Purdue University
ME 510 – Gas Dynamics – Spring 2017
Course Syllabus

Class Meeting Time & Location: WANG 2555, MWF 1:30 – 2:20pm

Instructor: Prof. Aaron Morris
ME
Office: ME 1065
abmorris@purdue.edu
Office Hours: TBD
I am happy to assist outside of regularly scheduled office hours. Email me or speak to me after class to arrange a time.

Teaching Assistant: None

Recommended Text: Anderson, J.D., Modern Compressible Flow, 3rd ed., McGraw Hill, 2003.

Additional References:

Anderson, J.D., Fundamentals of Aerodynamics, 5th ed., McGrow-Hill, 2011.
Shapiro, A.H., The Dynamics and Thermodynamics of Compressible Fluid Flow. Vol. I., Wiley.ISBN: 047106691-5.
Zucrow, M.J. & Hoffman, J.D., Gas Dynamics: Volume I, Wiley. ISBM: 047198440X.

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.

Blackboard Learn: Please log into Blackboard to download homework assignments, lecture notes, and solutions. You can get to this site by following the 'Blackboard' link on the Purdue homepage.

Homework: Typically, 3-4 homework problems will be assigned each week and be posted on Blackboard. The homework will be collected on Friday in class and the solutions will usually be posted to Blackboard by Friday evening. Homework will not be accepted after the solutions have been posted on Blackboard.

Exams: There are 2 in-class exams and a final exam. Exams are closed book and closed notes. You are allowed a one-page crib sheet and reference tables will be provided. Exams must be completed on the exam date. Exams dates are TBD.

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.

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Grades:	Homework:	10%
	Two tests:	50% (Higher score 30%; Lower score 20%)
	Final Exam:	40%

Final grades will be assigned on a plus/minus scale from A to F. Exam and homework 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.

Important Dates:

Tuesday January 17th: Last day for registration without late fees
Monday January 23rd: Last day to cancel course without it appearing on record

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, Momentum, and Energy - Thermodynamics o 1st and 2nd laws o Equations of state for ideal, perfect, and imperfect gases	**Shock Waves and Expansion Fans** - Normal shock waves - Oblique shock waves - Expansion fans and plumes - Oblique shock interactions and reflections - Expansion fan interactions and reflections - Flow in converging-diverging nozzles o Supersonic wind tunnels
Basics of Compressible Flow - Speed of Sound - Mach number and Mach angle - Isentropic 1-D flow of a perfect gas - Stagnation and sonic conditions	**Multi-Dimensional Flow** - Compressible potential flow - Perturbation theory - Method of characteristics - Thin and flat plate airfoils - Linearized flow past a wavy wall
1-D Flow - Steady isentropic flow with area change o Choked flow o Flow of an imperfect gas - Fanno flow (flow with friction) - Rayleigh flow (flow with heat addition) - Flow with mass addition	**Unsteady Flows** - Shock tubes - *t-x* diagrams for traveling shocks/waves - Simple and non-simple wave interactions

LEC	Date	Content	LEC	Date	Content
1	TBD	Admin / General introduction	23	TBD	Diffusers
2		Reynolds Transport Theorem	24		Mass addition
3		Flow equations (C.V.) – 1	25		General 1-D flow
4		Flow equations (C.V.) – 2	26		Oblique Shocks
5		Thermodynamics review – 1	27		Expansion Fans
6		Thermodynamics review – 2	28		Shock-shock interactions – 1
7		1-D steady flow	29		Shock-shock interactions – 2
8		Spd. of sound & Mach angle	30		Expansion fan interactions
9		Normal Shocks	31		Plumes
10		Normal Shocks	32		Flat plate airfoils
11		Stagnation and sonic cond.	33		Comp. velocity potential
12		Area change	34		Perturbation theory
13		Choked flow	35		Wavy walls
14		Imperfect gas	36		Exam #2 (Lec 16-32)
15		Fanno flow	37		Thin airfoil theory
16		Fanno flow sonic	38		Drag on a SS airfoil
17		Choking Fanno flow	39		Unsteady 1-D Flow
18		Rayleigh Flow	40		Shock tubes – 1
19		Rayleigh examples	41		Shock tubes – 2
20		Exam #1 (Lec 1-19)	42		Method of Characteristics
21		Conv- Div Nozzle	43		Nonsimple interactions
22		Supersonic wind tunnels	44		Review

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