Syllabus

Thermodynamics & Fluids Fundamentals – AE 2010-A

Instructor: Dr. Turab Zaidi
Office Hours: TBD

Grading GTA: TBD
Email:
Office Hours:

Recitation UTA: TBD **Recitation:** Tuesdays, 5:00 pm-06:15pm, Skiles 371
Recitations are an optional session in support of AE 2010. The recitation is designed to allow students the chance to apply their knowledge of concepts via problem solving and discussion.
Email:
Office Hours:

Learning Assistant TA: TBD
Email:
Office Hours:

Course Description

This document provides basic information regarding the Thermodynamics & Fluids Fundamentals course. The course covers topics of Thermodynamic and fluid properties including Conservation laws, Isentropic flow, shocks and expansions, introduction to flows with friction and heat transfer along with applications to aerospace devices. The course is listed as **Thermodynamics & Fluids Fundamentals – AE2010-A** for **4 credit hours** in the course catalogue of the Georgia Institute of Technology.

Pre-requisites

PHYS 2211 – Intro Physics 1
MATH 2401/2551 – Calculus 3/Multivariable Calculus
CHEM 1310 or CHEM 1211K – General Chemistry or Chemical Principals 1

Course Website

The course website is available via the Canvas portal at:
https://canvas.gatech.edu/

This website is intended to provide official course materials, assignments, announcements, and relevant information. Note that the website will be updated and must be checked on a regular basis. It is the student's responsibility to maintain access to this account and address email filtering issues.

To log in, use your GT account username and your GT account user password. Once in Canvas, select the AE 2010-A course for this semester.

Lectures

Lectures take place on **Mondays and Wednesdays,** from **9:30am-12:15pm** in **Weber SST III | Room 2**. These locations and timings will not change unless otherwise specified by the instructor. You should also reference the course schedule for further details on lecture days and topics for each class. **In-person attendance is required for all lectures and assessments**, attendance will be monitored and recorded for participation credit.

School Calendar

The official school calendar of the Georgia Institute of Technology is provided by the Office of the Registrar and is available at:
http://www.registrar.gatech.edu/home/calendar.php

Course Schedule

The course schedule provided to students on Canvas to help plan their studies and course work. It is a tentative outline of the course activities and is subject to change at the discretion of the instructor as the course progresses. Students are expected to use the schedule to prepare their readings in advance of each lecture and to prepare for assessments.

Course Textbooks

Anderson, John D. *Fundamentals of Aerodynamics*, *6th ed*. New York: McGraw-Hill.
Turns, Stephen R. *Thermodynamics: Concepts and Applications*. New York: Cambridge University Press, 2006.
(Please check with me if you would like to use a different edition of the textbook)

Course Goals

Short Term (While taking your next courses, what do I want you to remember):

1. Define basic thermodynamic properties and calculate one property using state equation relationships and knowledge of other proprieties.
   For example: Given knowledge about the density and temperature of a closed-system, determine the pressure, assuming idealized conditions.
2. Define and apply basic theorems of thermodynamics to analyze both closed and open systems.
   For example: Draw an appropriate control volume in order to analyze a system and determine the change in internal energy.
3. Pose and solve quasi-one-dimensional compressible flow problems, including: converging-diverging nozzles, supersonic flows over simple bodies/airfoils, and shock tube flows.
   For example: Evaluate an airfoil by analyzing shock waves and expansion waves in order to determine properties of the flow at various chord-wise locations.
4. Analyze, synthesize, and evaluate a problem of interest: describe the system under analysis and develop a mental model; distinguish and choose relevant laws, relationships, equations,

etc.; combine these "tools" to help solve the problems; evaluate answers by explaining their relevance to the bigger picture.

For example: Instead of giving up on a difficult problem in senior design, you know to collect the information you have been given, examine relevant assumptions you can make, apply appropriate laws, relationships, etc., and then scrutinize your results for accuracy and their meaning.

5. Demonstrate professional engineering skills, including: teamwork (e.g., time management, communication, cooperation, technical contributions), technical communication (e.g., documenting engineering analysis), and insightfully interpret your results.

   For example: While working on team projects in future classes, you are able to effectively handle your responsibilities by conducting proper (engineering)analysis and clearly documenting/reporting your results. You also actively contribute in the dividing of tasks/responsibilities in order to ensure that everyone on the team is actively participating.

Long Term (10 years later, what do I want you to remember):

1. Describe basic thermodynamic properties and theorems/laws, including assumptions and their applications.

   For example: The system cannot exist because analysis shows that it reduces the total entropy, which violates the Second Law of Thermodynamics.

2. Compare and contrast properties of compressible and incompressible flow and their behavior in the presence of simple bodies/airfoils.

   For example: Generally speaking, describe how the flow changes in the presence of a shock wave on a wing compared to incompressible flow over that wing.

3. Explain difference between open and closed systems and draw appropriate control volume/mass diagrams to describe a system of interest.

   For example: When analyzing an electric water-heating tank, how does one account for the incoming water and the incoming electricity to the system?

4. Apply problem-solving skills developed in this class to problems concerning thermodynamics, fluids, or any range of topics.

   For example: Instead of giving up on a difficult problem at work, you know to collect the information you have been given, examine relevant assumptions you can make, apply appropriate laws, relationships, etc., and then scrutinize your results for accuracy and their meaning.

Expectations of Students

The GT Student-Faculty Expectations page articulates some basic expectations that we can have of each other. Students are expected to participate in a learner-centered classroom so that they can learn the material of this course in order to become exceptional aerospace engineers. With this in mind, students are expected to ask questions, show respect to the instructor and other students, participate in classroom activities, actively participate in groups, and make every effort to understand the course material.

Remember that the best way to learn these concepts is by doing problems! Make an effort to try problems on your own and reach out to the TA and I if you need help.

The student is expected to be on time to lecture and not leave early, unless making prior arrangements with the instructor.
Whenever possible, please notify the instructor in advance if missing class so I can help make arrangements to support you.
Speak with LAs before/after class periods to express concerns, ask questions, or catch up on material.
Monitor Canvas announcements closely and respond to requests in a timely manner.
Be proactive about communicating by reaching out to me early and often, so we can quickly resolve your concerns.
This is a challenging course that will require dedication and effort from students, throughout the semester, in order to succeed.

Expectations of the Instructor

I deeply care about your learning of the course material, in fact it is my first priority as your instructor. I will always try to start and end lecture on time because I understand the importance of your time. If there is ever a time that class needs to be cancelled, alternate arrangements will be made for that class. I will always try to return your graded assignment within 1 week or less. You are always welcome to stop by my office to ask questions about the course.
If you have not heard back within 48 hours, please do not be afraid to reach out a second time in case your e-mail or text was misfiled or undelivered. I strongly recommend using your campus e-mail for communication.

Assignment Overview & Grade Breakdown

Assignment	Point Value
Exam 1	20
Exam 2	20
Quizzes	20
Individual HWs	30
Group HWs	15
Final Exam (Cumulative)	35
Participation	10
TOTAL	150

Total Points	Grade
135 - 150	A
120 – 134.9	B
105 – 119.9	C
90 – 104.9	D
<89.9	F

Assignment Details

Exams – A closed book, in-person, individual 80-minute assessment seeking to test student's comprehension of the course material. **Exam 1 and Exam 2** dates can be found in the **Course Schedule**. These dates are tentative and may be adjusted at the discretion of the instructor depending on the progress of the course.
Your handwritten solutions will be submitted in two ways, similar to the Homework assignments. However, the HW format is not required on timed exams.
First, you will take a pdf scan of your written work from your phone's camera with a scanning app like Camscanner and create a pdf (photo files are not acceptable). Then upload your pdf to Gradescope through the link in the Canvas Assignments area. There

will be a Practice Exam (grade will not count) prior to Exam 1 to help you get acclimated to the procedure.
Then, submit your physical exam paper to the TA before leaving the room. Both submissions are required for your exam to be graded.

Quizzes: An individual 50-minute assessment seeking to test your understanding of recent material and how it applies to problems of interest. **Quiz 1, Quiz 2, and Quiz 3** dates can be found in the Course Schedule.

Homeworks: These will be a mix of individual and group assignments to be completed outside of class time. Collaboration policies will be defined for each handout. There will be many of these throughout the semester. They will be distributed at the beginning of class and will not be announced ahead of time, the assignment will only be available to students that attend lecture the day they are assigned. If you are absent when a handout is assigned, you will not receive credit for submitting that handout. Due dates will be indicated on the handout, typically due 1 week from date assigned. No makeups or late submissions will be accepted. Any homework submitted 24 hours or more before the due date will receive a 5% bonus.
No makeups or late submissions will be accepted. All submissions will be made in two ways:
First, make a pdf scan of your written work from your phone's camera with a scanning app like Camscanner and create a pdf (**photo files are not acceptable**). Then upload your pdf to Gradescope through the link in the Canvas Assignments area before the due date.
Then, submit your physical homework paper with cover sheet to the TA at the start of class on the due date. **Both submissions** are required on time for your homework to be graded.

Make submissions to Gradescope from the link in the Canvas Assignments area. Gradescope is an external tool, linked within Canvas, which assists with remote learning. Please watch this short video about it to help familiarize yourself with using it.

1) Individual Homework: While you are allowed to discuss your approach with a study group to complete these, the work you submit must be your own original work, not copied.
2) Group Homework: The TA will assign you to a group for each group homework. These will typically be more challenging problems, and you will work together to submit one solution to the problem(s). Groups will be responsible for coming up with a mutually agreeable time to work together. These times must work for all participants. If a group is having trouble agreeing upon a meeting time or has issues with a group member missing sessions, the instructor should be notified as soon as possible. Groups may or may not be shuffled during the semester at the discretion of the instructor. **Although you will submit one assignment, you will be asked to specifically list out the team members that contributed to the working session and provide a description of how your team collaborated.**

When the Homeworks are returned to you, please review them and ask questions if you don't understand your grade or why you lost points on a particular problem. As part of your

learning process, you must ensure that you know how to properly complete all Exam and Homework problems, solutions will not be posted. However, we will help guide you along if you need assistance.
The course assignments have an intended purpose and are meant to be of appropriate difficulty – if you find yourself struggling with the any assignments, please seek assistance.

All Homework solutions must be completed in the following format to receive credit:

- **Given** – Rephrase important part of problem in your own words. Present all values given in the description. Include a sketch or free body diagram.
- **Find** – Concisely describe what the problem is asking you to calculate.
- **Assumptions** – List basic assumptions that will be used in solving the problem.
- **Analysis** – Show all your work, do not skip steps.
    - "Do Algebra, not Arithmetic!" Please keep your solutions in variable form until numbers are needed at the end to solve for the answer.
    - Always write an appropriate equation in generic form to begin analysis. Never jump directly to writing numbers without providing an equation in variable form first!
    - Then clearly indicate which values you are using for each variable when substituting in numbers
    - When inserting numbers, always **write units** clearly with every number, on each line of your analysis. You should not have any numbers floating around without a unit next to them!
    - Remember to always **simplify all math** and give an actual number in your final answer!
    - Draw a **box** around your **final answer** to make it clear.
    - Remember, if I can't follow your work, then I can't give you credit, so make sure your work is **neat**, **clear**, easy to follow, written **large** and **legible**.
    - *No points for magically appearing answers!*
- **Implications** – Describe, in words, something interesting about the result from the problem.

Final Exam: Students will have the opportunity to showcase their knowledge of the course material by taking a cumulative final exam; this is not optional. This will allow students to synthesize information learned throughout the semester.

Participation: This portion of the grade will determined by the instructor based on the student's overall participation in the course and the learner-centered classroom including meeting deadlines, submitting all assignments, and demonstrating engagement with the course content (lectures, readings, Canvas notes, etc.).
Attendance is required in all classes and students must be punctual to receive full participation points. Students must be able to answer questions about course readings for

that day and actively contribute to in-class group activities. Always bring your calculator to class for in-class exercises.
This course will also utilize Ed Discussion Board (available through Canvas side menu) to enhance communication and discussion between all members of the course. You can post (publicly or anonymously) questions there and get feedback collaboratively from everyone, including your peers in the class. **If you ever find yourself in any situation in which an unexpected personal challenge is preventing you from performing your best in the course, please reach out so we can come up with a plan for you.**

Progress Report

Since this is a 2000-level course, everyone will be assigned a progress report. A grade of a **U** means that you are currently performing unsatisfactorily and are on track to earn a low grade in the course unless you change your approach to the course. A grade of an **S** means that you are performing satisfactorily up to that point in the semester. If you earn a **U**, then you are highly encouraged to meet with the course instructor. It should be noted that these grades are only based on a small number of assignments and do not guarantee any final grade.

What Does Your Grade Mean?

A – If you receive an A, then you have demonstrated significant mastery of course material. You ability to master complex material means that you have the skills necessary to thrive in industry.

B – If you receive a B, then you possess a deep understanding of the course material. You are able to synthesize complex ideas and solve complex problems. You have the necessary skills to have a successful career in engineering.

C – If you receive a C, then you are able to understand the course material. This means that you have demonstrated sufficient knowledge of the subject matter. You possess the skills necessary of an engineer.

D – If you receive a D, then there is something missing. You may not completely understand the course material, or you may not be able to synthesize the various concepts. Regardless of the reason, there is improvement needed in order to gain an adequate working knowledge of the material.

F – If you receive an F, then there is a significant gap in your knowledge of the course material. Every F is unique – it is highly encouraged that you reflect on what led to you receiving this grade and make an appointment with an academic advisor in the School of AE and/or Georgia Tech.

Honor Code Statement

Students are expected to abide by the Honor Code of the Georgia Institute of Technology. Information on the Honor Code can be found at:
http://www.honor.gatech.edu/
It is the student's responsibility to become familiar with the Honor Code of the Institute. When in doubt about rules or specific situations students should contact the class assistants or an Honor Advisory Council member. Violations to the Honor Code have serious consequences and will be enforced at all times. Suspected violations will be reported to the Office of Student Integrity for further investigation.

Course Ethics

Students are expected to uphold high ethical standards including adherence to the Georgia Institute of Technology Honor Code, Academic Regulations and Student Regulations.

Below are some guidelines to help you understand what constitutes appropriate academic behavior in this course:

- Students are not permitted to review or use materials from previous semesters. This includes the use of old homeworks, exams, or solutions.
- Students are permitted and encouraged to work collaboratively on assignments and seek help from one another, but the work that is turned in must be the student's own work. Copying another student's work is not permitted.
- On group assignments, students are expected to do their fair share of the work. If there is an instance where a student is not contributing to a group project, the team members should notify the instructor as soon as possible.
- Plagiarism of any kind is not permitted.

Other Course Policies

- Late and/or Incomplete assignments will not be accepted
- You are expected to attend all lectures
- Multiple instances of unexcused attendance issues are unacceptable and will incur higher penalties
- All excused absence must be handled by the Office of the Dean of Students – no exceptions
- Each student will be allowed **one** unexcused attendance issue (absence or lateness) per semester, please use it wisely if necessary.
- Exams cannot be made up or moved, so carefully take note of the schedule and plan accordingly
- If you know you are missing class, please inform me in advance if possible
- I strongly believe in the philosophy of "ask permission, not forgiveness"
- All re-grade requests must be submitted within 72 hours of assignment being returned. All requests must be submitted in writing – detailing the specifics of the re-grade (i.e., why points should be given back, with clear evidence). The instructor reserves the right to re-grade the entire assignment.

- Extensions may be granted in cases where extenuating circumstances prevented the student from reasonably completing an assignment on time. Examples include illness, emergencies, family situations, and institute excused absences. The Office of the Vice President and Dean of Students can assist students with documented emergencies by contacting professors on behalf of the student. You can get more information on this process here: https://studentlife.gatech.edu/content/class-attendance

Tips for Success

Successful learning requires significant effort from both the instructor and the student. I will do everything in my power to make this course a success and provide you with the resources you need to learn. However, being successful will require you to do your part as well. Here are a few tips to help you be successful in this course.

- Come to class! (And also come on time)
- Engage with the material. Understanding the concepts in aerospace engineering comes as a result of working through example problems and stretching your understanding. Don't be tempted to shortcut your learning process by looking up solutions online or copying from a friend. If you are stuck, ask for help, but don't be tempted to just copy the answer. Your learning will come through the (sometimes painful) process of working through the connections.
- Ask for help when you need it. Office hours are a great time to get help with homework, ask questions about the material covered in class, discuss your own performance in the course, or just to come and chat. These are a resource for you, and I encourage you to use it!
- Your peers are a resource. Talking out a problem with a classmate can be a fantastic tool to enhance learning for all parties. Explaining your thought process to someone else is often all it takes to get un-stuck. Plus, your current peers are the start of your professional network.
- Focus on your problem-solving process. Rather than focusing on simply learning the equations or memorizing a set of problems, focus on learning an approach to use when faced with a new problem. This skill will serve you well in all your courses and beyond.
- Make sure you contribute in group work, in class and outside class. These are designed to help you learn the material. Plus, your peers are the first of your future professional network. Don't start off with a bad impression!
- Use the Course Schedule and plan ahead!

Accommodations

Georgia Tech values diversity and inclusion; we are committed to a climate of mutual respect and full participation. Our goal is to create learning environments that are usable, equitable, inclusive and welcoming. If there are aspects of the instruction or design of this course that result in barriers to your inclusion or accurate assessment or achievement, please notify the instructor as soon as possible. Students with disabilities should contact the Office of Disability Services to discuss options of removing barriers in this course, including accommodations. ODS can be reached at 404.894.2563, dsinfo@gatech.edu, or disabilityservices.gatech.edu. If you need a classroom accommodation, please make an

appointment with the ADAPTS office (see www.adapts.gatech.edu). No request can be handled through the instructor.

Georgia Tech School of Aerospace Engineering Values

1. **Honesty:** The School of Aerospace Engineering values honesty and integrity of all members of our community. An important element of this value is the academic honor code.
   Georgia Tech Honor Challenge Statement: I commit to uphold the ideals of honor and integrity by refusing to betray the trust bestowed upon me as a member of the Georgia Tech community.
   Honor Code: http://policylibrary.gatech.edu/student-affairs/academic-honor-code#Article_I:Honor_Agreement

2. **Well Being:** The School of Aerospace Engineering values the complete well-being of all members of its community, which includes professional, physical, spiritual, emotional, and social dimensions. There are numerous resources to support the health and well-being of all members of our community: https://gatech.instructure.com/courses/108574

3. **Mental Health Resources:**
   Emergencies: Can either Call 911 or call Campus Police at 404.894.2500 http://www.police.gatech.edu/
   Center for Assessment, Referral, & Ed. (CARE): https://care.gatech.edu/ 404.894.3498 (Counselor On-Call)
   Counseling Center: https://counseling.gatech.edu/ 404.894.2575
   Stamps Health Services: https://health.gatech.edu/ 404.894.1420
   Student Life and Dean of Students: https://studentlife.gatech.edu/content/get-help-now 404.894.6367
   Victim-Survivor Support (VOICE): https://healthinitiatives.gatech.edu/well-being/voice 404-385-4464/(or 4451)
   National Suicide Prevention Lifeline: 1.800.273.TALK (8255)
   Georgia Crisis and Access Line: 1.800.715.4225