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

Class Meeting Time & Location:

Instructor:

Teaching Assistants:

Required Text: N/A

Reference Texts:

Zucrow, M.J. & Hoffman, J.D., Gas Dynamics: Volume I, Wiley. ISBN: 047198440X.
Shapiro, A.H., The Dynamics and Thermodynamics of Compressible Fluid Flow. Vol. I., Wiley. ISBN: 047106691-5.
Liepmann, H.W. and Roshko, A., Elements of Gas Dynamics, Wiley. ISBN: 0471534609.
Oosthuizen, P.H. and Carscallen, W.E., Compressible Fluid Flow, McGraw-Hill. ISBN: 0-07-048197-0, 0-07-048198-9.

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 be 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/.

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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

LEC	Date			Comment	LEC	Date			Comment
1	Mo	Jan	9	Reynolds Transport Thm	24	Mo	Mar	6	Diffusers
2	We		11	Cons of Mass	25	We		8	Mass Addition
3	Fr		13	Lin Momentum Eqn	26	Fr		10	Gen 1-D Flow
	Mo		16	Holiday – No Class		Mo		13	Holiday - No Class
4	We		18	Cons of Energy, 2nd Law		We		15	Holiday - No Class
5	Fr		20	Eqns of State		Fr		17	Holiday - No Class
6	Mo		23	1-D Steady Flow	27	Mo		20	Oblique Shocks
7	We		25	Spd of Sound	28	We		22	Expansion Fans
8	Fr		27	Stagnation & Sonic Cond	29	Fr		24	Flat Plate Airfoils
9	Mo		30	Area Change	30	Mo		27	Obl Shk Interaxns
10	We	Feb	1	Choking	31	We		29	Exp Fan Interactions
11	Fr		3	Imperfect Gas	32	Fr		31	Comp Vel Potential
12	Mo		6	Fanno Flow	33	Mo	Apr	3	Small Perturbation Theory
13	We		8	Fanno Flow Sonic	34	We		5	Exam #2: Lecs 1-31
14	Fr		10	Choking Fanno Flow	35	Fr		7	Wavy Wall
15	Mo		13	Isothermal w/ Frxn	36	Mo		10	Thin Airfoil Theory
16	We		15	Rayleigh Flow	37	We		12	Drag on a SS AF
17	Fr		17	Rayleigh Examples	38	Fr		14	Method of Characteristics
18	Mo		20	Normal Shocks	39	Mo		17	MoC – Regions
19	We		22	Normal Shocks	40	We		19	Unsteady 1-D Flow
20	Fr		24	Conv-Div Nozzle	41	Fr		21	Simple Unsteady Flow
21	Mo		27	Exam #1: Lecs 1-17	42	Mo		24	Shock Tube
22	We	Mar	1	Blowdown WT	43	We		26	Shock Tube Ex
23	Fr		3	Cont Duty WT	44	Fr		28	Review

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