AE 2010 Thermodynamics and Fluid Fundamentals
Summer 2023 @ Georgia Tech – Europe

Instructor: Mackenize Lau, PhD
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Prerequisites:
Math 2551; Physics 2211; 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

This class will be run as a flipped classroom. Students are expected to review course materials on their own time, inside and/or outside of class. Worksheets will be provided by the instructor and class time will be allocated for students to work on them. Working in groups to solve worksheet problems is strongly encouraged; students are reminded that the copying and/or claiming ownership of another student's work is a violation of the Georgia Tech Honor Code.

Learning Outcomes:
Students will develop understandings of:

- Descriptions and definitions of systems
- Properties of fluids
- Thermodynamic properties and equations of state
- Basic concepts of thermodynamics
- The laws of thermodynamics
- Conservation equations and their applications
- Static and stagnation properties of fluids
- Propagation of and property variations due to flow disturbances
- Quasi-1D analysis of compressible internal flows
- Bernoulli equation, hydrostatics, and flow visualization techniques
- 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 and Minimum Percentage to Guarantee Grade:
Final grades may be curved at the discretion of the instructor. Curves will always benefit students: A 91% will never receive a B but an 89% may be bumped to an A.

Attendance:	10%
Worksheets:	20%
Project:	20%
Midterm 1:	15%
Midterm 2:	15%
Final Exam:	20%

A:	90%
B:	80%
C:	70%
D:	65%
F:	60%

Attendance:
Attendance is required. Absences will be permitted for reasonable circumstances, provided adequate notice is provided to the instructor and the academic office. The first unexcused absence will result in a 2% deduction from the final grade, a second will result in a further 3% reduction, and a third will result in a further 5% reduction. Any further unexcused absences will be handled at the discretion of the instructor and academic office.

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.*
3) Basically everything on the second shelf from the top in cabinet 3845 in the GTE library

Tentative Schedule:

Worksheet	**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
6	Incompressible fluids, phases
7	Spring Recess
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
13	Isentropic flows, normal shocks
14	Oblique shocks, expansion fans
15	Supersonic airfoils, friction and heat transfer
16	Applications to aerospace system design, review, final exams
17	Final Exams

The actual class schedule is subject to change based on the pace of in-class discussions and activities.

Georgia Tech School of Aerospace Engineering Values

Integrity

I achieve excellence by embodying the highest ethical standards and communicating openly, authentically, and with humility.

Respect

I extend courtesy to everyone and promote a culture of inclusion, fairness, and equity.

Community

I am a global citizen and celebrate our collective achievements and contributions to the world around us.

Accountability

I take ownership of my actions and value the responsibility to honor public trust.

Adaptability

I embrace change as a path to progress, success, and innovation.

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
   GT Safety Guidelines: https://health.gatech.edu/tech-moving-forward
   Current guidance is summarized at the site above and please continue to follow the site above and other Institute communications in case changes occur:
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