ME 3500: INTRODUCTION TO FLUID AND THERMAL ENERGY TRANSPORT

Syllabus and Course Policies (CRN 13762)

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Office Hours: After/before class/lab or by appointment.

Class Times: Tuesday and Thursday, 5:30 pm - 7:17 pm, DHE 135

Lab Times: Tuesday or Thursday, 7:30 pm – 9:17 pm in EC 360

Teaching Assistant: TBD, 1:00 pm - 2:00 pm EC 360

Course Web Site:
The Moodle course management system will be used this semester. You may access the ME 3500 website using your OUCA name and password at: https://moodle.oakland.edu

HW assignments, solutions, announcements, interesting web links and handouts can be found on this site. Please visit the website on a regular basis for course updates. Note: Lab handouts and HW assignments will not be distributed in class.

Required Textbooks:

1) Introduction to Fluid Mechanics, R.W. Fox and A.T. McDonald, 9th John Wiley; 2016. You must get a version that includes an online code to access the WileyPlus online resources. You have the option of purchasing the textbook in loose-leaf form with WileyPlus access (ISBN 9781119032038), in hardcopy with WileyPlus access (ISBN 9781119031895) or you can purchase the WileyPlus access only with also gives you access to the textbook online for the duration of the course (ISBN 9781118471340). You can also get WileyPlus access with an **ebook which you can keep (ISBN 9781119445159) through the WileyPlus website.**

2) Fundamentals of Thermal-Fluid Sciences, 5th edition by Yunus Cengel. Publisher: McGraw-Hill (ISBN: 0078027683)

Course Prerequisites:
(EGR 250 or EGR 2500) with a grade of 2.0 or higher, (MTH 254 or MTH 2554) and major standing. Pre/Corequisite(s): (EGR 280 or EGR 2800).

Course Objectives:

The primary objective of this course is to teach the fundamental concepts and engineering applications of fluid mechanics and heat transfer. The laboratory component is intended to reinforce these basic concepts, teach principles of experimentation and experiment design, and improve teamwork and communication skills. An additional goal of this course is to assist the student in developing the ability to analyze and solve engineering problems using logical reasoning and mathematical principles. By the end of this course, the successful student will be able to:

1. List and define elementary terminology related to fluid flow and heat transfer; explain the different flow classifications and flow field descriptions. Describe the different mechanisms of heat transfer and the different regimes of fluid flow. (a)

2. Design and perform experiments. Formulate, evaluate, and calculate experimental uncertainties of indirect measurements. Analyze experimental data and write quality technical reports. (b, d, f, g, i, k)

3. Explain the integral form of the conservation of mass and momentum principles and apply to a variety of static and dynamic fluid problems. (a, e, k)

4. Describe the development of the Bernoulli and Euler's equations for inviscid flows and list the underlying assumptions; apply the Bernoulli equation to appropriate engineering problems. (a, e, k)

5. Describe the meaning and the physical significance of the continuity and Navier-Stokes equations. (a)

6. Derive the velocity profile in a simple laminar viscous flow; explain viscous drag and the role of the Reynolds number in distinguishing between laminar and turbulent flows; evaluate the head loss and pressure drop in single-path piping systems. (a, e, k)

7. Use the heat diffusion equation with appropriate boundary conditions to determine a steady one-dimensional temperature distribution in a solid. (a, e, k)

8. Describe viscous and thermal boundary layers; select and apply suitable empirical convection correlations to determine the convective heat transfer coefficients for simple engineering geometries. (a, e, k)

9. Use convection correlations to evaluate the overall heat transfer coefficient in problems involving convection and conduction such as heat exchangers. (a, e, k)

Tentative Course Calendar: (Subject to Change)

Week	Date	Topic	Reading
1	Thur, Jan. 4	Course overview. Introduction to Fluid Mechanics	1.1-1.7
2	Tues, Jan. 9	Fundamental Concepts – Viscosity and Newtonian Fluids	2.1-2.4
	Thurs, Jan. 11	Velocity Field; Stress Field, viscosity	2.5-2.7
3	Tues, Jan. 16	Basic Equations, Standard Atmosphere, Pressure Variation	3.1-3.3
	Thurs, Jan. 18	Hydrostatics, Buoyancy and Stability	3.4, 3.6
4	Tues, Jan. 23	Basic Laws of a System and System Derivatives	4.1-4.2
	Thurs, Jan. 25	Test #1 (Chapters 1-3)	
5	Tues, Jan.30	Conservation of Mass and Momentun	4.3-4.4
	Thurs, Feb. 1	Conservation of Mass, Motion of a Fluid Particle	5.1, 5.3
6	Tues, Feb. 6	Differential Form Equation, Flow Motions	5.4
	Thurs, Feb. 8	Momentum Equation, Euler's Equations, Bernoulli Equation	6.1-6.4
7	Tues, Feb. 13	Test #2 (Chapters 4-5)	
	Thurs, Feb. 15	Bernoulli Equation; Static, Stagnation, Total Pressure	6.6
WINTER BREAK			
8	Tues, Feb. 27	Incompressible Viscous Flow	8 (Part I)
	Thurs, Mar. 1	SNOW DAY – EVENING CLASSES CANCELLED	
9	Tues, Mar. 6	Internal Flow: Energy Consideration	8 (Part II)
	Thurs, Mar. 8	Internal Flow: Energy Consideration (Continued)	8 (Part II)
10	Tues, Mar. 13	Internal Flow Problems	8 (Part III)
	Thurs, Mar.15	Review of heat transfer concepts Introduction to Lab #4: Minor Loss through a Fitting	16.1-16.2

Week	Date	Topic	Reading
11	Tues, Mar. 20 Thurs, Mar. 22	Test #3 (Chapters 6 & 8) Review of heat transfer concepts	 16-3 -16.4
12	Tues, Mar. 27 Thurs, Mar. 29	Convection Heat Transfer-External Flow Part I Convection Heat Transfer-External Flow Part II	19.1-19.2 19.3-19.4
13	Tues, Apr. 3 Thurs, Apr. 5	Heat Exchanger Designs; Fouling factor Test #4 (Chapters 16 & 19)	22.1-22.2
14	Tues, Apr. 10 Thurs, Apr. 12	Analysis of heat exchangers: LMTD method Review for Final	22.3-22.4
15	Tues, Apr. 17 Thurs, Apr. 19	Study Day Comprehensive Final Exam 7:00 pm -10:00 pm in classroom	

Laboratory Schedule (Tentative)			
	Lab Experiment Title	**Introduced during the week of:**	**Due Date**
Lab #1	Measuring Oil Viscosity	January 15	February 3
Lab #2	Thrust from a Jet	January 29	February 17
Lab #3	Bernoulli Equation Demonstration	February 26	March 24
Lab #4	Minor Loss in a Fitting Design Experiment	March 12	April 17

Course Grade:

Laboratory	24%
Tests	50%
Final Exam	26%
Total	100%

The following "standard scale" shows the lowest possible grade that a given percentage score will generally earn (the grade may be higher than this): 95%→4.0, 80%→3.0, 70%→2.0, 60%→1.0.

Important Dates:

- Wednesday, January 17th – Last day for 100% semester refund
- Feb. 17th – Feb. 26th – No class (Winter break)
- Thursday, April 12th, - Last ME 3500 class
- Thursday, April 19 - Final Examination (7:00pm – 10:00pm in classroom)

Other important semester dates can be accessed at https://wwwp.oakland.edu/registrar/important-dates.

Homework:

Homework will be assigned but not collected. Problem numbers for each chapter can be found in Moodle and the solutions will be posted.

Activities: Some activities will be assigned in the class, and then collected by the instructor at the end of the class. Student should prepare a piece of paper for the in-class activities. Activities will be randomly graded. NO LATE ACTIVITIES WILL BE ACCEPTED.

Tests:

a) Exam dates and times are given in the class calendar.

b) All exams will be **closed notes and closed book**. Formula sheets will be provided with some of the exams.

c) A score of zero will be recorded for a missed exam. Make-up exams will be given only by prior arrangement, or for a documented illness or serious emergency. Any makeup exam will not be eligible for any bonus point questions and the instructor reserves the right to provide an exam of a different format than that given to the rest of the class.

d) Exam solutions will be posted to Moodle and graded exams will be returned to the students.

Laboratory: Team members will have the opportunity to evaluate the performance and contribution of fellow team-members for each lab. An individual student's cumulative laboratory grade will be adjusted at the end of the course by up to ±20% based on these evaluations. If repeated efforts to improve team functioning (including faculty intervention) fail, a non-participant may be fired by unanimous consent of the rest of the team, and a team member doing essentially all the work may quit. This however requires prior instructor approval. Individuals who quit or are fired must find a team of three unanimously willing to accept them; otherwise they will receive zeros for the remainder of the labs. I reserve the right to adjust the grade of any lab based on the written communication skills demonstrated in the lab report. A poorly written lab can lose up to half the total possible points. The laboratory will begin the *third week* of class. Details regarding the operation of the lab, laboratory reports and a schedule will be given during the first lab meeting. In order to pass this course, students must pass the laboratory portion.

Academic Conduct: All students are expected to read, understand, and comply with the *Academic Conduct Policy* found in the *Oakland University Undergraduate Catalog*. It may also be found on the OU website at http://www.oakland.edu/?id=24228&sid=482. The policy applies to testing, homework and laboratory work, and is taken very seriously by the instructor. Perceived violations of this policy will be taken before the OU Academic Conduct Committee. Engineering is a profession that serves the public and demands integrity within its membership.

Program Outcomes: ABET 3(a-k)

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environ., social, political, ethical, health, safety, manufactured ability, sustainability
(d) an ability to function on multi-disciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global economical, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice