]Philadelphia University

Faculty of Engineering - Department of Mechanical Engineering
First Semester 2020/2021

Course Information

Title: Fluid Mechanics_1 (620320)

Prerequisite: Engineering analysis (1)- (650262), Dynamics - (620212)

Credit Hours: 3 credit hours (16 weeks per semester, approximately 44 contact hours)

Textbook: Engineering Fluid Mechanics, by, Donlad F. & Elger, Barabra C. Williams, Clayton T Crowe, and John A. Roberson, 10th OR 11th Edition.

References:

- Fluid mechanics by Hibbeler, R. C. Boston: Pearson, 2017.
- Fluid mechanics by Franck M. white. New York: McGraw Hill education, 2016.
- Fluid mechanics by Fox W. et al. John Wiley & Sons, 2016, 9th ed.

Description: The course is a requirement for Mechanical Engineering students. At completing this course, the student should be able to understand fluid properties, Hydrostatics, principle of floating objects, buoyancy principle, Fluid in motion, Bernoulli equation, One dimensional Euler's equation, Free and forced vortices, rotational flow equation and pressure variation, Control volume approach, Reynolds transport theorem, Continuity equation, Impulse-Momentum principles, Energy equation, Hydraulic and energy grade lines

Instructor: **Professor Munzer Ebaid**
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Office hours:

Course Topics:

Week	Topic
1	Introduction
2	Fluid properties
3 + 4	Fluid statics

5+6+7	Fluid in motion and pressure variation
8+9+10	Control volume approach
11+12+13	Momentum principle
14+15	Energy principle
16	Revision

ABET Student Outcomes (SOs)

1	An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2	An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3	An ability to communicate effectively with a range of audiences
4	An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5	An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7	An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Course Learning Outcomes and Relation to ABET Student Outcomes:

Upon successful completion of this course, a student should be able to:

1.	(a) Define engineering fluid mechanics. (b) Define fluid liquid and gas and their characteristics. (c) Describe units and dimensions and check for dimensional homogeneity. (d) Define ideal gas law. (e) Describe Walls – Wood model.	[1]
2.	(a) Define system, boundary surroundings, state, process, and property. (b) Define density, specific gravity, and specific weight. Relate these properties us1ng calculations. (c) Explain the meaning of a constant density flow and discuss the relevant issues. (d) Look up fluid properties. (e) Define viscosity, shear stress, shear force, velocity gradient, velocity profile, the no-slip condition, and kinematic viscosity. (f) Apply the shear stress equation to problem solving. (g) Describe a Newtonian and non-Newtonian fluid. (h) Describe surface tension, solve relevant problems. (i) Describe vapor pressure; look up data for water.	[1]
3.	(a) Define hydrostatic equilibrium. Define pressure. (b) Convert between gauge, absolute, and vacuum pressure and pressure units. (c) Derive the hydrostatic differential equation and the meaning of the variables that appear in the equation. (d) Explain piezometric and head pressure. (e) Define and apply manometer equation. (f) Explain how these instruments work: mercury barometer, piezometer, manometer, and Bourdon tube gauge. (g) Explain center-of-pressure and hydrostatically equivalent force. Describe how	[1, 2]

	pressure is related to pressure force. (h) Apply the panel equations to predict forces and moments and solve problems of curved surfaces. (i) Describe the physics of the buoyancy equation. (j) Describe surface tension property and identify examples related to surface tension.	
4.	(a) Describe streamlines, streaklines, and pathlines. Explain how these ideas differ. (b) Describe velocity and the velocity field. (c) Describe the Eulerian and Lagrangian approaches. (d) Define acceleration, sketch the direction of the acceleration vector of a fluid particle, define local acceleration and convective acceleration. (e) Apply Euler's equation to describe pressure venations. (f) Apply the Bernoulli equation along a streamline. (g) Define static pressure and kinetic pressure. Explain how to measure velocity using a Pitot-static tube. (h) Define the rate-of-rotation and vorticity and define an irrotational flow. (i) Apply the Bernoulli equation in on irrotational flow. (j) Define the pressure coefficient. Sketch the pressure variation for flow around a circular cylinder. (k) Calculate the pressure variation in a rotating flow.	[1]
5.	(a) Define mass flow rate and volume flow rate. (b) Apply the flow rate equations. (c) Define and calculate the mean velocity. (d) Describe the types of systems that engineers use for analysis. List the key differences between a CV and closed system. (e) Describe the purpose, application, and derivation of the Reynolds transport theorem. (f) Describe, drive and apply the continuity equation. (g) Explain what cavitation means, describe why it is important, and list guidelines for designing to ovoid cavitation.	[1,2]
6.	(a) Define a force, o body force, and a surface force. (b) Explain Newton's second law (particle or system of particles). (c) Define a force, o body force, and a surface force. (d) Derive the linear momentum equation. (g) Describe or calculate momentum flow and momentum accumulation. (e) Sketch a force diagram. Sketch a momentum diagram. (f) Describe the process for applying the momentum equation. (g) Apply the linear momentum equation to problems involving jets, vanes, pipe bends, nozzles, and other stationary objects. (h) Apply the linear momentum equations to moving objects such as carts and rockets. (i) Apply the angular momentum equation to analyze rotating machinery such as pumps and turbines. (j) Describe the physics of the momentum equation and the meaning of the variables that appear in the equation. (k) Describe the process for applying the momentum equation. Apply the linear momentum equation to problems involving jets, vanes, pipe bends, nozzles, and other stationary objects. (l) Apply the linear momentum equations to moving objects such as carts and rockets. (m) Apply the angular momentum equation to analyze rotating machinery such as pumps and turbines. (n) Apply the angular momentum equation to analyze rotating machinery such as pumps and turbines.	[1,2]
7.	(a) Explain the meaning of energy, work, and power and classify energy into categories. (b) Define a pump and a turbine. (c) Explain conservation of energy for a closed system and a CV. (d) Derive the energy equation. (e) Explain flow work and shah work. (f) Define head loss and the kinetic energy correction factor. (g) Describe the physics of the energy equation and the meaning of the variables that appear in the equation. (h) Describe the process for applying the energy equation. (i) Apply the energy and power equation. (j) Define mechanical efficiency and apply this concept. (k) Contrast the energy equation and the Bernoulli equation. (l) Calculate head loss for a sudden expansion. (m) Explain the conceptual foundations of the energy grade line and hydraulic grade line and how to sketch these lines.	[1,2]

Teaching methodology: Online, Blended or both

Electronic platform: Microsoft-teams

Assessment Instruments:

Evaluation of students' performance (final grade) will be based on the following categories:

Mid Exam	Two written exams will be given. Each will cover about 3-weeks of lectures
Quizzes	Five minute quizzes will be given to the students during the semester. These quizzes will cover material discussed during the previous lecture(s).
Homework	Problem sets will be given to students. Homework should be solved individually and submitted before the due date. Copying homework is forbidden, any student caught copying the homework or any part of the homework will receive zero mark for that homework
Participation	Questions will be asked during lectures and the students are assessed based on his/her response
Final Exam	The final exam will cover all the class material.

Grading policy:

Mid Exam	30%
Home works, Quizzes and participation	20%
Final Exam	50%
Total:	**100%**

Attendance policy:

Absence from classes and/or tutorials shall not exceed 15%. Students who exceed the 15% limit without a medical or emergency excuse, acceptable to and approved by the Dean of the relevant college/faculty, shall not be allowed to take the final examination and shall receive a mark of zero for the course. If the excuse is approved by the Dean, the student shall be considered to have withdrawn from the course.

February, 2018