

AEE 343: Compressible Flow (3 credits) Syllabus – Spring 2024



Instructor

Prof. Yiyang Sun
Mechanical and Aerospace Engineering
212 Link Hall
(315)-443-1395
ysun58@syr.edu

Teaching Assistant

Mitesh Thakor, Md Rashid Islam, and Melissa Yeung
Mechanical and Aerospace Engineering
217 Link Hall
mmthakor@syr.edu

Course Information

	Time	Location
Classes	Tuesday/Thursday 9:30 - 10:50AM	Life Science Building 011
Office hours (Instructor)	Monday/Wednesday 3:00 - 4:00 PM	Link 212
Office hours (TA)	Friday 10:00AM - 12:00PM	Link 217
LAB 1 (TA)	2/19 - 2/23	Link Hall 0019
LAB 2 (TA)	3/25 - 3/29	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. A final presentation is required to be completed in a team.

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](#)]

Course Learning Objectives Aligned to MAE Learning Outcomes & the SU Shared Competencies

ABET Program Outcome	MAE Program Values & Learning Outcome Statements	AEE 343 Course Learning Objectives. This semester you will:	Top Two Syracuse University Shared Competencies Stressed in AEE 343
1	Be able to identify, formulate, and solve complex engineering problems involving compressible flows by applying principles of engineering, science, and	(1) Learn, identify, and solve compressible flow problems by applying formulas and tables.	Scientific Inquiry and Research Skills
3	Be able to communicate technical information effectively in written and oral form with a range of audiences.	(5) Prepare a presentation with technical explanation to demonstrate analysis of supersonic flows	Communication Skills: Employ communication strategies across various situations (i.e., lab collaboration and team presentation), apply communication tools (i.e., text, figure/plot, and table) to a given medium, context, and audience.
5	Be able to function effectively on a team	(2) Conduct wind tunnel experiments in a lab with teammates	
6	Be able to conduct high-speed flow experiments, analyze and interpret data and use engineering judgement to draw conclusions.	(3) Compile lab reports to illustrate how to design an experiment to analyze supersonic flows	
9	Be able to understand operations of some aircraft and rocket components (e.g., wave drag and supersonic inlets/nozzles)	(4) Learn the practical applications of fundamental principles in compressible flow	

Grading

- The final grade will be computed using the:

Homework	15%
Midterm exam	15%
Final exam	30%
Lab reports	20%
Team presentation	20%

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

100-94	A	93-90	A-
89-87	B+	86-84	B
79-77	C+	76-74	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	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
Week 6	Lab #1 (no class lectures)	Hand-out materials
Week 7	Oblique shocks, Midterm Exam	Chapter 9
Week 8	Spring Break	
Week 9	Oblique shocks	Chapter 9
Week 10	Expansion waves	Chapter 9
Week 11	Lab #2 (no class lectures)	Hand-out materials
Week 12	Aero application problems	
Week 13	Reyleigh flow	MAE 341 textbook
Week 14	Fanno flow	MAE 341 textbook
Week 15	Presentation of a selected compressible flow topic	

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	1/16 1/18	Ch 7	Review of thermo																											
2	1/23 1/25			Isentropic flow																										
3	1/30 2/1	Ch 8			Normal shock																									
4	2/6 2/8					Convergent-divergent nozzle																								
5	2/13 2/15	Ch 10					Convergent-divergent nozzle																							
6	2/20 2/22	LAB						1st LAB																						
7	2/27 2/29								Midterm																					
8	3/5 3/7									Oblique shock																				
9	3/12 3/14	Ch 9									Spring break																			
10	3/19 3/21											Expansion waves																		
11	3/26 3/28	LAB											2nd LAB																	
12	4/2 4/4	Ch 9												Aero app/demo																
13	4/9 4/11	*Ch 11.9													Rayleigh flow															
14	4/16 4/18	*Ch 11.8														Fanno flow														
15	4/23 4/25	Ch 11																												Team Presentations
	5/7	FINAL																										FINAL 5/7, 7:30-9:30AM		

(*: chapters in the textbook of Fundamentals of Fluid Mechanics, Munson/Young/Okiishi. 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 SSuccess. More information regarding Orange SSuccess 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.

Orange SSuccess (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 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.