrated in homework problems and lecture examples. Make-up examinations will only be given with good reason (per UIUC rules) and prior arrangement with the instructor.

- The dates and time and location of the exams are provided separately with lecture schedule.
- Details of Exams (*Type*-traditional/take home, *Access*-calculator, formulae, open/closed book, *duration* etc.) will be discussed in class before each Exam.

Grading Policies:

- All submissions must represent the student's own understanding (no exception).
- No group submission will be accepted for HomeWorks and exams. Students are encouraged to discuss the homework(s) with peers but are not allowed to duplicate other's work by any means and by any extent. Any duplication will result in zero credit on the corresponding homework(s)/exam(s), along with potential further action according to the existing UIUC rules.
- Plagiarism is a serious violation of academic integrity and will be severely dealt with according to existing UIUC policy.
- Partial credit(s) will be given in all homework(s) and exam(s), provided that a clear and coherent understanding/thought-process is presented.

Laboratory

This course has a separate laboratory section that will help illustrate the concepts presented in class through physical demonstration. For details on lab activity and report submission follow the instructions provided by your TA.

Course Content:

- Introduction (fluid and flow, continuum (application), properties)
- Fluid Statics (fluids that is not in motion: hydrostatics; buoyancy; manometry; stability)
- Fluid Dynamics (why and how fluids flow)
- Fluid Kinetics (why fluids flow: mass, momentum, and energy)
- Control volume analysis ("chunks" of fluid)
- Differential analysis ("points" of fluid)
- Fluid Kinematics (How fluids flow: streamlines, velocity, acceleration)
- Dimensional Analysis and Similarity (you won't be asked to build the whole Titanic to investigate what "actually happened" that day!)
- Internal Flow (channel and pipe flows, head loss)
- External Flow (boundary layers, momentum integral analysis, lift and drag- how Tennis ball top spin prevents hitting the ball to go Long!)
- Open-Channel Flow (critical depth, hydraulic jump etc.)
- Turbomachinery (basic introduction)

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Academic Integrity:

The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: <http://studentcode.illinois.edu/>. Academic dishonesty will result in a sanction proportionate to the severity of the infraction, with possible sanctions described in 1-404 of the Student Code (<https://studentcode.illinois.edu/article1/part4/1-404/>). Every student is expected to review and abide by the Academic Integrity Policy as defined in the Student Code: <https://studentcode.illinois.edu/article1/part4/1-401/>. As a student, it is your responsibility to refrain from infractions of academic integrity and from conduct that aids others in such infractions. A short guide to academic integrity issues may be found at <https://provost.illinois.edu/policies/policies/academic-integrity/students-quickreference-guide-to-academic-integrity/>. Ignorance of these policies is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

Anti-Racism and Inclusivity Statement:

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 gender 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 an 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 also report these behaviors to Campus Belonging Resources (<https://diversity.illinois.edu/diversity-campus-culture/belonging-resources/>). Based on your report, Members of the Office of the Vice Chancellor for Diversity, Equity & Inclusion staff 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.

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/communityof-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, we understand the impact that struggles with mental health can have on your experience at Illinois. Significant stress, strained relationships, anxiety, excessive worry, alcohol/drug problems, a loss of motivation, or problems with eating and/or sleeping can all interfere with optimal academic performance. We encourage all students to reach out to talk with someone, and we want to make sure you are aware that you can access mental health support at McKinley Health Center (<https://mckinley.illinois.edu/>). Or the Counseling Center (<https://counselingcenter.illinois.edu/>). For urgent matters during business hours, no appointment is needed to contact the Counseling Center. For mental health emergencies, you can call 911.

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Disruptive Behavior: Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability to teach. A student responsible for disruptive behavior may be required to leave class pending discussion and resolution of the problem and may be reported to the Office for Student Conflict Resolution (<https://conflictresolution.illinois.edu>; conflictresolution@illinois.edu; 333-3680) for disciplinary action.

Emergency Response Recommendations:

Emergency response recommendations can be found at the following website: <http://police.illinois.edu/emergency-preparedness/>. I encourage you to review this website and the campus building floor plans website within the first 10 days of class. <http://police.illinois.edu/emergency-preparedness/building-emergency-action-plans/>.

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-ofcare/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 here: <https://wecare.illinois.edu/>.

Students with Disabilities:

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the lab manager as soon as possible. To ensure that disability-related concerns are properly addressed from the beginning, students with disabilities who require assistance to participate in this class should contact Disability Resources and Educational Services (DRES) and see the instructor as soon as possible. If you need accommodation(s) for any sort of disability, please speak to me after class, or make an appointment to see me or see me during my office hours. DRES provides students with academic accommodations, access, and support services.

To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-4603 (V/TDD), or e-mail disability@illinois.edu. <http://www.disability.illinois.edu/>.