Spring 2022 MEEG 5533 Fundamentals of Aerodynamics-MSE

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Office phone (not preferred): 479-575-4054.

Office Hours/Voice Contact: On as needed basis using Blackboard Collaborate sessions. Initiate by emailing me with a request that you would like to meet with me.

Preferred Contact Method: Email. I carry a smart phone with data, so I usually responds quickly and can answer your questions unless it is something I need the textbook/documents for.

Text: Fundamentals of Aerodynamics, 5th Edition
John D. Anderson, Jr.

Lecture Notes and Videos: They will be posted on Blackboard. The first few and a couple of latter ones does not have sound. I've typed out some notes at the end of the first couple of lectures.

Software Needs: Programming language and graphing software. I would recommend MATLAB as one integrated package. You can also use any other language and Excel to plot if needed, but not recommended. Download MATLAB from the following weblink for instructions:
https://its.uark.edu/software-equipment/get-software/matlab-get-started.php

Evaluation: Homework – 10%
Exam #1 (Ch. 1-4) – 30%
Exam #2 (Ch. 5-9) – 30%
Final Project – 30%

Topics:
1. Background Review [Ch. 1]
2. Fundamental Principles [Ch. 2-3]
3. Inviscid, Incompressible Flow [Ch. 4-6]
4. Compressible Flow and Shockwaves[Ch. 7-9]

Exam Rules:
Prior to taking the exam(s), students must file the "Exam Proctor Form" with the MSE program office, indicating the proctor's authority and contact information, and email a copy to the instructor. Exam rules for this class are:

> 2 hours long, open course textbook (Andersons) ONLY, no notes of any kind, work on white copier paper provided by proctor, pen/pencil, and basic scientific calculator. No electronics with digital storage/playback of any kind and internet access, with the only exception for electronic textbooks that must be pre-loaded on the viewing electronic device used.

Homework:
Homework is due for submission on Bb as you finished them. But, they must be turned in successive fashion (HW#1 before #2, etc..). The only exception is HW5, which will be a programming-based. You will be given the homework solutions after you turn in your worked problems. Please do not share with other students and I reserved the right to not provide solutions if this becomes an issue. The corresponding HW sets must be submitted before you can take/submit the corresponding exams.

Exam#1: HW #1-4.
Exam#2: HW #6-9.

Final Exam Project: HW #5.

Grading is based on submission of completed problems only, they will not be corrected/marked. However, I reserve the right to give zero credit to specific problem(s) and/or entire homework sets if I feel there's a lack of sincerity in the efforts to complete them (such as incomplete work, solution copying, etc…). Solutions will be emailed to you after the submission of the corresponding homework. The concept here is for you to work on the homework problems earnestly and without pressure, submit it to get credit for the effort, and then get the solutions to review and/or learn the correct ways.

Notes:

The grading scheme is a fixed scale at 87.5+ to 100% A, 75+ to 87.5-% B, 62.5+ to 75-% C, and less than 50% F…this sounds easy but only if you work on the class materials diligently. Each of the two tests will be given when you are ready with the covered materials and after turning in their associated homework problems (HW1-4 for Exam#1; HW6-9 for Exam#2). The Final Project is a computer code on a topic relevant to the course material. A programming-based homework problem (HW#5) on the source panel codes will be assigned as a pre-cursor to the more involved final project. I highly suggest you also refresh your basic programming skills before these assignments are made. This class is nominally 8 weeks, but can be stretched out as long as you feel comfortable, with the associated restrictions of the program. You can contact Jane Ann Cromhout harris@uark.edu if you need more information.

Academic Honesty and Integrity:

As a core part of its mission, the University of Arkansas provides students with the opportunity to further their educational goals through programs of study and research in an environment that promotes freedom of inquiry and academic responsibility. Accomplishing this mission is only possible when intellectual honesty and individual integrity prevail.

Each University of Arkansas student is required to be familiar with and abide by the University's 'Academic Integrity Policy' which may be found at https://honesty.uark.edu/policy/index.php. Students with questions about how these policies apply to a particular course or assignment should immediately contact their instructor.

MEEG 5533-Fundamentals of Aerodynamics

Lecture 1: Review of concepts on aerodynamics 1. [Ch. 1.1-1.6]

Lecture 2: Review of concepts on aerodynamics 2. [Ch. 1.1-1.6]

Lecture 3: Buckingham Pi Theorem, similarity, and scaling. Review of Fluid Statics. Basic flow phenomenon. [Ch. 1.7-1.12]

Lecture 4: Vector Calculus, fields, gradient, divergence, and curl. [Ch. 2.1-2.2]

Lecture 5: Integrals: line, surface, and volume. [Ch. 2.2-2.3]

Lecture 6: Eulerian and Lagrangian Viewpoint (pathlines, steamlines, and streaklines). Substantial (Total) Derivative and Reynolds Transport Theorem (RTT). [Ch. 2.9-2.11 and Intro to Fluid review]

Lecture 7: RTT and Continuity Equation. [Ch. 2.4]

Lecture 8: Momentum Equation. [Ch. 2.5-2.6]

Lecture 9: Energy Equation. [Ch. 2.7]

Lecture 10: Motion of Fluid Element. [Ch. 2.12]

Lecture 11: Angular Velocity and Vorticity. Circulation, Velocity Potential and Stream Function. [Ch. 2.13-2.16]

Lecture 12: Euler and Bernoulli’s Equations; Pressure coefficient. Incompressible flow and Laplace Equation. [Ch. 3.1-3.7]

Lecture 13: Elementary Flow 1: Uniform and Source/Sink. [Ch. 3.9-3.10]

Lecture 14: Elementary Flow 2: Rankine half/full ovals. [Ch. 3.11]

Lecture 15: Elementary Flow 3: Doublet and Vortex Flow [Ch. 3.12-3.14]

Lecture 16: Lifting flow over cylinder. [Ch. 3.15]

Lecture 17: Kutta-Joukowski theorem and Source Panel Method. [Ch. 3.16-3.18]

Lecture 18: Vortex sheets, Kutta Condition, and Kelvin’s circulation theorem. [Ch. 4.1-4.6]

Lecture 19: Thin Symmetric Airfoils. [Ch. 4.7]

Lecture 20: Thin Cambered Airfoils. [Ch. 4.8]

Lecture 21: Thin Cambered Airfoils. [Ch. 4.8]

Lecture 22: Downwash and Induced Drag. [Ch. 5.1]

Lecture 23: Biot-Savart Law and Helmholtz’s Theorems. [Ch. 5.2]

Lecture 24: Prandtl's Lifting-Line Theory. [Ch. 5.3]

Lecture 25: Elliptical lift distributions [Ch. 5.3.1]

Lecture 26: General lift distribution and Aspect Ratio [Ch. 5.3.2-3]

Lecture 27: Review of thermodynamics and Compressibility [Ch. 7.1-7.4]

Lecture 28: Concepts of Total and Stagnation Conditions [Ch. 7.5]

Lecture 29: Introduction to Normal Shocks [Ch. 8.1-8.2]

Lecture 30: Speed of Sound and More Normal Shock Relations [Ch. 8.3-8.7]

Lecture 32: Oblique Shock [Ch. 9.1-9.5]

Lecture 33: Expansion Waves [Ch. 9.6]

Lecture 34: Supersonic Airfoils [Ch. 9.7-9.10]