ASEN 5519-001 Introduction to Hypersonic Aerothermodynamics
Course Syllabus, Fall 2023

INSTRUCTOR

Dr. Hisham K. Ali
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TEACHING ASSISTANTS

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OFFICE HOURS AND CONTACT INFORMATION

In-Person / Zoom Office Hours: Tuesday and Thursday 1pm to 2pm
In-Person Office Location: AERO 369
Zoom Virtual Office Link:
Email: hisham.ali@colorado.edu

Email Policy: It is my intent to make myself as accessible as possible to you during this semester within the bounds of my other responsibilities. In general, I will do my best to accommodate student needs and respond as promptly as possible to e-mails. In your email, please identify yourself by providing your name and the course number at the start of your message. However, all technical questions on course content should be asked during lecture, office hours, or on the course Slack Workspace. One-on-one meetings will only be scheduled to address individual administrative or academic issues.

COURSE SCHEDULE, LOCATION, and LINKS

Schedule: 2:30 PM ï 3:45 PM, Tuesday and Thursday

In-Person: ASEN 5519-001 AERO 114 ï students enrolled in the class should attend the class synchronously in-person or asynchronously.

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COURSE TEXTBOOK AND WEBSITE

There is no required textbook, but interested students may refer to the following books for further discussion and resources. Reading may be assigned from these books, but they will either be available online through the CU Library or the relevant sections will be provided.

Bertin, ñ*Hypersonic Aerothermodynamics*", AIAA, 1994. Full text is available online through the library at http://tinyurl.com/y292lqnt.

Anderson, ñ*Hypersonic and High-Temperature Gas Dynamics",* AIAA, 2006. Full text is available online through the library at https://tinyurl.com/yyyxpjvr.

Hankey, ñ*Re-entry Aerodynamics*", AIAA, 1988. Full text is available online through the library at http://tinyurl.com/yymhlaw9.

Heiser and Pratt, ñ*Hypersonic Airbreathing Propulsion*", AIAA, 1994. Full text is available online through the library at https://tinyurl.com/yybuuvwh.

ASSIGNMENTS, EXAMS, AND GRADING

This course will be assessed through assignments and examinations, with a more detailed breakdown below:

8 assignments, 5% each	40%
1 midterm exam, Thursday, November 2nd	25%
1 final exam, Wednesday, December 20th	35%
Total	100%

Extensions and Late Assignments: The late penalty for assignments is 10% per day, for up to 5 days. Beyond 5 days late, the assignment is worth 0%. Please email me for accommodations due to illness or other extenuating circumstances.

Assignment Policy: Students are asked to complete their homework assignments on standard plain white or engineering paper, however this is not a requirement. That said students should keep individual problems separated on different pages. In other words, page breaks should be inserted between problems to simplify the uploading to the website and identification of individual problems. Students should make an effort to turn in assignments that are organized, professional looking, and they must be legible. **Collaboration is permitted on homework.** This means students may discuss the means and methods for solving problems and even compare answers, but students are not free to copy assignments from other students/sources. The work that a student turns in must be their own ï copying is not allowed for any assignment and will not be tolerated.

Exam Policy: The time-limited midterm and final examinations will cover all material in the course including lecture, discussions, readings, and assignments. The final examination will be cumulative. **There is no collaboration allowed on exams.** All exams will be administered with an in-person option and will tentatively take place at the days and times provided in the course schedule portion of this syllabus. To allow flexibility for both distance and in-person students but also ensure consistency in the assessments, students will have an option to complete the timed exams (with the same time limit as the in-person exam) remotely within a reasonable (24 ï 36 hour) window of the in-person exam date.

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HONOR CODE

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COURSE MATERIAL AND OUTLINE

Below is a (tentative) course outline for the class as of the 1st day. The specific schedule is subject to change.

1. Introduction [2 lectures]
- Course outline
- Broad overview of hypersonics

2. Hypersonic Flight Mechanics [3 lectures]
- Trajectory equations
- Ballistic entry (missile)
- Equilibrium glide (Space Shuttle)
- Air-breathing, powered flight

3. Aerothermodynamics phenomena [6 lectures]
- Review of compressible gas dynamics
- High-temperature gas effects
- Nonequilibrium thermochemical kinetics
- Fluid conservation equations
- Molecular transport processes
- Review of aerodynamics

4. Surface pressure [3 lectures]
- Stagnation point
- Newtonian models
- Sharp cones

5. Boundary layers [3 lectures]
- Self-similar equations
- Solution for a flat plate
- Stagnation-point heating (Fay-Riddell)

6. Heat transfer and skin friction [2 lectures]
- Surface temperature
- Laminar and turbulent boundary layers

7. Hypersonic propulsion [2 lectures]
- Rockets and ramjets
- Scramjets

8. Thermal Protection Systems [3 lectures]
- Design drivers
- Passive (Space Shuttle, X43)
- Ablative (Stardust)
- Guest lecture: TBD

9. Cutting-edge capabilities (subject to change) [2 lectures]
- Computational tools
- Experimental facilities
- Guest lecture: TBD

10. Conclusions and exam preparation [1 lecture]