

**AE 2010 – Thermodynamics and Fluid Fundamentals**  
**Spring 2023**  
**Georgia Tech – Lorraine**  
**Mackenzie Lau, PhD**

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**Catalog Description:**

Thermodynamic and fluid properties. Conservation laws. Isentropic flow, shocks and expansions, introduction to flows with friction and heat transfer. Applications to aerospace devices.

**Course Prerequisites:**

Math 2551 Multivariable Calculus  
Physics 2211 Physics 1  
Chem 1310 or Chem 1211K

Students will be expected to have or be willing to develop a basic proficiency with a suitable computer coding language, such as MATLAB or Python, for the project.

**Course Description:**

- 1) Provide students with a fundamental understanding of the conservation laws and properties used to analyze fluids, flows, and energy conversion devices
- 2) Enable students to analyze basic compressible flows, including applications to nozzles, diffusers, and simple airfoils

**Learning Outcomes:**

Students will develop understandings of:

- Properties of fluids
- Thermodynamic properties and equations of state
- Basic concepts of thermodynamics
- The laws of thermodynamics
- Conservation equations and their applications, in both integral and differential form, to fluid phenomena and energy conversion devices
- Static and stagnation properties
- Propagations of and property variations due to flow disturbances
- Quasi-1D analysis of compressible internal flows
- Bernoulli equation, hydrostatics, and streamlines
- Physical characteristics and similarity parameters associated with continuum flow regimes
- Derivation of the basic conservation equations of thermodynamics and fluid mechanics
- Applications of covered material to aerospace systems

## Grading:

Attendance:	5%	A:	90-100%
Worksheets:	20%	B:	80-90%
Project:	15%	C:	70-80%
Midterm 1:	15%	D:	50-70%
Midterm 2:	15%	F:	0-50%
Final Exam:	30%		

The class will be taught using a semi-flipped structure. A brief lecture will be presented on each section, after which a worksheet will be provided. Students will spend the remaining time in class working on problems in small groups. Worksheets will be due at the beginning of class on conclusion of the relevant section. Late worksheets will receive a penalty of two (2) points per day. Collaboration on worksheets is encouraged; plagiarism will not be tolerated.

**The project will be assigned at or around the end of March and due during the last week of instruction.**

## Textbooks (Optional):

- 1) Anderson, J. D. (2001). *Fundamentals of aerodynamics*. Boston: McGraw-Hill.
- 2) Turns, S. R., & Haworth, D. C. (2021). *An introduction to combustion: Concepts and applications*.

## Tentative Schedule:

Week	Topic
1	Orientation, introduction
2	Matter, systems, and energy
3	Equilibrium and properties, flow fields
4	States: Extensive, intensive, postulate, and equations of
5	Ideal gases, incompressible fluids, phases
6	Spring Break
7	<b>Review and Midterm 1</b>
8	Transport properties, mass conservation
9	Control volumes, Reynolds transport theorem, momentum
10	Bernoulli equation, energy analysis
11	The second law of thermodynamics
12	High speed flows, isentropic flows, normal shocks
13	<b>Review and Midterm 2</b>
14	Oblique shocks, expansion fans
15	Supersonic airfoils, friction and heat transfer
16	Applications to aerospace system design, review, final exams
17	<b>Final Exams</b>

The class schedule is subject to change based on, among other factors, the pace of in-class discussions and activities.

# Georgia Tech School of Aerospace Engineering Values



## Discussion Points

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>

### 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

### COVID-19 Safety: Vaccinate, Mask, Test

GT Safety Guidelines: <https://health.gatech.edu/tech-moving-forward>

Current guidance is summarized below, but continue to follow the site above and other Institute communications in case changes occur:

- If there is one thing each one of us can do to protect ourselves and keep others safe, it is to get vaccinated. The new vaccines have proven to be extraordinarily effective at preventing severe illness. [Getting vaccinated at Georgia Tech](#) easy and free.
  - At Georgia Tech, everyone is encouraged to wear a mask or face covering while inside campus facilities.
  - The free asymptomatic surveillance testing program remains available to all students and employees. You may participate in regular testing even if you have been fully vaccinated. We especially encourage those who have not been vaccinated to [get tested weekly](#).
3. **Social Justice:** The School of Aerospace Engineering values social justice for all members of the Georgia Tech community and the larger society. Social justice means that everyone's human rights are respected and protected. We stand committed in the fight against racism, discrimination, racial bias, and racial injustice. Our shared vision is one of social justice, opportunity, community, and equity. We believe that the diversity and contributions from all of our members are essential and make us who we are. We believe that our impact must reach beyond the classroom, research labs, our campus, and the technology we create, but must also improve the human condition where injustice lives. We will continue to work to understand, value, and celebrate all people and create an inclusive educational and work environment that welcomes all.

As a matter of policy, Georgia Tech is committed to equal opportunity, a culture of inclusion, and an environment free from discrimination and harassment in its educational programs and employment. Georgia Tech prohibits discrimination, including discriminatory harassment, on the basis of race, ethnicity, ancestry, color, religion, sex (including pregnancy), sexual orientation, gender identity, national origin, age, disability, genetics, or veteran status in its programs, activities, employment, and admissions.

<http://policylibrary.gatech.edu/equal-opportunity-nondiscrimination-and-anti-harassment-policy>