ME304 FLUID MECHANICS II

2022-2023 SPRING

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Çankaya University
Faculty of Engineering
Mechanical Engineering Department

ME 304 FLUID MECHANICS II

INSTRUCTOR:
Prof. Dr. Haşmet TÜRKOĞLU

Teaching Assistant:
Eyüp KOÇAK

Office Hour: Monday 2:00 pm or by appointment (Zoom meeting)

Course Objectives:
Teach derivation and application of basic equations in differential form governing the fluid motion, solution of differential equations to find velocity distribution, calculation of forces exerted by flows on bodies, introduce the dimensional analysis, similitude and the boundary layer concept.

Course Outcomes (Ders Çıktıları):

1. Students will be able to **derive the basic equations** of fluid motion in **differential form** and **use them** for flow analysis.
2. Students will be able to select and use proper equations for **the analysis of inviscid flows**.
3. Students will be able to **derive boundary layer flow equations** and **use them** for the analysis
4. Students will be able to **perform dimensional analysis** and **use it** and similarity laws for flow analysis.
5. Students will be able to **calculate forces acting on immersed bodies** due to a flow.

Textbook:
Introduction to Fluid Mechanics, R. W. Fox, P. J. Pritchard and A. T. McDonald, John Wiley & Sons, Inc., Nineth Edition.

Reference Books:
Introduction to Fluid Mechanics, D. F. Young, B. R. Munson and T. H. Okiishi and W. W. Huebsch John Wiley & Sons, Inc., 5th Edition.
Mechanics of Fluids, M. C. Potter and D. C. Wiggert, Prentice Hall, Second Edition.

Assessment Criteria:

Midterm Exam: 40% (Subject to change according to the possible in class lessons)
Quizzes: 15% (Best six out of eight online quizzes)
Final Exam: 45% (Subject to change according to the possible in class lessons)

NOTES:

1. All the lectures will be online according to the scheduled program until a further notice.
2. Class notes will be uploaded on the course webonline. Every student should print the class notes and have it ready during the lectures.
3. Every student MUST be able to use webonline well, should be able to download and upload files.
4. Regulations about the exams will be announced before the exams.

COURSE PLAN

Week	Topics
1	DIFFERENTIAL ANALYSIS OF FLUID MOTION: Derivation of continuity equation. Stream function for two-dimensional incompressible flows.
2	DIFFERENTIAL ANALYSIS OF FLUID MOTION: Motion of fluid elements (kinematics), derivation of momentum equation.
3	INCOMPRESSIBLE INVISCID FLOW: Derivation and application of Euler's equation. Derivation and application of Bernoulli equation. Static, stagnation and dynamic pressure. Flow Measurement.
4	INCOMPRESSIBLE INVISCID FLOW: Irrotational flow. Bernoulli equation for irrotational flow. Velocity potential and stream function.
5	INCOMPRESSIBLE INVISCID FLOW: Elementary plane flows. Superposition of plane flows.
6	DIMENSIONAL ANALYSIS AND SIMILITUDE: Introduction. Buckingham Pi theorem. Determination of Pi groups.
7	DIMENSIONAL ANALYSIS AND SIMILITUDE: Dimensionless groups of significance in fluid mechanics. Flow similarity and model studies.
8	BOUNDARY LAYER: The boundary layer concept, boundary layer thicknesses.
9	BOUNDARY LAYER: Laminar flat-plate boundary layer: Exact solution.
10	BOUNDARY LAYER: Momentum integral equations.
11	FLOW ABOUT IMMERSED BODIES: Drag and lift on surfaces parallel and normal to flow.
12	FLOW ABOUT IMMERSED BODIES: Flow over cylinder and sphere: Drag and lift forces. Flow over different geometrical shapes.
13	FLOW ABOUT IMMERSED BODIES: Drag and lift forces. Flow over different geometrical shapes.
14	COMPRESSIBLE FLOW: Introduction. Analysis of steady one-dimensional compressible flow. Fanno line and Rayleigh line.