Compressive Flow

EAS 4132 & EML 5714
Class Periods: M/W/T, 2nd period, 8:30 – 9:20 am
Location: TUR 0GL005
Academic Term: Spring 2026

Instructor:
Claire Grégoire
c.gregoire@ufl.edu
Office Hours: MWF, 9:45 – 10:45 am, NEB 439

Teaching Assistant:
A TA will be responsible for grading all homework assignments and will be announced as soon as the details worked out. Please contact through the Canvas website.

Course Description
One-dimensional and quasi one-dimensional compressible fluid flows. Includes Mach waves, normal shocks, oblique shocks, Prandtl-Meyer expansions, isentropic flow with area change, Fanno flow and Rayleigh flow.

Course Pre-Requisites / Co-Requisites
Fluid Mechanics (ENG3353C or equivalent), and Thermodynamics (EML3100 or equivalent)

Course Objectives
At the end of this course, students should be able to:

1. **Understand Core Principles:** Grasp fluid mechanics and thermodynamics fundamentals (continuity, momentum, energy, and 2nd law) from a control volume perspective.
2. **Apply Gas Dynamics Concepts:** Use the ideal gas law, calculate sound speed, Mach number, and understand flow regimes (subsonic to supersonic).
3. **1-D Compressible Flow**: Analyze flow behavior using 1-D theory, including area changes, choked flow, and effects in nozzles and diffusers.
4. **Stagnation Properties & Diagrams**: Use stagnation temperature/pressure and T-s diagrams to describe and solve flow problems.
5. **Shock Waves Analysis**: Analyze stationary normal and oblique shock waves, shock wave location in converging-diverging nozzles, and moving shock waves in ducted systems.
6. **Expansion Fans**: Understand Prandtl-Meyer expansions and their application in supersonic flows and nozzle exhausts.
7. **Shock Tubes**: Understand the fundamentals of shock tubes and their applications.
8. **Advanced Flow Effects**: Include heat transfer, friction, Rayleigh and Fanno lines in compressible flows.
9. **Problem-Solving Tools**: Use tables or develop small programs (e.g., Excel) to solve compressible flow equations efficiently.

Required Textbooks
Gas Dynamics by James E. A. John and Theo G. Keith, Third Edition by Pearson Prentice Hall, 2006. ISBN-13: 978-0131206687.

Recommended Materials
Fundamental of Gas Dynamics by Robert D. Zucker and Oscar Biblarz, Third Edition by Wiley, 2019. ISBN: 978-1-119-48170-6.
Modern Compressive Flow by John D. Anderson Jr., Third edition by McGraw-Hill, 2003. ISBN O-01-242443-5.
Compressible Fluid Flow by Michel A. Saad, Second Edition by Prentice Hall, 1992. ISBN: 9780131613737.

Relation to Program Outcomes (ABET):

Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	Low
3. An ability to communicate effectively with a range of audiences	Low
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	High
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative environment, establish goals, plan tasks, and meet objectives	
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	Low
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	Medium

*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

Policies and Procedures:
Since this course has both undergraduate (EAS 4132) and graduate (EML 5714), in order to distinguish between the student's levels, students registered for EML 5714 will be required to perform a journal article review project and periodically an extra problem in homework assignments.

Attendance Policy, Class Expectations, and Make-Up Policy
Attendance at all lectures is expected and will occasionally be monitored. Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies: https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/

Homework:
Periodically problems will be assigned with a due date specified. ***All homework assignments must be turned in through the e-learning website.*** Late homework's will not be accepted. Hardship cases are rare but will be considered on an individual basis and only if the instructor has been contacted ***before*** the due date of the assignment.

Exams:
Three exams will be given during the semester during the regularly ***scheduled class time***. Excuses from exams will only be given for approved incidences of those required by university policy. If there is a conflict it is on the student to contact me ***before*** the scheduled exam time, and some type of arrangement will be made. →Open-book, open-notes exams with small programs ready to solve the compressive flow equations.

Journal Article Critical Review Project (EML 5714 only):
For this project, students will be asked to select an article from a ***provided*** pool of published articles related to compressible flows and perform a technical review of it (***800-1000 words***). This assignment and the provided research articles will be given ***2 month*** prior to work on it (02/20), and it will be due on 4/17.

*A critical review includes a motivation for the study reported, a summary that describes the experiment and highlights key findings (you may include figures/tables from the paper), and most importantly, provides a **critique** of the work. You must be able to analyze published literature and come to reasoned conclusions on quality of published articles. It helps you become a better researcher- either, by learning from exceptional work, or learning how not to do research if you identify work that is not good quality (i.e., incorrect assumptions, unclear delivery style, incorrect experiments with poor controls, etc.). This project is also a good way to help you improve your writing skills.*

No AI allowed for this assignment: The learning that takes place in this project requires your unique perspective and human experience. Use of AI would make it harder to evaluate your work. It is not permitted to use any generative AI tools in this assignment, and the use of AI will be treated as an academic integrity issue.

Course Schedule

Week	Monday	Wednesday	Thursday	Comments
1	01/12	01/14	01/16	Chapter 1 – Basic Equations of Compressive Flow.
2	~~01/19~~	01/21	01/23	Chapter 2 – Wave Propagation in Compressive Media.
3	01/26	01/28	01/30	Chapter 3 – Isentropic Flow of a Perfect Gas. 01/30: Homework 1 Due Date.
4	02/02	**02/04**	02/06	Review Chapter 1-3 and Practice Problems. **02/04: Midterm 1.**
5	02/09	02/11	02/13	Chapter 4 – Stationary Normal Shockwaves.
6	02/16	02/18	02/20	Chapter 5 – Moving Normal Shockwaves.
7	02/23	02/25	02/27	Chapter 6 – Oblique Shockwaves. 02/27: Homework 2 Due Date.
8	03/02	**03/04**	03/06	Review Chapter 4-6 and Practice Problems. **03/04: Midterm 2.**
9	03/09	03/11	03/13	Chapter 7 – Prandtl-Meyer Flow. Chapter 8 – Applications Involving Shocks and Expansion Fans.
10	03/16	03/18	03/20	Spring Break
11	03/23	03/25	03/27	Chapter 9 - Flow with Friction. 03/27: Homework 3 Due Date.
12	03/30	**04/01**	04/03	Review Chapter 7-9 and Practice Problems. **04/01: Midterm 3.**
13	04/06	04/08	04/10	Chapter 10 – Flow with Heat Addition or Heat Loss.
14	04/13	04/15	04/17	Review All Chapters and Practice Problems. 04/17: Homework 4 and Critical Review Due Date.
15	04/20	04/22	***04/24***	***Reading Days.***
16	04/27	04/29	05/01	**04/30**: Final Exam, 7:30 – 9:30 am.

Grading (EML 5714):
Grades will be determined using these weights: 5% per Homework, 8% Review Project, and 18% per Exam.

Grading (EAS 4132):
Grades will be determined using these weights: 5% per Homework, and 20% per Exam. **Co-listed** undergraduate students will be tested as graduate students!

Grading Scale (EML 5714 and EAS 4132)

Percent	Grade	Grade Points
93 - 100	A	4.00
90 - 92.9	A-	3.67
87 - 89.9	B+	3.33
83 - 86.9	B	3.00
80 - 82.9	B-	2.67
77 - 79.9	C+	2.33
73 - 76.9	C	2.00
70 - 72.9	C-	1.67
67 - 69.9	D+	1.33
63 - 66.9	D	1.00
60 - 62.9	D-	0.67
0 - 59.9	E	0.00

Students Requiring Accommodations
Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation
Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

In-Class Recording
Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy
UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (https://sccr.dso.ufl.edu/process/student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment
The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University's core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:
- Your academic advisor or Graduate Coordinator
- HWCOE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use
All faculty, staff, and students at the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against the University of Florida policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy
There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: https://registrar.ufl.edu/ferpa.html

Campus Resources:

Health and Wellness

U Matter, We Care:
Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at **352-392-1575**. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength.

Gatorwell: Time Management, Procrastination, Stress/Mindfulness, Sleep, Alcohol and Drug Harm Reduction, Interpersonal Violence Prevention, Healthy Relationships, Sexual Health, Lifelong Wellbeing.
https://gatorwell.ufsa.ufl.edu, and 352-273-4450.

Counseling and Wellness Center: Counseling, Mental Health Workshops, Emotional Support, Consultation, Crisis Consultation.
https://counseling.ufl.edu, and 352-392-1575.

RecSports: Nutrition, Physical Activity, Sport Programs, Aquatics, Outdoor Recreation.
https://recsports.ufl.edu, and 352-846-1081.

Disability Resource Center: Assistive Technology, Classroom Accessibility, Academic & Testing, Accommodations.
https://disability.ufl.edu, and 352-392-8565.

Care Area: Case Management, Medical Petitions, Food Security.
https://care.dso.ufl.edu, and 352-392-1261.

Student Health Care Center: Primary, Urgent & Acute Care, Immunizations, Pharmacy, Physical Therapy, Sports Medicine. **SHCC Psychiatry:** Clinical Psychiatric Care, Medical Management.
https://shcc.ufl.edu, and 352-392-1161. https://shcc.ufl.edu/shcc-psychiatry

Sexual Discrimination, Harassment, Assault, or Violence
If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, 352-273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)
Student Health Care Center, and 352-392-1161.

University Police Department at 352-392-1111 (or **911** for emergencies), or http://www.police.ufl.edu/.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
https://elearning.ufl.edu/

Career Connections Center, Reitz Union, 352-392-1601. Career assistance and counseling;
https://career.ufl.edu

Library Support, Various ways to receive assistance with respect to using the libraries or finding resources.
http://cms.uflib.ufl.edu/ask

Teaching Center, Broward Hall, 352-392-2010 or 352-392-6420. General study skills and tutoring.
https://teachingcenter.ufl.edu/

Writing Studio, 302 Tigert Hall, 352-846-1138. Help brainstorming, formatting, and writing papers.
https://writing.ufl.edu/writing-studio/

Student Complaints Campus:
https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/
https://care.dso.ufl.edu

On-Line Students Complaints:
https://distance.ufl.edu/getting-help/
https://distance.ufl.edu/state-authorization-status/#student-complaint