The University of Texas at San Antonio
Department of Mechanical Engineering
ME 3663 Fluid Mechanics
Syllabus Spring 2021

Part A – Course Outline

Required course in Mechanical Engineering Program

Catalog description:
(3-0) 3 hours credit. Prerequisites: EGR 2323, EGR 2513, and completion of or concurrent enrollment in ME 3293. Fluid properties, fluid statics, integral and differential analysis of fluid flow, viscous laminar and turbulent flow in conduits, dimensional analysis, boundary layer concepts, drag and lift.

Prerequisites:
EGR 2323 – Engineering Analysis I (requires a grade of C- or better)
EGR 2513 – Dynamics (requires a grade of C- or better)

Textbook(s) and/or required material:
1. Munson, Young and Okiishi's ***Fundamentals of Fluid Mechanics***, 8th Edition (2016).
2. Other items as identified by instructor (**see Part B of course syllabus**).

Major prerequisites by topic:
1. Fundamental Units and Dimensions
2. Differential Calculus
3. Integral Calculus
4. Force Balance

Topics covered:
1. Basic concepts of fluids
2. Fluid properties
3. Hydrostatics
4. Fluid kinematics
5. Buoyancy
6. Reynolds transport theorem
7. Control volume analysis for conservation of mass
8. Control volume analysis for conservation of momentum
9. Control volume analysis for conservation of energy
10. Differential analysis for a fluid system
11. Bernoulli's equation
12. Dimensional analysis
13. Internal viscous flow
14. External flows
15. Introduction to boundary layer theory

Contribution of course to meet the professional component:
This course builds the foundation for preparing students to work professionally in the area of thermal systems.

Relationship of course to Student Outcomes:
This course primarily contributes to Mechanical Engineering student outcomes:

(SO1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics*

(SO4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts*

*This student outcome is covered and assessed as part of the Mechanical Engineering program continuous improvement processes.

Course objectives (contribution to Student Outcomes):
After the successful completion of this course, the student will be able to do the following
1. Evaluate basic fluid properties (SO1)
2. Solve fluid statics problems (SO1)
3. Apply the basic laws of fluid mechanics (SO1)
4. Perform control volume analysis for mass, momentum, and energy conservation (SO1)
5. Evaluate viscous drag force using differential boundary layer analysis (SO1)
6. Apply dimensional analysis to generalize empirical results (SO1)
7. Calculate head loses for internal, viscous, and incompressible flows (SO1)
8. Compute drag and lift for external, viscous, incompressible flows (SO1)
9. Demonstrate a knowledge in and awareness of contemporary issues of pollution, energy conservation, and aviation as they relate to fluid mechanics (SO1, SO4)

Course Coordinator: **Chris Combs**

Persons who prepared this description:
- Alaa Hassan Ali, Nigil Jeyashekar, Zhi-Gang Feng, Randy Manteufel, and Clark M. Butler, August 2015
- Modified by Ender Finol, August 2020
- Modified by Chris Combs, January 2021

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Part B – General Information

Instructor: Christopher Combs, Ph.D.
Office: EB 3.04.26
E-mail: ccombs@utsa.edu
Virtual Office Hours: Tues., Wed., & Thur. 10a-12p or by appointment
Zoom Link: https://utsa.zoom.us/my/ccombspersonalroom

Time: Asynchronous Virtual

Location: Content to be posted online via Blackboard

Graders: Angelina Andrade, Email: angelina.andrade@my.utsa.edu
Ivana Chen, Email: ivanamchen@gmail.com

Grading:
The grading will be calculated as follows:

Homeworks	45%
Current Events Project	5%
Exams	50%
Total	**100%**

A standard decade scale (A ≥ 90%, B+ = 88-89.9, B = 80-87.9%, C+ = 78-79.9%, C = 70-77.9%, D = 60-69.9%, F < 60%) will be used to assign final grades in this course. The instructor reserves the right to curve grades in a manner that will benefit students.

Excused Absences:
Excused absences include personal illnesses, deaths in the family, religious holidays, and UTSA sponsored activities. For illnesses, you must provide documentation (physician's statement/note, etc.) within 3 class meetings in order to be excused. Absences in observance of religious holidays are authorized only if you notify your instructor in writing (email or physical note) at least one week in advance. UTSA sponsored events require an original signed letter on UTSA letterhead from the faculty or staff sponsor.

Make-up Exams:
Make-up exams will not be allowed unless previously approved by the instructor.

Late Work:
Late work will only be accepted if a student has an excused absence on the day an assignment is due. Students missing class on the due date of an assignment owing to a planned excused absence (religious holiday or UTSA sponsored activity) should arrange with the instructor an appropriate time to submit the assignment. If an assignment is not submitted, the grade will always be a 0.

Lecture Attendance:
Lecture content will be pre-recorded and made available online. Each student will be responsible for learning all of the material covered in the lectures.

Extra Credit
Any potential extra credit opportunities will be offered by the instructor to the class as a whole and will never be offered exclusively to individual students hoping to improve their grade. Solicitations by students for extra credit opportunities will not be provided with a response, given that this action would violate UTSA policy by promoting differential treatment between students.

Scholastic Dishonesty:
Scholastic dishonesty is a serious offense that includes, but is not limited to, copying homework, cheating on a test, plagiarism, or collusion. The Office of Student Life (458-4720) should be contacted if a student has questions about what constitutes scholastic dishonesty/ http://utsa.edu/studentlife/conduct/scholastic_dishonesty.html

While it is acceptable to look at other students' written reports, for example, for the purpose of seeing the format and style, it is a violation of University policy to plagiarize (copy) text, figures, or illustrations from other students' work without proper citation.

Cases of suspected scholastic dishonesty related to exams and written reports will be prosecuted through the UTSA Office of Student Life, with the recommended penalty that the student receive an "F" grade for the class.

Blackboard:
Most of the documents you need for this course will be posted in Blackboard. It is your responsibility to check Blackboard on a regular basis throughout the semester. I may post important messages regarding assignments, schedules, and any changes to the syllabus through Blackboard. These messages may require a response from you. Some assignments and quizzes will be posted to Blackboard as well.

To learn how to navigate Blackboard, you can view these tutorials:
https://www.youtube.com/playlist?list=PLontYaReEU1seUE3ACG3sEc3zR7Br7URU

E-mail Communication:
The instructor will send messages related to the course using the student's UTSA preferred email address (check your preferred email address on ASAP). Students are expected to check their UTSA e-mail accounts on a daily basis. If you use a different e-mail account, please make sure that your UTSA e-mails are forwarded to your non-UTSA e-mail account.

Electronic Devices:
Laptops and/or tablets are encouraged in class. I will show you step-by-step how to complete various assignments and we will also have activities where your electronic devices will be very useful to you. (Remember, you can borrow a laptop from the library: https://lib.utsa.edu/services/technology-lending).

Audio/Video Recording:
Feel free to record any lectures or presentations in my class for your own personal use. However, these recordings may not be duplicated, shared, or disseminated without the express written consent of the instructor.

Course Evaluation:
I use the feedback provided by my students in course evaluations to improve my teaching. Additionally, course evaluations are a strategy used by the university as one factor in evaluating an instructor's effectiveness. As a faculty member, I encourage you to complete the course evaluation during the availability period near the end of the semester so that I can make improvements for my next group of students.

University Policies:
Required university policy link: http://teaching.utsa.edu/wp-content/uploads/2018/07/Required-University-Policies.pdf

Roadrunner's Creed: https://www.utsa.edu/studentlife/creed.html

Student Support Services:
http://teaching.utsa.edu/wp-content/uploads/2018/07/UTSA-Student-Support-Services.pdf

Responsible Employee Notice:
The University has an obligation to maintain an environment free of sexual harassment and sexual violence, thus many University employees, including the instructor, have mandatory reporting and response obligations and may not be able to honor a complainant's request for confidentiality. Complainants who want to discuss a complaint in strict confidence may use the resources outlined in HOP Section IX.A.5, "Confidential Support and Resources" at the following link: http://www.utsa.edu/hop/chapter9/9-24.html

Disclaimer:
This syllabus is provided for informational purposes regarding anticipated course content and schedule of courses. It is based on the most recent information available on the date of its issuance and is as accurate and complete as possible. I reserve the right to make any changes necessary and/or appropriate and will make every effort to communicate any changes in a timely manner in class. Students are responsible for staying up to date on any changes to the syllabus that may occur during the term of this course.

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Department of Mechanical Engineering
ME 3663 Fluid Mechanics
Spring 2021 | M/W/F 10:00a-10:50am (virtual) | Online
Course Schedule

(all dates tentative, changes will be announced in class)

WEEK	DATE	TOPICS
1	1/20	Syllabus overview and course introduction
	1/22	1 INTRODUCTION 1.1 Some Characteristics of Fluids 1.2 Dimensions, Dimensional Homogeneity, and Units 1.3 Analysis of Fluid Behavior 1.4 Measures of Fluid Mass and Weight 1.5 Ideal Gas Law
2	1/25	1.6 Viscosity 1.7 Compressibility of Fluids
	1/27	1.8 Vapor Pressure (cavitation) 1.9 Surface Tension
	1/29	2 FLUID STATICS 2.1 Pressure at a Point 2.2 Basic Equation for Pressure Field
3	2/1	2.3 Pressure Variation in a Fluid at Rest 2.4 Standard Atmosphere
	2/3	2.5 Measurement of Pressure 2.6 Manometry
	2/5	2.8 Hydrostatic Force on a Plane Surface 2.9 Pressure Prism
4	2/8	2.10 Hydrostatic Force on a Curved Surface 2.11 Buoyancy, Flotation
	2/10	2.12 Pressure Variation in a Fluid with Rigid-Body Motion
	2/12	3 ELEMENTARY FLUID DYNAMICS – THE BERNOULLI EQUATION 3.1 Newton's Second Law 3.2 F = ma Along a Streamline 3.3 F = ma Normal to a Streamline 3.4 Physical Interpretations and Alternate Forms of the Bernoulli Equation
	2/15	**Inclement Weather - No Class**
	2/17	**Inclement Weather - No Class**
	2/19	**Inclement Weather - No Class**

5	2/22	3.5 Static, Stagnation, Dynamic, and Total Pressure 3.6 Examples of the Bernoulli Equation
	2/24	3.6 Examples of the Bernoulli Equation (cont'd) 3.8 Restrictions of the Bernoulli Equation
	2/26	Review / Summary of Chapters 1-3
		EXAM #1 (Chapters 1-3)
6	3/1	4 FLUID KINEMATICS 4.1 The Velocity Field
	3/3	4.2 The Acceleration Field
	3/5	4.3 Control Volume and System Representations 4.4 The Reynolds Transport Theorem
	3/8	**Spring Break - No Class**
	3/10	**Spring Break - No Class**
	3/12	**Spring Break - No Class**
7	3/15	5 FINITE CONTROL VOLUME ANALYSIS 5.1 Conservation of Mass–The Continuity Equation
	3/17	5.2 Newton's Second Law–The Linear Momentum Equation
	3/19	5.2 Newton's Second Law–The Linear Momentum Equation (cont'd)
8	3/22	5.2 Newton's Second Law–The Linear Momentum Equation (cont'd)
	3/24	5.3 First Law of Thermodynamics–The Energy Equation
	3/26	5.3 First Law of Thermodynamics–The Energy Equation (cont'd)
9	3/29	5.3 First Law of Thermodynamics–The Energy Equation (cont'd)
	3/31	6 DIFFERENTIAL ANALYSIS OF FLUID FLOW 6.1 Fluid Element Kinematics
	4/2	Review / Summary of Chapters 4 & 5
		EXAM #2 (Chapters 4 & 5)
10	4/5	6.2 Conservation of Mass
	4/7	6.3 The Linear Momentum Equation 6.4 Inviscid Flow
	4/9	6.8 Viscous Flow
11	4/12	6.9 Some Simple Solutions for Laminar, Viscous, Incompressible Flows 6.10 Other Aspects of Differential Analysis
	4/14	7 DIMENSIONAL ANALYSIS, SIMILITUDE, AND MODELING 7.1 The Need for Dimensional Analysis 7.2 Buckingham Pi Theorem 7.3 Derivation of Pi Terms
	4/16	7.4 Some Additional Comments about Dimensional Analysis 7.5 Determination of Pi Terms by Inspection 7.6 Common Dimensionless Groups in Fluid Mechanics

12	4/19	8 VISCOUS FLOW IN PIPES 8.1 General Characteristics of Pipe Flow 8.2 Fully Developed Laminar Flow
	4/21	8.3 Fully Developed Turbulent Flow
	4/23	8.4 Dimensional Analysis of Pipe Flow
13	4/26	8.5 Pipe Flow Examples
	4/28	8.6 Pipe Flowrate Measurement
	4/30	Review / Summary of Chapters 6-8
		EXAM #3 (Chapters 6-8)
14	5/3	9 FLOW OVER IMMERSED BODIES 9.1 General External Flow Characteristics
	5/5	9.2 Boundary Layer Characteristics
	5/7	9.3 Drag 9.4 Lift
15	**5/10**	**FINAL EXAM (comprehensive)**