AE 6050 - Syllabus

High-Temperature Gas Dynamics, 3 Credits

General Information

Description

Defining equations for compressible flows, high temperature gas properties, and their effect on the behavior of equilibrium and non-equilibrium flows.

Pre- &/or Co-Requisites

AE 6765 or ME 6765 minimum grade of D

Course Goals and Learning Outcomes

Upon successful completion of this course, the student should be able to:

1. Define the basic equations of motion for compressible flows.
2. Describe the difference between a calorically perfect, thermally perfect, and chemically reacting gas
3. Calculate equilibrium properties of high temperature, chemically reacting gases.
4. Describe the behavior of a high temperature gas in an equilibrium and frozen flow.
5. Define the rates of nonequilibrium processes and describe the behavior of nonequilibrium flows.

Course Requirements & Grading

Note: Graded components of a course may vary with each offering. The example below is typical but subject to change.

Description of Graded Components

Assignment	Date	Weight (Percentage, points, etc)
Homework	Bi-weekly	20%
Mid-term exam	Mid-semester	25%
Final project	Last class day	30%
Final Exam	Finals week	25%

Homework: Homework is assigned to provide students with an opportunity to apply the theoretical material discussed in the lectures to practical applications. Homework dissemination, submission, and due dates will be managed electronically via Canvas. Late homework will in general not be accepted without prior approval. In-class verbal or Canvas due date announcements override projected dates in the lecture plan. Homework should be professional, legible, indicate units, and sufficiently describe all important steps in a solution.

Your final answer for each problem should be boxed or otherwise clearly indicated. Electronic submissions will be done via Canvas and should also include any source code used to obtain your solutions (if applicable). Deductions will be made for incomplete solutions and improper formats. Details on submission instructions will be provided in the homework assignment description. Note that some assignments will require heavy use of Matlab or other programming language, and students are responsible for familiarizing themselves with Matlab and/or another programming language.

Exams: As with homework solutions, exam solutions should be legible, include units, and sufficiently describe all important steps in a solution. Put your name and page number on each page, and 'box' your final answer for each problem. Deductions will be made for incomplete solutions and improper formats. Additional instructions and restrictions for each exam will be discussed in class and will be clearly identified on the exam coversheet. In general, exams are closed-book, meaning that you are to complete the exam without the aid of textbooks, hand-outs, class notes, cellular telephones, personal digital devices, or computers/software. Use of a pocket (non-programmable) calculator and one 8.5" x 11" page of notes is allowed.

Computer Project: An individual computer project will be assigned prior to the mid-term exam and is designed to give students the opportunity to apply the course material to a topic of their choice. More detail will be provided on the scope and content of the project and report, but the final report should emulate a journal-style manuscript in both style and format. The report will be assessed on the relevance, novelty, and technical quality of the analysis done, as well as the presentation of the results in the report (a formal grading rubric will be provided).

Grading Scale

Your final grade will be assigned as a letter grade according to the following scale:

A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	0-59%

Topics Covered

Note: The exact topics covered in a course may vary with each offering. The example below is typical but subject to change.

Review of Low Speed, Low Temperature Compressible Flow

Review of Kinetic Theory and Statistical Mechanics

Equilibrium Properties of Reacting Gas Mixtures

Equilibrium and Frozen Flows

Nonequilibrium Processes: Vibrational and Chemical Nonequilibrium

Inviscid Nonequilibrium Flows

Nonequilibrium Kinetic Theory

Radiative Energy Transfer in Gases

Course Materials

Note: Course materials may vary with each offering. The example below is typical but subject to change.

Textbook

Required: Vincenti and Kruger, *Introduction to Physical Gas Dynamics,* Krieger, 1967.

Reference: Anderson, John D., *Hypersonic and High Temperature Gas Dynamics*, 3rd Edition, AIAA Education Series, 2019

Course notes

Couse notes and other materials are posted online to Canvas.