Fall 2020

Çankaya University
Faculty of Engineering
Mechanical Engineering Department
ME 516 ADVANCED FLUID MECHANICS

Instructor:
Prof. Dr. Haşmet TÜRKOĞLU, Room: LA01

Course content:
Introduction to fluid mechanics. Scalar, vector and tensor analysis. Definition of continuum. Lagrange and Eulerian description of fluid motion. Transport theorem. Kinematics of fluid motion; streamline, streakline, pathline and timeline; vorticity, circulation, rotation and deformation. Fundamental equations and constitutive relations; derivation of differential continuity, momentum and energy equations. Subsonic potential flows. Application of complex functions to two-dimensional potential flows. Conformal mapping.

Textbook:
Fundamental Mechanics of Fluids, I. G. Curie, McGraw-Hill Book Company, 1974.

Reference Books:
1. Introduction to Fluid Mechanics, R. W. Fox, P. J. Pritchard and A. T. McDonald, John Wiley & Sons., In., Eighth Edition.
2. Introduction to Fluid Mechanics, Donald F. Young, Bruce R. Munson, Theodore H. Okiishi and Wade W. Huebsch, John Wiley & Sons, Inc., Fifth Edition.

Course Objective:
To introduce basic properties of fluids and importance of fluid mechanics in engineering applications. Introduce the basic approaches and derive the basic equations in differential form and apply them to engineering problems involving fluids.

Course Outcomes:
Students are expected to know the basic laws and equations used for analysis of fluid motion. Students are also expected to be able to apply and solve differential form of the basic equations to the simple flow problems and interpret the results.

COURSE PLAN

Week	Topics
1	**INTRODUCTION**: Definitions, scalar, vector and tensor analysis.
2	**BASIC LAWS**: Conservation of mass, Newton's laws, the first law of thermodynamics.
3	**DERIVATION OF BASIC EQUATIONS**: Constitutive relations, governing equations for laminar flows, boundary conditions.
4	**DERIVATION OF BASIC EQUATIONS**: Governing equations for turbulent flows, turbulence models.
5	**ANALYSIS OF VISCOUS FLOWS**: Solution of simple viscous flow problems.
6	**ANALYSIS OF VISCOUS FLOWS**: Solution of simple viscous flow problems.
7	**KINEMATICS OF FLUID MOTION**: Streamline, streakline, pathline and timeline; vorticity, circulation, fluid rotation and deformation.
8	**INVISCID FLOW**: Derivation of basic equations of inviscid flow. Complex functions, complex potential, complex velocity.
9	**INVISCID FLOW**: Elementary plane flows: uniform flow, source flow, sink flow, vortex flow, and doublet.
10	**INVISCID FLOW**: Superposition of elementary plane flows.
11	**INVISCID FLOW**: Derivation and application of Blasius laws.
12	**INVISCID FLOW**: Derivation and application of Blasius laws.
13	**INVISCID FLOW**: Conformal transformation, Joukowski transformation, Schwarz-Crhristofell transformation.
14	**INVISCID FLOW**: Analysis of flow over ellipse and airfoils.

Assessment Criteria:

If Final Exam is Conducted in Class	**If Final Exam is Conducted Remote**
Midterm Exam/Term Project: 25% (1 exams) **Quizzes:** 25% (Best four out of six quizzes) **Final Exam:** 50%	**Midterm Exam/Term Project:** 30% (1 exams) **Quizzes:** 30% (Best four out of six quizzes) **Final Exam:** 40%

NOTES:

1. All the lectures will be online according to the scheduled program.
2. Class notes will be uploaded on the course webonline page. Every student should print the class notes and have it ready during the lectures.
3. In the notes, some of the derivations and problem solutions left blank to be completed in the class (lecture). In lectures, these derivations and problem solutions will be completed. Students are expected to take notes during the lectures on blank spaces left.
4. Every student MUST be able to use webonline effectively, should be able to download and upload files.
5. Regulations about the exams will be announced before the exams.