SYLLABUS
SPRING 2019/20

AE 306 AERODYNAMICS II (COMPRESSIBLE AERO.)

Instructor: Asst. Prof. Dr. Emre Kara (Room Z04) – Office Hour: 15:30 – 16:30 Mon

Lecture Assistant: Mr. Ahmet Şumnu

Lecture Hours: 08:30 – 11:05 Thursday - A03

Course Webpage: http://www1.gantep.edu.tr/~emrekara/index.php/ae306/

Course Objectives

To define compressibility and its effects on fundamental flow equations.
To teach students shock and expansion waves and related calculation methods.
To teach students linearization of fundamental equations and the conditions under which they apply.
To furnish the students with the ability to calculate the flow field and aerodynamic forces in compressible flow.

Textbooks

- **"**Fundamentals of Aerodynamics*"*, J.D. Anderson, McGraw-Hill, 2001 or newer.
- "Modern Compressible Flow: With Historical Perspective", Third Edition , J.D. Anderson, McGraw-Hill, 2003.

Supplementary Textbooks

- "Gas Dynamics", M.H. Aksel and O.C. Eralp, , Prentice-Hall, 1993.
- "Aerodynamics for Engineering Students", Fifth Edition, E.L. Houghton and P.W. Carpenter, Butterworth-Heinemann, 2003.
- "Aerodynamics for Engineers", Fifth Edition, J.J. Bertin and M.L. Smith, Prentice-Hall, 2008.
- "Compressible Flow", M.A. Saad, Prentice Hall, 1993.
- "The Dynamics and Thermodynamics of Compressible Fluid Flow", A.H. Shapiro, Wiley, 1953.

Prerequisites

AE 305

TENTATIVE SCHEDULE (Lecture notes will be followed as the primary source of the exams)

FIRST WEEK LECTURES (FEB 13TH) ARE POSTPONED TO FEB 20TH DUE TO SNOW AND UNFAVORABLE WEATHER CONDITIONS BY UNIVERSITY EXECUTIVE.

Week 2 (Feb 20th)	Introduction ***Chapter 1: Compressible Flow: Fundamental Aspects*** 1.1 Conservation Equations (Review on Thermodynamics and Fluid Mechanics)
Week 3 (Feb 27th)	1.2 Speed of Sound and Mach Angle 1.3 Isentropic Flows 1.4 Bernoulli Equation for Compressible Flows 1.5 Compressibility 1.6 Stagnation and Static Quantities 1.7 Ideal Motion of Gases in Variable-Area Ducts 1.8 Effects of Variable Area in Subsonic and Supersonic Flows
Week 4 (Mar 5th)	***Chapter 2: Shocks (Normal and Oblique) and Expansion Waves*** 2.1 Surfaces of Discontinuity 2.2 Shock Waves 2.3 Weak Shocks
Week 5 (Mar 12th)	2.4 Prandtl-Meyer Expansion Fans 2.5 Supersonic Wave Drag and Compression Lift 2.6 Reacting Normal Discontinuities
Week 6 (Mar 19th)	2.7 Interactions of Shock Waves with Walls 2.8 Internal Structure of Shock Waves and Non-Equilibrium Processes ***Chapter 3: Compressible Flows in Ducts and Nozzles*** 3.1 Dynamics of Convergent-Divergent Nozzles 3.2 Rocket Engine Nozzles
Week 7 (Mar 26th)	Problem Solving Session
Week 8 (Apr 2nd)	**MIDTERM 1 Apr 2nd, 2020: 08:30 – A03**
Week 9 (Apr 9th)	3.3 Flows in Ducts with Heat Addition and Friction ***Chapter 4: Wave Motion in Compressible Flows*** 4.1 Moving Normal Shock Waves 4.2 Reflected Shock Wave 4.3 Physical Picture of Wave Propagation
Week 10 (Apr 16th)	4.4 Elements of Acoustic Theory 4.5 Finite (Nonlinear) Waves 4.6 Incident and Reflected Expansion Waves 4.7 Shock Tube Relations
Week 11 (Apr 23th)	National Sovereignty and Children's Day (Ulusal Egemenlik ve Çocuk Bayramı) NATIONAL HOLIDAY
Week 12 (Apr 30th)	***Chapter 5: Two Dimensional (Linearized) Compressible Flows*** 5.1 Irrotational Flow 5.2 The Velocity-Potential Equation 5.3 Small Perturbation Theory 5.4 Linearized Velocity Potential Equation 5.5 Linearized Pressure Coefficient 5.6 Linearized Subsonic Flow

Week 13 (May 7th)	Problem Solving Session
Week 14 (May 14th)	**MIDTERM 2 May 14th, 2020: 08:30 – A03**
Week 15 (May 21th)	5.7 Improved Compressibility Corrections 5.8 Linearized Supersonic Flow 5.9 Critical Mach Number

Exams

There will be two midterms and one final examination. **You must bring one A4 page (both sides of the page can be filled) of formula sheet (HANDWRITTEN BY YOUR OWN) for each midterm exam. You can bring 2 A4 pages of formula sheet to the final. Necessary tables will be supplied before the exam; each student should bring his/her own copy of this AERODYNAMICS TABLE to each exam.**

Course Grade

The grading will be based on a weighting of **10** % on the homeworks, **25** % on the midterm-1, **25** % on the midterm-2, and **40** % on the final exam.

Performance is assessed based on

1. The skill to solve given problems
2. Clarity of the motivation of the steps involved in solving a problem
3. Clarity of the presentation of the results.

Each of these three points carries equal weight.

Policies:

- Regular and punctual attendance (at least 70%) and participation are expected.
- Computers and cell phones must be turned off during lectures, no texting, chatting etc.
- Absence from tests must be explained with medical certificates or other valid reasons beyond your control and planning.
- Ask anyone for help on homework, but what you submit must be your own work.