

# AEE 343: Compressible Flow (3 credits)

## Syllabus – Spring 2023



### Instructor

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### Teaching Assistant

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### Course Information

	Time	Location
<b>Classes</b>	Tuesday/Thursday 9:30 - 10:50AM	Sims Hall 331
<b>Office hours (Instructor)</b>	Monday/Wednesday 3:00 - 4:00 PM	Link 212
<b>Office hours (TA)</b>	Friday 10:00AM - 12:00PM	Link 217
<b>LAB 1 (TA)</b>	2/20 - 2/24	Link Hall 0019
<b>LAB 2 (TA)</b>	3/27 - 3/31	Link Hall 0019

### Course Description

Isentropic flow, normal and oblique shock waves, expansion fans. Compressible flow in converging and diverging nozzles. The course includes a lab component with a written component.

### Prerequisite Courses

- MAE 251: Thermodynamics
- MAE 341: Fluid Mechanics

### Prerequisites By Topics

Students should possess the following knowledge and skills:

1. Calculus and Differential Equation
2. Thermodynamics (MAE 251)
3. Fluid Mechanics (MAE 341)
4. Ability to use computers and a working knowledge of word processing programs, spreadsheets, and computer programming for technical problem-solving (ECS 101, ECS 104)

### Audience

Junior Mechanical and Aerospace Engineering students

### Textbook

- (Required) J. D. Anderson Jr., *Fundamentals of Aerodynamics* (6th edition), McGraw-Hill. (AEE 342)
- Munson, Young and Okiishi, *Fundamentals of Fluid Mechanics*, Wiley. (MAE 341)
- J. E. John and T. G. Keith, *Gas Dynamics* (3rd edition), Pearson Prentice Hall
- Video: *Understanding Shock Waves in Aerospace Applications* [\[Link\]](#)
- Video: *Sonic Boom explained – How is it created? – Animated Graphics* [\[Link\]](#)

## Course Learning Objectives

At the completion of the course, each student should be capable of the following:

1. Be able to identify/formulate/solve problems involving compressible flows by applying principles of engineering/science/mathematics. (Program Outcome 1)
2. Communicate technical information clearly and concisely in written and oral form. (Program Outcome 3)
3. Ability to function effectively on a team. (Program Outcome 5)
4. Conduct high-speed flow experiments. (Program Outcome 6)
5. Understand operations of some aircraft and rocket components (e.g., wave drag and supersonic inlets/nozzles). (Program Outcome 8)

## Grading

- The final grade will be computed using the:

Homework	15%
Two in-class exams	15% (each)
Final exam	25%
Lab reports	30%

- Numeric scores will be translated into letter grades with the following table:

		100-94	A	93-90	A-
89-87	B+	86-84	B	83-80	B-
79-77	C+	76-74	C	73-70	C-
69-60	D	< 60	F		

- Late assignments will not be accepted.
- Course Evaluations - Students will be asked to fill in an online evaluation form covering the course content and instructor effectiveness in conveying course objectives. This feedback will be used to improve the course in the future.

## Course Schedule

Week/Lecture	Topic	Reading
Week 1 (1/17)	Review of thermo/fluids	Chapter 7
Week 2	Isentropic flow, normal shock	Chapters 7 & 8
Week 3	Normal shock	Chapter 8
Week 4	Convergent-divergent nozzle	Chapter 10
Week 5	Convergent-divergent nozzle, aero application problems	Chapter 10
<b>Week 6</b>	<b>Lab #1 (no class lectures)</b>	Hand-out materials
Week 7	Oblique shocks, <b>Exam 1</b>	Chapter 9
Week 8	Spring Break	
Week 9	Oblique shocks	Chapter 9
Week 10	Expansion waves	Chapter 9
<b>Week 11</b>	<b>Lab #2 (no class lectures)</b>	
Week 12	Aero application problems, <b>Exam 2</b>	Hand-out materials
Week 13	Reyleigh flow	MAE 341 textbook
Week 14	Fanno flow	MAE 341 textbook
Week 15 (4/27)	Full potential flow, Prandtl-Glauert compressibility correction	Chapter 11

Week	Date	Readings	Lectures																											
			1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th	17th	18th	19th	20th	21st	22nd	23rd	24th	25th	26th	27th	28th
1	1/17 1/19	Ch 7	Review of thermo																											
2	1/24 1/26	Ch 8	Isentropic																											
3	1/31 2/2		Normal shock																											
4	2/7 2/9	Ch 10																												
5	2/14 2/16		Convergent-divergent nozzle																											
6	2/21 2/23	LAB																												
7	2/28 3/2																													
8	3/7 3/9	Ch 9																												
9	3/14 3/16		Oblique shock																											
10	3/21 3/23																													
11	3/28 3/30	LAB																												
12	4/4 4/6	Ch 9																												
13	4/11 4/13	*Ch 11.9																												
14	4/18 4/20	*Ch 11.8																												
15	4/25 4/27	Ch 11																												
	5/4	FINAL																										FINAL 5/4, 8:00-10:00AM		

(\*: chapters in the textbook of Fundamentals of Fluid Mechanics, Munson/Young/Okishi. Other chapters are from Fundamentals of Aerodynamics, J.D.Anderson)

**University Attendance Policy:**

Attendance in classes is expected in all courses at Syracuse University. Students are expected to arrive on campus in time to attend the first meeting of all classes for which they are registered. Students who do not attend classes starting with the first scheduled meeting may be academically withdrawn as not making progress toward a degree by failure to attend. Instructors set course-specific policies for absences from scheduled class meetings in their syllabi.

It is a federal requirement that students who do not attend or cease to attend a class be reported at the time of determination by the faculty. Faculty should use “ESPR” and “MSPR” in Orange Success to alert the Office of the Registrar and the Office of Financial Aid. A grade of NA is posted to any student for whom the Never Attended flag is raised in Orange SUESS. More information regarding Orange SUESS can be found at <http://orangesuccess.syr.edu/getting-started-2/>.

Students should also review the University’s religious observance policy and make the required arrangements at the beginning of each semester.

**Syracuse University Policies:**

Syracuse University has a variety of other policies designed to guarantee that students live and study in a community respectful of their needs and those of fellow students. Some of the most important of these concerns:

**Diversity and Disability** (ensuring that students are aware of their rights and responsibilities in a diverse, inclusive, accessible, bias-free campus community) can be found here, at: <https://www.syracuse.edu/life/accessibilitydiversity/>.

**Religious Observances Notification and Policy** (steps to follow to request accommodations for the observance of religious holidays) can be found here at: [http://supolicies.syr.edu/studs/religious\\_observance.htm](http://supolicies.syr.edu/studs/religious_observance.htm).

**Orange SUESS** (tools to access a variety of SU resources, including ways to communicate with advisors and faculty members) can be found here, at <http://orangesuccess.syr.edu/getting-started-2/>.

**Disability-Related Accommodations:**

Syracuse University values diversity and inclusion; we are committed to a climate of mutual respect and full participation. There may be aspects of the instruction or design of this course that result in barriers to your inclusion and full participation in this course. I invite any student to meet with me to discuss strategies and/or accommodations (academic adjustments) that may be essential to your success and to collaborate with the Center for Disability Resources (CDR) in this process.

If you would like to discuss disability-accommodations or register with CDR, please visit the Center for Disability Resources. Please call (315) 443-4498 or email [disabilityresources@syr.edu](mailto:disabilityresources@syr.edu) for more detailed information.

CDR is responsible for coordinating disability-related academic accommodations and will work with the student to develop an access plan. Since academic accommodations may require early planning and generally are not provided retroactively, please contact CDR as soon as possible to begin this process.

<https://disabilityresources.syr.edu/>.

**Academic Integrity Policy:**

Syracuse University's Academic Integrity Policy reflects the high value that we, as a university community, place on honesty in academic work. The policy defines our expectations for academic honesty and holds students accountable for the integrity of all work they submit. Students should understand that it is their responsibility to learn about course-specific expectations, as well as about university-wide academic integrity expectations. The policy governs appropriate citation and use of sources, the integrity of work submitted in exams and assignments, and the veracity of signatures on attendance sheets and other verification of participation in class activities. The policy also prohibits students from submitting the same work in more than one class without receiving written authorization in advance from both instructors. Under the policy, students found in violation are subject to grade sanctions determined by the course instructor and non-grade sanctions determined by the School or College where the course is offered as described in the Violation and Sanction Classification Rubric. SU students are required to read an online summary of the University's academic integrity expectations and provide an electronic signature agreeing to abide by them twice a year during pre-term check-in on MySlice.