

THE UNIVERSITY OF TEXAS-PAN AMERICAN  
College of Engineering and Computer Science  
Department of Mechanical Engineering

**MECE 3315-02 Fluid Mechanics – 3 Credits – Spring 2012**

**Room:** ENGR 1.274

**Time:** TR 9:10 – 10:25 am

**Instructor:** Dr. Constantine Tarawneh      **Office:** ENGR 3.228      **Phone:** (956) 665-2607

**Office Hours:** MTWR 1:00 - 2:25 pm **Strict**, or by Appointment

**Email:** [tarawneh@utpa.edu](mailto:tarawneh@utpa.edu)      **Website:** <http://mece.utpa.edu/~tarawneh/>

**Prerequisites:** Thermodynamics (MECE 2335) & Engineering Analysis II (MECE 3450).

**Prerequisite Knowledge:**

- Calculus (integration and differentiation) and Linear Algebra (systems of equations)
- Vector Analysis (understanding of vector representations and operations)
- Statics (free body diagrams and equilibrium analysis)

**Textbook:**

Fox, R. W., Pritchard, P. J., McDonald, A. T., **Introduction to Fluid Mechanics**, 7<sup>th</sup> Edition, John Wiley, 2009. [ISBN 978-0-471-74299-9]

**Course Description:**

This is an introductory course in fluid mechanics. The topics covered include fluid properties, fluid statics, conservation laws, inviscid and viscous incompressible flow, and flow in confined streams and around objects.

**Course Objectives:**

At the end of the course the students will gain the:

- Knowledge of physical quantities important to fluid flow; examples include hydrostatics pressure, friction, momentum, drag coefficient, etc...
- Ability to apply fundamental laws in control volume form to engineering applications.
- Knowledge of experimental results on the flow of fluids in pipes and around objects.
- Ability to apply basic laws of fluid mechanics to compute various parameters.

**Grading Policy:**

There will be weekly homework assignments (15%) and quizzes (5%), two in-class midterm exams (27.5% each), and a final exam (25%). Exams will be **closed-book and notes** but you will be

allowed to bring one 11" × 8.5" formula sheet (both sides). [  $A \geq 88\%$  ,  $88\% > B \geq 78\%$ ,  $78\% > C \geq 68\%$ ,  $68\% > D \geq 58\%$ ,  $F < 58\%$ ].

### **Homework:**

A homework will be assigned every week. The homework problems will be posted on the Web Site. To ensure that students do their own work, one of the problems, from each homework, will be chosen for a ten minute quiz that will be administered after the homework is handed in. The student's performance on the quiz will be used in grading the homework assignment. Any discrepancy between the student's performance on the quiz and the homework assignment may result in loss of credit in the total homework grade. After the homework is graded and returned, solutions will be made available in a folder put outside the instructor's office.

In solving the homework assignment, the following four steps should be followed very carefully:

1. Briefly summarize the problem statement.
2. Provide a schematic diagram of the problem.
3. Solve the problem showing your work in detail by stating your assumptions and providing the equations you used and the numerical values you obtained.
4. Write a sentence or two discussing your findings and conclusions.

Failure to follow the aforementioned four steps will result in points deducted from your homework assignment.

### **Topics Covered:**

- Velocity field, stress field, and viscosity.
- Fluid statics.
- Basic equations in integral forms for a control volume.
- Bernoulli equation.
- Introduction to differential analysis of fluid motion.
- Dimensional analysis and similitude.
- Internal incompressible viscous flow.
- External incompressible viscous flow.

| <b><u>CHAPTER</u></b> | <b><u>TOPIC</u></b>  | <b><u>SECTIONS COVERED</u></b> |
|-----------------------|--|--------------------------------|
| 1                     | <i>Introduction</i>  | All                            |
| 2                     | <i>Fundamental Concepts</i>                                  | All                            |
| 3                     | <i>Fluid Statics</i>   | All except 3-7                 |
| 4                     | <i>Basic Equations in Integral Form for a Control Volume</i> | All except 4-6 and 4-7         |
| <b>EXAM 1</b>         |  |                                |
| 5                     | <i>Introduction to Differential Analysis of Fluid Motion</i> | All except 5-5                 |
| 6                     | <i>Incompressible Inviscid Flow</i>                          | All except 6-6 and 6-7         |
| 7                     | <i>Dimensional Analysis and Similitude</i>                   | All                            |
| <b>EXAM 2</b>         |  |                                |
| 8                     | <i>Internal Incompressible Viscous Flow</i>                  | All                            |
| 9                     | <i>External Incompressible Viscous Flow</i>                  | 9-1 to 9-5                     |
| <b>FINAL EXAM</b>     |  |                                |

**Course Outcomes & Assessment:** At the conclusion of this course, students will be able to:

1. Understand the fundamental concepts of velocity field, stress field, and viscosity (H, Q, T).
2. Apply the basic equations of fluid statics to manometers and hydraulic systems (H, Q, T).
3. Determine the hydraulic force on submerged surfaces (H, Q, T).
4. Apply the basic equations in integral form for a control volume (H, Q, T).
5. Understand the differential analysis of fluid motion (H, Q, T).
6. Apply the dimensional analysis and similitude (H, Q, T).
7. Understand the fundamentals of internal and external incompressible viscous flow (H, Q, T).

Key: H - Homework, Q - Quiz, T - Test

**Contribution of Course Outcomes to Program Outcomes**

|   | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | S1 | S2 | S3 | E1 | E2 | E3 | E4 | E5 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|
| 1 | X |   | X |   |   |   |   |   | X  |    |    |    | X  |    |    |    |
| 2 | X | X | X |   |   |   |   |   | X  |    |    |    | X  |    |    |    |
| 3 | X | X | X |   |   |   |   |   | X  |    |    |    | X  |    |    |    |
| 4 | X | X | X |   |   |   |   |   | X  |    |    |    | X  |    |    |    |
| 5 | X | X |   |   |   |   |   |   | X  |    |    |    |    |    |    |    |
| 6 | X |   |   |   |   |   |   |   | X  |    |    |    |    |    |    |    |
| 7 | X | X | X |   |   |   |   |   | X  |    |    |    | X  |    |    |    |

## **Program Educational Outcomes**

It will be demonstrated that the student:

1. Is able to use knowledge of mathematics, basic sciences and engineering to analyze (identify, formulate, and solve) problems in mechanical engineering.
2. Is able to design and conduct experiments and interpret the results.
3. Is able to design mechanical devices, systems or processes that meet given specifications.
4. Is able to function in multi-disciplinary teams.
5. Is able to communicate ideas effectively in graphical, oral and in written media.
6. Understands the professional responsibility of an engineer and how engineering solutions impact safety, economics, ethics, politics, and societal, cultural and contemporary issues.
7. Understands the need for lifelong learning to keep abreast of current practice.
8. Is able to use state of the art computational hardware and software for analysis, design and documentation (techniques, skills, and modern engineering tools necessary for engineering practice).

## **Program Specific Outcomes for Mechanical Engineering**

**Fundamentals in Science and Mathematics:** It will be demonstrated that the student:

- S1) Has knowledge of chemistry and calculus-based physics with depth in at least one.
- S2) Has the ability to apply advanced mathematics to problems involving thermal and mechanical systems.
- S3) Has the ability to apply statistics and linear algebra to problems involving thermal and mechanical systems.

**Fundamentals in Engineering:** It will be demonstrated that the student:

- E1) Has the ability to create and annotate two-dimensional drawings, and generate three dimensional computer based solid models of mechanical components.
- E2) Has the ability to design and analyze components and systems for mechanical and energy performance.
- E3) Has the ability to specify and evaluate materials and manufacturing steps for mechanical components.
- E4) Has the ability to conceive and conduct experiments to measure the performance of materials, components and systems and to communicate the results.
- E5) Has the ability to acquire new skills and specialized knowledge from published sources.

## Mechanical Engineering Department Classroom Policies

### Attendance:

1. Attendance will be taken every time the class meets. Any student arriving to class **5 minutes** after the class has started will not be allowed in class. Students will be allowed a **maximum** of 5 absences for the whole semester for classes meeting three times a week, 3 absences for classes meeting twice a week, and 2 absences for classes meeting once a week. A **point** will be deducted from the total (100%) for each **unexcused** absence exceeding the maximum allowable.
2. Students **will not** be permitted to leave the classroom during lectures and exams except for **extreme emergencies**.

### Homework and Exams:

1. **Absolutely** no assignments will be accepted late.
2. Make-ups for in-class exams for **extreme emergencies** will be scheduled at the end of the semester.

### Plagiarism:

Any instance of cheating or plagiarism will result in **loss of credit** for the work, and will be reported to the Chair of the ME Department and/or the Dean of Students for appropriate action which may include **loss of credit** for the course or **dismissal** from the University.

### Drop Policy:

Students can withdraw from a course through the *Office of the Registrar* on or prior to:

- February 1<sup>st</sup>, 2012, Wednesday: Twelfth class day (Census date), courses dropped by this date do not count toward six course drop limit.
- February 15<sup>th</sup>, 2012, Wednesday: Last day to change course to non-credit.
- April 2<sup>nd</sup>, 2012, Monday: Last day to drop courses or withdraw from the University with a grade of “DR” or “W” recorded. After this date, student remains enrolled in course(s) and receives whatever letter grade(s) he/she earns.

### American Disabilities Act Statement:

If you have a documented disability which will make it difficult for you to carry out the work as I have outlined and/or if you need special accommodations/assistance due to a disability, please visit or contact the Disability Services Office in University Center, Room 322 immediately; or call (956) 665-7005. Appropriate arrangements/accommodations can be made.

**ACKNOWLEDGEMENT OF RECEIPT OF SYLLABUS**

By signing below, I hereby affirm that I have received a copy of the syllabus for **MECE 3315 Fluid Mechanics** and have been informed by the **Instructor** that it is my responsibility to **carefully** read and understand this document and abide by all its content. I also agree to prepare and submit to the **Instructor**, at the end of the semester, a folder that contains all my homework assignments, quizzes, exams, projects, reports and/or literature review (if applicable).

\_\_\_\_\_  
Student ID Number

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date