Purdue University
ME 510 – Gas Dynamics – Spring 2023
Course Syllabus

Class Meeting Time & Location:

Instructor:

Teaching Assistants:

Required Text: N/A

Reference Texts:

GENERAL COURSE POLICY

Course Goals: This course is designed to introduce seniors and beginning graduate students to the fundamentals of compressible fluid flow, with an emphasis on a wide variety of steady, one-dimensional flow problems and a general understanding of the principles of multi-dimensional flow.

Prerequisites: A first course in fluid mechanics or aerodynamics is required. Additionally, students must have taken a course in thermodynamics, dynamics, calculus, ordinary differential equations, and partial differential equations.

Brightspace: Please log into Brightspace to download homework assignments, lecture slides, and to check your grade. You can get to this site by following the ‘Brightspace’ link on the Purdue homepage.

Homework: Homework exercises will be posted on Brightspace every couple of weeks. Homework will not be collected for grading. The solutions will be posted a week after the problems are posted so that students can check their work and seek help in office hours on points that they do not understand. It is highly recommended that students diligently solve these problems to ensure understanding of the material to enable strong exam performance.

Exams: There are 2 in-class exams and a final exam. Exams are closed book and closed notes. You will be allowed to use the tables in the back of your text book (recommended book is Zucrow & Hoffman from the reference list) for the exams and a formula sheet will be provided. Students in the EPE section will have an exam window of 11:30am – 11:30pm on the day of the exam and will use the live proctor option in Examity. More info on setting this up will be available in the first month of the semester.

Attendance and Honesty Policies: Although attendance is not required, students should attend all classes to receive full benefit of lectures. Students are responsible for all information provided in lecture. Information presented in class supersedes any information posted elsewhere. The Engineering Honor Code is in effect for all students. Cheating will be prosecuted according to Purdue University policy.

Grades: Please check that your scores have been entered correctly into Brightspace. The last day to report an error in the on-line grade book is April 28th (last day of classes). Exam re-grade requests must be made within 1 week of the date that the graded document was available.

In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. Changes in this course will be announced in class and also posted on the Blackboard course web page.
Final Grade | Grade Scale
---|---
Exam 1 (in-class Feb. 27): 30% | 97 – 100% A+ 4.0
Exam 2 (in-class Apr. 5): 30% | 93 – 97% A 4.0
Final Exam (TBD): 40% | 90 – 93% A- 3.7
| 87 – 90% B+ 3.3
| 83 – 87% B 3.0
| 80 – 83% B- 2.7
| 77 – 80% C+ 2.3
| 73 – 77% C 2.0
| 70 – 73% C- 1.7
| 67 – 70% D+ 1.3
| 63 – 67% D 1.0
| 60 – 63% D- 0.7
| Below 60% F 0.0

**Emergency Preparedness Safety Briefing**

Emergency preparedness is everyone’s responsibility. Purdue University is actively preparing for natural disasters or human-caused incidents with the ultimate goal of maintaining a safe and secure campus. Let’s review the following procedures:

- For ANY emergency, call 911. Purdue Dispatch Center will send help... police, fire personnel or both will be immediately sent to your location.
- There are over 200 Emergency Telephone Systems throughout campus that connect directly to the Purdue Police Department (PUPD). If you feel threatened or need help when you are out on campus, push the button and you will be connected to the PUPD.
- If we hear a fire alarm, we will immediately evacuate the building using the stairwells (not the elevators).
- If we are notified of a Shelter in Place requirement for a hazardous materials release, we will shelter in our classroom shutting any open doors and windows.
- If we are notified of a Shelter in Place requirement for a civil disturbance such as an active shooter, we will shelter in a room that is securable, preferably without windows.
- If we are notified of a Shelter in Place requirement for a tornado warning, we will shelter in the lowest level of this building away from windows and doors. Our preferred location is in the basement of this building.

Each of you is strongly encouraged to sign up for the University’s Emergency Warning Notification System. It is a text messaging system that will send an alert to your cell phone. Please sign up at: [http://www.purdue.edu/securepurdue/](http://www.purdue.edu/securepurdue/)
# Course Syllabus

## Course Topics

### Review of Basic Concepts
- Reynolds Transport Theorem
- Conservation of Mass
- Linear Momentum for Inertial Ref. Frames
- 1st Law of Thermodynamics
- 2nd Law of Thermodynamics
- Equations of State
  - Ideal, Perfect, & Imperfect Gasses
- Governing Equations for 1-D Flow

### Shock Waves & Expansion Fans
- Normal Shock Waves
- Oblique Shock Waves
- Expansion Fans
- Reflections & Interactions of Oblique Shocks
- Reflections & Interactions of Expansion Fans
- Flow in Converging-Diverging Nozzles
  - Supersonic Wind Tunnels
  - Supersonic Diffusers

### Basics of Compressible Flow
- Speed of Sound
- Isentropic 1-D Flow of a Perfect Gas
- Stagnation & Sonic Conditions

### Multi-Dimensional Flow
- Compressible Velocity Potential
- Perturbation Theory
- Method of Characteristics
- Linearized Flow past a Wavy Wall
- Thin Airfoils in Supersonic Flow

### 1-D Flow
- Steady Isentropic Flow with Area Change
  - Choked Flow
  - Flow of an Imperfect Gas
- Fanno Flow
- Rayleigh Flow
- Flow with Mass Addition
- Generalized 1-D Flow

### Unsteady Flows
- Unsteady 1-D Flow
- Shock Tubes

### 1-D Flow

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Note: Schedule is subject to change at instructor’s discretion.