MEEN 3120  Fluid Mechanics  Spring 2023

Instructor:  Hamid Sadat
Office:  NTDP F115S
Email:  hamid.sadat@unt.edu
Lecture Time:  Tu/Th 8:30-9:50 am
Instructor Office Hours:  Tu/Th 2:30-3:30 pm or by appointment

TA: Mishal Raza (Mishal.Raza@unt.edu)

Course Description:

This course introduces basic concepts in fluid statics, kinematics, and dynamics. Control-volume and differential equation and dimensional analysis methods are derived and used to demonstrate applications to simple external- and internal-flow fluids engineering systems to determine variables of interest (pressure; shear stress; velocity distributions; flow rates; forces; energy losses; power requirements; etc).

Prerequisite(s): MATH 2730 and MATH 3410

ISBN-10: 1259696537
Course Learning Outcomes:
Upon successful completion of this course, students will be able to:

1. Identify engineering problems and use the basic laws of fluid mechanics to solve these problems.
2. Evaluate the pressure distribution and resultant force exerted by fluids at rest on submerged surfaces.
3. Use the control volume analysis and apply the conservation of mass, momentum, and energy to solve fluid mechanics problems.
4. Understand Bernoulli’s equation and its limitations.
5. Use differential equations to solve fluid mechanics problems.
6. Determine dimensionless groups from a list of variables using the Buckingham Pi theorem.
7. Use the Moody diagram to find the frictional head loss in the circular and non-circular pipe flow.
8. Understand the boundary layer, drag, and lift concepts in an external flow.

ABET Criteria:
MEEN 3120 addresses the following ABET program outcomes:
1. Ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

Homework
All assignments will be posted on Canvas.
1. Homework must be turned in by 8:30 am (before the class) on due dates. Late submission will not be accepted except for a legitimate reason submitted prior to due date. Legitimate reasons include personal/family emergency, religious holidays/duty, jury duty etc. Having no textbook is not a valid excuse for not doing your homework.
2. Homework can be turned in by your friend or classmate.
3. Homework may be turned in an electric format for a legitimate reason.
4. It is the student’s responsibility to acquire textbook for his/her study.
5. Homework should be stapled; instructor or TA will not be responsible for lost homework.
6. Homework dropped to instructor’s department mailbox will NOT be collected.
7. Homework problems will be graded by TA, who will hold regular office hours and should be consulted in case of difficulty in solution of problems or questions concerning grading.
8. Solutions will be posted on Canvas soon after the problems have been graded. Consult these to correct your solutions for future reference.
9. Homework accounts for 15% of the final grade.
Examinations
There will be two in-semester and one final examinations, on the dates shown on the Class Schedule.
1. Exams may include standard problems as well as multiple-choice, short answer, and true/false questions.
2. Examinations may include problems previously assigned for homework.
3. All exams are open-book and open-notes.
4. Calculator is allowed.
5. No electronic device that stores information or has the capability to connect to the Internet will be permitted during the exam (i.e., no cell phones).
6. Make up exams will not be given except for legitimate reason submitted prior to class.
7. Each in-semester exam accounts for 20% and final exam accounts for 25% of the final grade.

Quizzes
Quizzes will be given on the dates shown in the class schedule.
1. All quizzes are open-book and open-notes.
2. Calculator is allowed.
3. Electronic devices that store information or have the capability to connect to the Internet will not be permitted during the quizzes (i.e., no cell phones).
4. Make up quizzes will not be given except for legitimate reason submitted prior to class.
5. Quizzes account for 20% of the final grade.

Attendance Policy
Students are required to attend the sessions. Attendance will be checked randomly. Students with more than three unexcused absences will receive a grade of F for the course.

Grading
The final course grade will be based on the total points earned during the semester. The distribution of points is as follows:

Two in-semester exams, 20% each = 40
Final examination = 25
Quizzes = 20
Homework problems = 15
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TOTAL 100 points

90-100% A
80-89.9% B
70-79.9% C
60-69.9% D
< 60% F
**Note:** Grades will not be curved. Grades are based solely on your performance. Extra credit will not be given at the end of the semester for individual students. Please do not request extra work at the end of the semester to boost your grade – the answer will always be no.

**Canvas**
1. All homework assignments will be posted on Canvas.
2. Announcements regarding test dates, quizzes, and homework will be posted on Canvas.
3. All grades will be available on Canvas.
4. Each student is responsible for checking Canvas on a routine basis.

**Disability Accommodations**
If special accommodations are required, the student must first meet with the staff of the Office of Disability Accommodation (ODA), (940) 565-4323. You must have document which verifies the disability and makes you eligible for accommodations. After meeting with that office, please contact me to discuss what accommodations will be necessary. For more information, see [http://www.unt.edu/oda](http://www.unt.edu/oda).

**Academic Misconduct**
There is a zero-tolerance policy for academic dishonesty. Cheating of whatsoever will result in an automatic F in this course and the matter will be turned over to the appropriate student disciplinary committee.

**IMPORTANT EXAM DATES**

**Midterm Exam #1 (Tentative)**
Mar 2\(^{nd}\), 2023, Thursday 8:30 am

**Midterm Exam #2 (Tentative)**
Apr 13\(^{th}\), 2023, Thursday 8:30 am

**Final exam:**
May 9\(^{th}\), 2023, Tuesday 8:00 am
<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture</th>
<th>Date</th>
<th>Topics</th>
<th>HW</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>1</td>
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<td>Definition of a fluid, Classification of fluid flows, System and control volume</td>
<td>No HW</td>
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<td>Dimensions, fluid properties, Viscosity</td>
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<td>Surface tension, Cavitation, Statics of Fluids</td>
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<td>Pressure, Pressure gradient, Manometer, Hydrostatic force on flat plates</td>
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<td>Hydrodynamic force on curved surfaces, Buoyancy, Stability</td>
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<td>Quiz 1, Pressure distribution in rigid body motion</td>
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<td>Lagrangian and Eulerian, Flow patterns, Types of deformation, Vorticity</td>
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<td>Quiz 2, Reynolds Transport theorem, Mass conservation</td>
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<td>Bernoulli and limitations</td>
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<td>Quiz 3, Mechanical Energy and Efficiency, Energy Conservation</td>
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<td>Linear momentum Conservation 1</td>
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<td>Quiz 4, Linear momentum Conservation 2</td>
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<td>Angular Momentum Conservation, Review Session</td>
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<td>Midterm 1</td>
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<td>Chapters 1-5</td>
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<td>Units, Dimensional Homogeneity, Non-dimensional Equations, Similarity</td>
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<td>Quiz 5, Pi Theorem, Modeling and common non-dimensionalized variables</td>
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<td>Spring Break</td>
<td>03/14</td>
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<td>#10</td>
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<td>03/21</td>
<td>Pipe flow regime, entry length, Laminar pipe flow, Frictional loss for laminar pipe flow</td>
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<td>Quiz 6, Non-circular pipe, Turbulent pipe flow, Moody chart</td>
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<td>Types of Moody chart problems, Minor losses, Pipe system</td>
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<td>Quiz 7, Differential Analysis, Continuity, Stream function</td>
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<td>Differential linear momentum Eq., Navier Stokes (NS) Eq.</td>
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<td>Quiz 8, NS Exact Solutions 1</td>
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<td>NS Exact Solutions 2, Review Session</td>
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<td>External flow: Laminar flat plate boundary layer, Displacement and momentum thicknesses</td>
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<td>Quiz 9, Turbulent flat plate flow boundary layer, Momentum Integral</td>
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<td>Drag of streamlined body</td>
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<td>Quiz 10, Drag of bluff body. Friction and pressure drag, Drag coefficients</td>
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<td>Drags of cylinders/spheres, lift (airfoil, spinning body)</td>
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<td>Quiz 11, Intro to CFD, Course Review</td>
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<td>Final Exam</td>
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<td>All Chapters</td>
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