



AE/ME 5342 Gas Dynamics
Spring 2019



Instructor: Frank K. Lu

Office Number: 340 ERB

Office Telephone Number: 817-272-2083

Email Address: franklu@uta.edu

Faculty Profile: <https://www.uta.edu/profiles/frank-lu>

Office Hours:

1. Open door policy or by appointment (via email)
2. Ad hoc tutorial sessions will be held depending on demand
3. Further announcements will be provided

Section Information: AE 5342-001, AE 5342-002, ME 5342-001, ME 5342-002

Time and Place of Class Meetings: General Academic Classroom Building 103, Tuesday & Thursday, 9:30 – 10:50 a.m.

Description of Course Content: Review of fundamental compressible flow theory, method of characteristics for perfect gases, the Rankine-Hugoniot conditions, linearized flow theory.

Student Learning Outcomes:

1. To achieve a fundamental understanding of perfect gas flow
2. To be able to apply the concepts to practical engineering problems

Required Textbooks and Other Course Materials:

Liepmann, H.W. and Roshko, A., Elements of Gasdynamics, Dover reprint

Note 1: Online resource: Fundamental of Compressible Flow <http://www.potto.org/index.php>

Note 2: Applet: Compressible Aerodynamics Calculator
<http://www.dept.aoe.vt.edu/~devenpor/aoe3114/calc.html>

Note 3: Any further course materials will be announced in class, Blackboard and email as they arise.

Descriptions of major assignments and examinations:

- | | |
|---|---------|
| • Four homework assignments (each to be worked out individually) | 4 × 5% |
| • Two projects (each to be submitted as a complete report – details on submission will be provided) | 2 × 15% |
| • One mid-term exam | 20% |
| • One final comprehensive exam | 30% |

Course Schedule

Approximate Lecture/Topic Schedule (regular semester):

As the instructor for this course, I reserve the right to adjust this schedule in any way that serves the educational needs of the students enrolled in this course.

--Frank K. Lu

1. Introductory Concepts	1 week
Thermodynamic relations and definitions: reversible and irreversible processes	
Equilibrium, mixtures, law of mass action, dissociation, real gases	
2. One-Dimensional Wave Motion	2 weeks
Propagating shock wave	
One-dimensional isentropic equations	
Acoustic equations	
Shock tube, wave reflections	
Normal shock waves	
3. Waves in Supersonic Flow	3 weeks
Oblique shock waves, weak and strong solutions	
Prandtl-Meyer function and expansion	
Simple and nonsimple regions, reflection and intersection of oblique shocks	
Detached shocks, Mach reflection	
Shock-expansion theory	
Thin airfoil theory	
Flat lifting wings	
Hodograph plane	
Conical shocks – Taylor-Maccoll theory (depending on time)	
4. Flows in Ducts	3 weeks
Channel of varying area	
Convergent-divergent nozzle	
Effects of second throat	
Rayleigh and Fanno flow	
Generalized inviscid compressible duct flow of a perfect gas	
Rayleigh, Fanno, and combined quasi 1-D steady flows	
5. Equations of Frictionless Flow	2 weeks
Continuity, momentum, energy	
Eulerian Derivative	
Natural Coordinates, Crocco's Theorem	
Velocity Potential	
Irrotational Flow	
6. Small Perturbation Theory	1 week
Derivation of Perturbation Equations	
Pressure Coefficient	
Boundary Conditions	
7. Similarity Rules	1 week
Two-Dimensional Linearized Flow, Prandtl-Glauert and Gothert Rules	
Hypersonic Similarity	
8. Method of Characteristics	2 weeks
Hyperbolic equations	
Compatibility relation	
Computational method	

Grading: Students are expected to keep track of their performance throughout the semester and seek guidance from available sources (including the instructor) if their performance drops below satisfactory levels; see “Student Support Services,” below.

- Four homework assignments (each to be worked out individually) 4 × 5%
- Two projects (each to be submitted as a complete report) 2 × 15%
- One mid-term exam 20%
- One final comprehensive exam 30%

A weight (commonly called “curve”) based on the **second** highest overall score (raw score) will be used to determine the final individual scores prior to assigning the letter grade. The score will be rounded up.

Example:

Highest overall raw score = 95 → + 7 = 102

Second highest overall raw score = 93 → + 7 = 100

Individual raw score = 85

Final individual score = 85 + 7 = 92. Final letter grade: A

Make-up Exams:

1. **No missed quizzes and exams. Only valid excuses are**
 - a. **Authorized UTA activity with note**
 - b. **Religious observations-- see**
http://www.uta.edu/catalog/content/general/academic_regulations.aspx#19.
 - c. **Medical reason with medical note**
2. **No late homework or projects will be accepted**

Attendance: At The University of Texas at Arlington, taking attendance is not required but attendance is a critical indicator in student success. Each faculty member is free to develop his or her own methods of evaluating students’ academic performance, which includes establishing course-specific policies on attendance. As the instructor of this course, **I will NOT take attendance.** However, while UT Arlington does not require instructors to take attendance in their courses, the U.S. Department of Education requires that the University have a mechanism in place to mark when Federal Student Aid recipients “begin attendance in a course.” UT Arlington instructors will report when students begin attendance in a course as part of the final grading process. Specifically, when assigning a student a grade of F, faculty report the last date a student attended their class based on evidence such as a test, participation in a class project or presentation, or an engagement online via Blackboard. This date is reported to the Department of Education for federal financial aid recipients.

Expectations for Out-of-Class Study: Beyond the time required to attend each class meeting, students enrolled in this course should expect to spend at least an additional 9 hours per week of their own time in course-related activities, including reading required materials, completing assignments, preparing for exams, etc.

Grade Grievances: For undergraduate courses, see <http://catalog.uta.edu/academicregulations/grades/#undergraduatetext>. For student complaints, see <http://www.uta.edu/deanofstudents/student-complaints/index.php>.

Drop Policy: Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student’s responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance.** Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (<http://www.uta.edu/aao/fao/>).

Classroom Decorum:

- a. Cooperate in maintaining a positive learning experience and showing respect to me and your fellow students (etiquette: an old-fashioned idea)
 - i. Don't read the newspaper
 - ii. Don't engage in side discussions
 - iii. Don't eat or drink in class
 - iv. Don't play with your electronics – there is a place and time
- b. Use of laptops – only for notetaking
- c. Email communication with me is for coursework only. There is no guarantee of immediate or same day response.
- d. Your friends also paid their tuition
- e. Noncompliance will result in student being asked to leave the class for disruptive behavior

Disability Accommodations: UT Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including *The Americans with Disabilities Act (ADA)*, *The Americans with Disabilities Amendments Act (ADAAA)*, and *Section 504 of the Rehabilitation Act*. All instructors at UT Arlington are required by law to provide “reasonable accommodations” to students with disabilities, so as not to discriminate on the basis of disability. Students are responsible for providing the instructor with official notification in the form of a **letter certified** by the Office for Students with Disabilities (OSD). Only those students who have officially documented a need for an accommodation will have their request honored. Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting:

The Office for Students with Disabilities, (OSD) www.uta.edu/disability or calling 817-272-3364.

Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability.

Counseling and Psychological Services, (CAPS) www.uta.edu/caps/ or calling 817-272-3671 is also available to all students to help increase their understanding of personal issues, address mental and behavioral health problems and make positive changes in their lives.

Non-Discrimination Policy: *The University of Texas at Arlington does not discriminate on the basis of race, color, national origin, religion, age, gender, sexual orientation, disabilities, genetic information, and/or veteran status in its educational programs or activities it operates. For more information, visit uta.edu/eos.*

Title IX Policy: The University of Texas at Arlington (“University”) is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. *For information regarding Title IX, visit www.uta.edu/titleIX or contact Ms. Jean Hood, Vice President and Title IX Coordinator at (817) 272-7091 or jmhood@uta.edu.*

Academic Integrity: Students enrolled all UT Arlington courses are expected to adhere to the UT Arlington Honor Code:

I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.

I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.

UT Arlington faculty members may employ the Honor Code in their courses by having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System *Regents' Rule* 50101, §2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University. Additional information is available at <https://www.uta.edu/conduct/>.

Electronic Communication: UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at <http://www.uta.edu/oit/cs/email/mavmail.php>.

Campus Carry: Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit <http://www.uta.edu/news/info/campus-carry/>

Student Feedback Survey: At the end of each term, students enrolled in face-to-face and online classes categorized as "lecture," "seminar," or "laboratory" are directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student's feedback via the SFS database is aggregated with that of other students enrolled in the course. Students' anonymity will be protected to the extent that the law allows. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback is required by state law and aggregate results are posted online. Data from SFS is also used for faculty and program evaluations. For more information, visit <http://www.uta.edu/sfs>.

Final Review Week: for semester-long courses, a period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week *unless specified in the class syllabus*. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Emergency Exit Procedures: Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exits. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.

Active Shooter/Threat: Details can be found in police.uta.edu/activeshooter

Student Support Services: UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include [tutoring](#), [major-based learning centers](#), developmental

education, [advising and mentoring](#), personal counseling, and [federally funded programs](#). For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to resources@uta.edu, or view the information at <http://www.uta.edu/universitycollege/resources/index.php>.

The IDEAS Center (2nd Floor of Central Library) offers **free** tutoring to all students with a focus on transfer students, sophomores, veterans and others undergoing a transition to UT Arlington. To schedule an appointment with a peer tutor or mentor email IDEAS@uta.edu or call (817) 272-6593.

Emergency Phone Numbers: In case of an on-campus emergency, call the UT Arlington Police Department at **817-272-3003** (non-campus phone), **2-3003** (campus phone). You may also dial 911. Non-emergency number 817-272-3381

Stop. Think. Protect Yourself. You Have Choices.

The safety and security of our campus is the responsibility of everyone in our community. Each of us has an obligation to be prepared to appropriately respond to threats to our campus, such as an active aggressor. This graphic provides each member of the UTA community with information and options for responding to an active threat. These options are not chronological, but are designed to address dynamic situations. Assess the situation (your location, the location of the threat, type of threat, etc.), identify and weigh your options, develop a plan of action and commit to it.

<h2 style="color: #c00000; text-decoration: underline;">YOUR OPTIONS TO AN ACTIVE THREAT</h2> <h3 style="color: white;">You Have Choices!</h3>	
A V O I D	<ul style="list-style-type: none"> • AVOID the situation. <u>Stay away</u> from the area and campus. • If you can safely leave the area, RUN. • Get others to leave the area, if possible. • Prevent others from entering the area.
D E N Y	<p>If you can't leave the area safely, DENY or slow entry to the intruder:</p> <ul style="list-style-type: none"> • Lock/barricade doors with heavy items. • Turn off lights/projectors/equipment. • Close blinds and block windows. • Stay away from doors and windows.
D E F E N D	<p>If you can't AVOID or DENY entry to the intruder, DEFEND your location:</p> <ul style="list-style-type: none"> • As a last resort, <u>FIGHT for your life</u>. • Use physical force and any weapons available - fire extinguishers, books, chairs, belts, umbrellas, pens/scissors, hot coffee/drinks, trash cans, etc.
<p>Follow ALL instructions.</p> <p>For more information, go to: police.uta.edu/activeshooter</p> <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;">  </div> <div style="text-align: right;"> <p>Emergency: 817.272.3003 Non-Emergency: 817.272.3381 police.uta.edu</p> </div> </div>	

Additional information for active threat and other emergency situations can be found through the links below:

- police.uta.edu/activeshooter
- police.uta.edu/em