Philadelphia University

Faculty of Engineering - Department of Mechanical Engineering
2nd Semester 2020/20221

Course Information

Title:	Fluid Mechanics_2 (620428)
Prerequisite:	Fluid Mechanics (1)-620320, Engineering analysis (2) - 630262
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, 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 the following:

- Description Couette and Hell-Shaw flows
- Viscous flow equations of motion
- Laminar and turbulent flow boundary layers over flat plates.
- Laminar and turbulent flow in conduits.
- Friction factor, Darcy-Weisback equation and Moody diagram.
- Hydraulic diameter and hydraulic radius
- Drag and lift forces, Coefficient of drag and lift, terminal velocity, lift and drag on airfoil.
- Compressible flow, normal and obligue shock waves, significance of the Mach number, isentropic flow through varying area channels and Laval nozzle.
- Flow measurements of pressure, velocity and mass flow rates. Orifice and Venturi meter.
- Thrust and efficiency of a propeller, performance Axial and radial pumps, performance of axial and radial turbines, and specific speed.

Instructor:

Professor Munzer Ebaid
Office: Mechanical Engineering building, room E61305 , ext. : 2445
Office hours:.

Course Topics:

Week	Topic
1+2+3	Surface resistance
3 + 4+6	Flow in conduits
7+8	Drag and Lift
9+10+11	Compressible Flow
12+13+14	Flow measurements
14+15	Turbo-machinery
16	Revision

<u>ABET Student Outcomes (SOs)</u>

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) Describe Couette flow. Show how to derive and apply the working equations. (b) Describe Hele-Show flow and derive and apply the working equations. (c) Sketch the development of the boundary layer on o flat plate, and define the local and average shear stress coefficient. (d) Define the laminar boundary layer thickness. the shear stress, and the shear force using	[1, 6]

	suitable correlations. (e) Describe the transition Reynolds number. (f) Describe or apply the power low equation for the turbulent boundary layer and describe the three zones layer of flow. (g) For the turbulent boundary layer, calculate the boundary layer thickness, the shear stress, and the shear force using suitable correlations.	
2.	(a) Define a conduit. Classify o flow as laminar or turbulent. (b) Define or calculate the Reynolds number. (c) Describe developing flow and fully developed flow. And classify a flow into these categories. (c) Specify a pipe size using the NPS standard. (d) Describe total head loss, pipe head loss, and component head loss. (e) Define the friction factor *f* and derive the Darcy-Weisbach equation. (f) Describe the physics of the Darcy-Weisbach equation and the meaning of the variables that appear in the equation. (g) Calculate head loss for laminar flow.(h) Describe the main features of the Moody diagram and calculate friction factor for turbulent flow using the Moody diagram or the Swamee-Jain correlation. (i) Define the minor loss coefficient. And describe and apply the combined head loss equation. (j) Define hydraulic diameter and hydraulic radius and solve relevant problems. (k) Solve problems that involve pumps and pipe networks.	[1, 6]
3.	(a) Define lift and drag and explain how lift and drag are related to shear stress and pressure distributions. (b) Define form drag and friction drag. (c) Define the coefficient of drag and calculate the drag force. (d) Describe how to calculate the power required to over come drag and solve relevant problems. (d) Explain how to calculate terminal velocity and solve relevant problems. (f) Describe vortex shedding and explain what streamlining means. (g) Define circulation and describe the circulation theory of lift. (h) Define the coefficient of lift and calculate the lift force and calculate the lilt and drag on airfoil.	[1, 6]
4.	(a) Describe the propagation of a sound wave. (b) Explain the significance of the Mach number.(c) Calculate the speed of sound and Mach number. (d) Describe how pressure and temperature vary for flow along a streamline in compress1ble flow. (e) Describe a normal shock wove. (f) Calculate property change across a normal shock wave. (g) In a de Laval nozzle, describe how flow properties vary. Also, calculate the moss flow rote and Mach number.	[1, 6]
5.	(a) Describe common instruments for measuring velocity and pressure. (b) Calculate flow rate by integrating velocity distribution data. (c) Describe common instruments for measuring discharge (volume flow rote). (d) Calculate flow rate for on obstruction flow meter (i.e., an orifice, venturi, flow nozzle). (f) Calculate flow rate for a rectangular or triangular weir. (g) Describe the methods and instruments that are used in compressible flow. (h) Quantify the accuracy of a measurement by using the uncertainty equation	[1, 6]
6.	(a) Describe the factors that influence the thrust and efficiency of a propeller. (b) Calculate the thrust and efficiency of a propeller. (c) Describe axial flow and radial flow pumps. (d) Define the head coefficient and the discharge	[1, 6]

	coefficient. (f) Sketch a pump performance curve. (g) Explain how specific speed is used to select an appropriate type of pump for an application. (h) Describe an impulse turbine and a reaction turbine. (i) Describe the maximum power that can be produced by a wind turbine.	

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	30%
Final Exam	40%
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