# AME 511 – Compressible Gas Dynamics

Spring 2018

Units: 3.0

Lecture hours: Thursday, 6:40-9:20pm; Lecture location: OHE 132

Instructor: Prof. Iván Bermejo-Moreno (email: bermejom@usc.edu)

Office hours: Tuesday, 3-5pm (office: RRB 215).

TA: Robert Lawson (rlawson@usc.edu)

Office hours: Monday, 11am-1pm; Tuesday 5-7pm (office: VHE 202).

Recommended Textbooks:

- John D. Anderson "Modern Compressible Flow," 3rd Ed, McGraw-Hill, Inc.
- Liepmann & Roshko "Elements of Gas Dynamics," Dover Publications

Grade breakdown:

- Homework: 30% of final grade.
- Midterm exam: 30% of final grade.
- Final exam: 40% of final grade.

Assignment Submission Policy

- No late homework will be accepted.
- Discussion of homework assignments with your classmates is allowed but each student should develop and write their own original solution.
- Assignments **should be submitted electronically** as a PDF file via the course D2L DEN website, with legible and logically organized solutions that explicitly include all necessary steps and assumptions (if any) made.
- Course grading policy and letter grade equivalence: http://arr.usc.edu/services/grades/gradinghandbook/gradingpolicies.html

## Academic Conduct

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Section 11, Behavior Violating University Standards https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the Office of Equity and Diversity http://equity.usc.edu or to the Department of Public Safety http://adminopsnet.usc.edu/department/department-public-safety. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. The Center for Women and Men http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage http://sarc.usc.edu describes reporting options and other resources.

## Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the American Language Institute http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. The Office of Disability Services and Programs http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, USC Emergency Information http://emergency.usc.edu will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.

Course schedule – Weekly breakdown (HW = homework, PR = Project report)

| W | Date | Topics | HW |
|---|---|---|---|
| **1** | Jan 11 | Introduction; concepts from classical thermodynamics | |
| **2** | Jan 18 | Conservation laws in integral and differential form | HW1 due |
| **3** | Jan 25 | Crocco's theorem, constitutive equations, indicial form | |
| **4** | Feb 1 | Rotational and irrotational (potential) flow.<br>Sound speed and Mach number.<br>One-dimensional steady compressible flow. | HW2 due |
| **5** | Feb 8 | Normal shock waves<br>One-dimensional steady flow with heat addition (Rayleigh flow) | |
| **6** | Feb 15 | One-dimensional adiabatic steady flow with friction (Fanno flow)<br>Oblique shocks; hodograph, shock polar, pressure-deflection plane | |
| **7** | Feb 22 | Regular and singular (Mach) shock reflections<br>Prandtl-Meyer expansions<br>Shock-expansion theory; wave drag; aerodynamic coefficients | HW3 due |
| **8** | Mar 1 | **Midterm** | |
| **9** | Mar 8 | Wave reflections, intersections and interactions<br>Oblique shocks in wedges, cones and blunt bodies<br>Crocco's theorem applied to shock waves | |
| **10** | Mar 15 | **Spring recess (no class)** | |
| **11** | Mar 22 | Quasi-one-dimensional steady isentropic flow<br>Area-Mach relations; Riemann invariants;<br>1D unsteady homentropic flow<br>Nozzles, diffusers and wind tunnels | HW4 due |
| **12** | Mar 29 | Unsteady wave motion; acoustic, finite and shock wave propagation<br>Reflection of a propagating shock<br>Propagation and reflection of centered expansion waves | |
| **13** | Apr 5 | Shock-tubes and shock-tunnels<br>Potential flow and linearized potential theory | HW5 due |
| **14** | Apr 12 | Transonic flow | |
| **15** | Apr 19 | Hypersonic flow | HW6 due |
| **16** | Apr 26 | High-temperature gases; non-equilibrium; viscous effects | |
| **17** | May 3 | **Final Exam** 7-9pm | |

# Academic Dishonesty Sanction Guidelines

| Violation | USC – Recommended sanction | AME – Recommended sanction |
|---|---|---|
| **Copying answers from other students on any course work **** | F for course | First offense: F on assignment<br>Second offense: F for course |
| **One person allowing another to cheat from his/her exam or assignment** | F for course for both persons | If assignment:<br>First offense: F on assignment<br>Second offense: F for course<br>If exam: F for course |
| **Possessing or using material during exam (crib sheets, notes, books, etc.) which is not expressly permitted by the instructor.** | F for course. | First offense: F on exam.<br>Second offense: F for course. |
| **Continuing to write after exam has ended.** | F for course. | F on exam |
| **Taking exam from room and later claiming that the instructor lost it.** | F for course and recommendation for further disciplinary action (possible suspension). | F for course |
| **Changing answers after exam has been returned.** | F for course and recommendation for further disciplinary action (possible suspension). | F for course |
| **Fraudulent possession of exam prior to administration.** | F for course and recommendation for suspension. | F for course |
| **Obtaining a copy of an exam or answer key prior to administration.** | Suspension or expulsion from the university; F for course. | F for course |
| **Having someone else complete course work for oneself.** | Suspension or expulsion from the university for both students; F for course. | F for course |
| **Plagiarism — Submitting other's work as one's own or giving an improper citation.** | F for course. | First offense: F on assignment.<br>Second offense: F for course. |
| **Submission of purchased term papers or papers done by others.** | F for course and recommendation for further disciplinary action (possible suspension). | F for course |
| **Submission of the same assignment to more than one instructor, where no previous approval has been given.** | F for both courses. | F for both courses |
| **Unauthorized collaboration on an assignment.** | F for the course for both students. | First offense: F on assignment.<br>Second offense: F for course. |
| **Falsification of information in admission applications (including supporting documentation).** | Revocation of university admission without opportunity to reapply. | Revocation of university admission without opportunity to reapply. |
| **Documentary falsification (e.g., petitions and supporting materials; medical documentation.)** | Suspension or expulsion from the university; F for course when related to a specific course. | Suspension or expulsion from the university; F for course when related to a specific course. |
| **Plagiarism in a graduate thesis or dissertation.** | Expulsion from the university when discovered prior to graduation; revocation of degree when discovered subsequent to graduation.*** | Expulsion from the university when discovered prior to graduation; revocation of degree when discovered subsequent to graduation.*** |

*Assuming first offense; **Exam, quiz, tests, assignments or other course work; ***Applies to graduate students