Course Description:
The course covers basic concepts of a fluid and the fundamentals and applications of ideal and real fluid flow. Topics include fluid statics, conversation principles, the Bernoulli equation, dimensional analysis and similitude, internal and external viscous flow, fluid flow measurement devices, and others. Prerequisite: EGR 321 or PHY 321 - Dynamics

Prerequisites: EGR 321 or PHY 321 - Dynamics
Co-Requisites: None

Credits: 3 Hours (Lecture: 3 Hours, Laboratory: 0 Hours)

Instructor: Christopher J. Aul


Supplemental Materials: None

Topics Covered:

Course Learning Outcomes
By the end of the course, a successful student will be able to:
1. Understand basics of hydrostatics to determine pressure at depth. (SO-1)
2. Calculate fluid flow analysis in both Eulerian and Lagrangian methods. (SO-1)
3. Analyze engineering problems using Reynolds Transport Theorem. (SO-1)
4. Solve conservation of mass problems using the continuity equation. (SO-1)
5. Analyze energy systems using Bernoulli Equation for various elements including pumps and turbines. (SO-2)
6. Calculate fluid momentum as it pertains to bodies at rest and in motion. (SO-1)
7. Understand how to apply control volumes to real-world engineering problems. (SO-2)
8. Calculate fluid flow using differential analysis. (SO-1)
9. Determine geometric relationships for similitude in fluid mechanics. (SO-2)
10. Apply methods of analysis for viscous flow in enclosed surfaces in pipes. (SO-1)
11. Determine conditions for rough pipe flow with a Moody diagram. (SO-2)
12. Calculate viscous fluid flow over external surfaces with boundary layers. (SO-1)
13. Analyze a contemporary subject in fluid mechanics and report on how methods described in class can be applied directly. (SO-4)

Student Outcomes
Graduates of the program will show:
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 Outline

Engineering 345.001 – Spring 2019
Fluid Mechanics

Department of Physics, Engineering, and Astronomy; Stephen F. Austin State University

Instructor: Christopher J. Aul, PhD
Email: aulcj@sfasu.edu
Office: 207D Ed & Gwen Cole STEM Building
Phone: 936-468-1512
Office Hours: MW 8-11am, TR 10-11am, or by appointment
Class Meetings: TR 8-9:15am, Room 306 Ed & Gwen Cole STEM Building
Course Home Page: http://d2l.sfasu.edu

Course Description
The course covers basic concepts of a fluid and the fundamentals and applications of ideal and real fluid flow. Topics include fluid statics, conversation principles, the Bernoulli equation, dimensional analysis and similitude, internal and external viscous flow, fluid flow measurement devices, and others. Prerequisite: EGR 321 or PHY 321 - Dynamics

Text and Materials

Fluid Mechanics
Hibbeler, Pearson, 2nd Edition


It is necessary that you acquire this edition of the text. Homework and reading will be assigned assuming the student has this text. Hard copies of homework assignments will not be handed out to the student.

Other materials needed in the course:

- Engineering paper that is grid ruled (assignment submission)
- Scientific calculator or better (for exams and homework)
- Ruler, compass, any other drafting tools for control volume sketches

Grading Policy

Exam 1 17%
Exam 2 17%
Exam 3 17%
Course Project 10%
Homework & Assignments 15%
Reading Quizzes 4%
Final Exam 20%

Letter grades are based on the following ranges:

A 90.0 – 100%
B 80.0 - 89.9%
C 70.0 - 79.9%
D 60.0 - 69.9%
F < 60.0%

The grade is based on three mid-term exams, one comprehensive final exam, a course project, homework which will be assigned in class, as well as in-class assignments. Exams will be graded on a 100 point scale, including the final, and homework will be averaged with in-class assignments for the final 15% of your grade.

C. Aul  EGR 345 – Fluid Mechanics  aulcj@sfasu.edu
Attendance Policy
Attendance will be taken at the beginning of class by instructor. If you have 3 unexcused absences then your final grade will be reduced one letter grade. If you have 4 unexcused absences, you will receive an “F” in the course. A written and signed notice is required for an excused absence within three class days of the absence. Instructor checks for attendance at the beginning of class according to the official NIST US CST time: http://www.time.gov. Failure to show up to class on time results in a tardy (which can be excused if you show excuse for your tardy to instructor that day). Accruing 2 tardy marks results in an unexcused absence.

Students who miss class without approval of their instructor will receive a grade of zero on the missed assignment. Authorized absences must be approved by your instructor in advance of the absence, unless you have an emergency or illness. Make-up work must be completed outside of normal class hours within one week following an excused absence. It is your responsibility to see the instructor to make arrangements for make-up work if you have an excused absence.

Course Requirements

Exams
There will be three mid-term exams and a final, each covering a specific set of lecture, text, and homework material that will be communicated to the student in class. The final exam will be comprehensive to the material covered in the course. The tentative dates of these exams are listed in the course outline shown in this document. Exams will be given outside of class time to allow for extra time to sufficiently solve problems. Inability to attend these exam times due to conflicts with other classes shall be communicated to the professor within the first week of class, otherwise the times will not change.

Students will have one week after each exam to review the exams and discuss the grades. No make-up exams will be given except in the case of an excused absence. An official written notice is required for an excused absence within three days of the exam. Any makeup exam must be taken within three days of the missed exam. The style of exam as well as allowed materials for the four exams will be communicated to the student in-class.

Homework Assignments
Homework will be assigned from the required text for the course. Homework assignments will be given to the student in class along with the due dates. An overall tentative schedule of homework problems are given on the last page of this syllabus. When completing homework, the following guidelines must be followed:

- Always restate the problem and draw a diagram if needed
  - Label your engineering sketch neatly with given and unknown values
- Make sure to outline all knowns and unknowns
- Use engineering style paper that is grid ruled
- Use only one side of the paper (typically the side facing you on the pad)
- Include your name and page number on each page
- Use a ruler to set up your diagrams or in drawing elements
- Show the progression of your solution, clearly identify appropriate units when necessary
- Indicate final answers by placing a surrounding box, don’t forget the units!!
- Staple all of your papers together for submission

The above criteria, as well as accuracy of the information, will be used to grade your homework. Treat this as if I am your client and you need to impress me with your engineering calculations. Homework will be scanned and submitted online in a D2L dropbox for each submission. No late homework will be accepted unless you have an excused absence or delay.
In Class Assignments
All in class assignments must be completed by the end of the class period. This may include working out example or homework problems on the board or separate assignments given throughout the class. The student may also be asked to present completed homework to the rest of the class in a “flipped class” manner. This is done to assess the communication and presentation skills of the student. The grade for these assignments and participation will be averaged with the homework to give 15% of your final grade. It is the discretion of the instructor to grant additional time if deemed necessary.

Course Project
Details for the course project will be provided in class. The project will be due the second-to-last week of class on 5/3/2019 and will cover concepts discussed in class. The scoring rubric for the project will be provided and will consist of 10% of the final grade for the student.

Reading Quizzes
It is imperative that you read the textbook for this course. There will be a series of reading quizzes posted on D2L covering specific sections of the textbook reading. The due dates for these reading quizzes will be communicated to the student in class and on D2L. In general, the reading quizzes should be completed before the material is covered in class.

Meet Your Professor: I am not so scary once you get to know me
In an effort to encourage students to meet with professor outside of class the instructor is requiring an initial visit with the professor within the first month of class. For the Spring 2019 semester students will arrange to meet with the instructor for ~30 minutes during office hours (or by appointment if unable to meet during office hours) no later than 2/22/2019. I encourage you to visit regularly, but this is for me to ask some questions regarding your expectations and interests in this class. Please try to meet early as students who might wait until the last minute might take up all of my availability on the due date.

Email Communication
All official course communication will be made using your SFA email account. You must use your SFA email account for all communications. You will be notified via your SFA email account about grades and attendance. You can look up your SFA email account or setup email forwarding using this link: http://www.sfasu.edu/mysfa/o365/forwarding-email/

It is important to practice good email communications in college courses. Use "EGR345" in the subject of your email messages. Use complete sentences and capitalization when appropriate. The body of your email messages should begin with your instructor's name and end with your name.

Classroom Policies
For the benefit of your fellow students and your instructor, you are expected to practice common courtesy with regard to all course interactions. For example:

- Be considerate toward your classmates and instructor and arrive to class on time.
- Do not leave class early and do not rustle papers in preparation to leave before class is dismissed.
- Avoid classroom distractions. Be attentive in class: stay awake, do not read newspapers, etc.
- If you are late to class or must leave early please inform your instructor in advance (enter or leave quietly, don’t walk across the front of the classroom (use the side aisles) and don’t walk in front of the projector).
- Cell phones, pagers and other communication devices must be turned off during class.
- Play well with others. Be kind and respectful to your fellow students and your teachers.
Collaboration on examinations, in class assignments, and homework assignments is forbidden except where specifically specified as "Team" activities. For example, homework assignments can be worked on as a team but must be completed separately. In general, one team may not collaborate with another team on "Team" activities. Students violating this policy will be subject to procedures described in the Stephen F. Austin State University Policies and Procedures Manual.

Academic integrity is a responsibility of all university faculty and students. Faculty members promote academic integrity in multiple ways including instruction on the components of academic honesty, as well as abiding by university policy on penalties for cheating and plagiarism.

Definition of Academic Dishonesty
Academic dishonesty includes both cheating and plagiarism. Cheating includes but is not limited to (1) using or attempting to use unauthorized materials to aid in achieving a better grade on a component of a class; (2) the falsification or invention of any information, including citations, on an assigned exercise; and/or (3) helping or attempting to help another in an act of cheating or plagiarism. Plagiarism is presenting the words or ideas of another person as if they were your own. Examples of plagiarism are (1) submitting an assignment as if it were one's own work when, in fact, it is at least partly the work of another; (2) submitting a work that has been purchased or otherwise obtained from an Internet source or another source; and (3) incorporating the words or ideas of an author into one's paper without giving the author due credit.

Please read the complete policy at http://www.sfasu.edu/policies/academic_integrity.asp

Withheld Grades - Semester Grades Policy (A-54)
Ordinarily, at the discretion of the instructor of record and with the approval of the academic chair/director, a grade of WH will be assigned only if the student cannot complete the course work because of unavoidable circumstances. Students must complete the work within one calendar year from the end of the semester in which they receive a WH, or the grade automatically becomes an F. If students register for the same course in future terms the WH will automatically become an F and will be counted as a repeated course for the purpose of computing the grade point average.

Students with Disabilities
To obtain disability related accommodations, alternate formats and/or auxiliary aids, students with disabilities must contact the Office of Disability Services (ODS), Human Services Building, and Room 325, 468-3004 / 468-1004 (TDD) as early as possible in the semester. Once verified, ODS will notify the course instructor and outline the accommodation and/or auxiliary aids to be provided. Failure to request services in a timely manner may delay your accommodations. For additional information, go to http://www.sfasu.edu/disabilityservices/

Student Code of Conduct: Policy 10.4
Classroom behavior should not interfere with the instructor’s ability to conduct the class or the ability of other students to learn from the instructional program. Unacceptable or disruptive behavior will not be tolerated. Students who disrupt the learning environment may be asked to leave class and may be subject to judicial, academic or other penalties. This policy applies to all instructional forums, including electronic, classroom, labs, discussion groups, field trips, etc. The instructor shall have full discretion over what behavior is appropriate/inappropriate in the classroom. Students who do not attend class regularly or who perform poorly on class projects/exams may be referred to the iCare: Early Alert Program at SFA. Information regarding the iCare program is found at https://www.sfasu.edu/judicial/earlyalert.asp or call the office at 936-468-2703.

General Education Core Curriculum Objectives/Outcomes (EEO)
This course is not included in the general education core curriculum. Therefore, please see the learning outcomes above rather than any Exemplary Educational Objectives (EEOs).
<table>
<thead>
<tr>
<th>Class</th>
<th>Date</th>
<th>Topic</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>1/22/2019</td>
<td>CH 1: Introduction, fundamental concepts</td>
<td>1.1 - 1.6</td>
</tr>
<tr>
<td>R</td>
<td>1/24/2019</td>
<td>CH 1 &amp; 2: Viscosity, vapor pressure, surface tension</td>
<td>1.7 - 1.10</td>
</tr>
<tr>
<td>T</td>
<td>1/29/2019</td>
<td>CH 2: Pressure, pressure measurement and variation</td>
<td>2.1 - 2.6</td>
</tr>
<tr>
<td>R</td>
<td>1/31/2019</td>
<td>CH 2: Hydrostatics, buoyancy</td>
<td>2.7 - 2.11</td>
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<tr>
<td>T</td>
<td>2/5/2019</td>
<td>CH 3: Fluid flow; Eulerian &amp; Lagrangian, concepts</td>
<td>3.1 - 3.3</td>
</tr>
<tr>
<td>R</td>
<td>2/7/2019</td>
<td>CH 3: Fluid acceleration &amp; streamlines</td>
<td>3.4</td>
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<tr>
<td>T</td>
<td>2/12/2019</td>
<td>CH 4: Finite control volumes, Volumetric Flow</td>
<td>4.1 &amp; 4.2</td>
</tr>
<tr>
<td>R</td>
<td>2/14/2019</td>
<td>CH 4: Volumetric Flow, RTT</td>
<td>4.2 &amp; 4.3</td>
</tr>
<tr>
<td>T</td>
<td>2/19/2019</td>
<td>CH 4: Continuity equation</td>
<td>4.4</td>
</tr>
<tr>
<td>R</td>
<td>2/21/2019</td>
<td>CH 5: Euler's equations of motion, Bernoulli equation</td>
<td>5.1 - 5.3</td>
</tr>
<tr>
<td>T</td>
<td>2/26/2019</td>
<td>CH 5: Pressure &amp; hydraulic head, energy equation</td>
<td>5.4 &amp; 5.5</td>
</tr>
<tr>
<td>R</td>
<td>2/28/2019</td>
<td>CH 6: Fluid momentum, linear momentum equation</td>
<td>6.1 - 6.3</td>
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<tr>
<td>T</td>
<td>3/5/2019</td>
<td>CH 6: Angular momentum, applications</td>
<td>6.4 &amp; 6.5</td>
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<tr>
<td>R</td>
<td>3/7/2019</td>
<td>CH 6: Control volumes under acceleration</td>
<td>6.6 - 6.8</td>
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<tr>
<td>T</td>
<td>3/12/2019</td>
<td>CH 6: Control volumes review</td>
<td>6.6 - 6.8</td>
</tr>
<tr>
<td>R</td>
<td>3/14/2019</td>
<td>CH 7: Intro to differential flow</td>
<td>7.1 - 7.6</td>
</tr>
<tr>
<td>T</td>
<td>3/19/2019</td>
<td>Spring Break</td>
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<tr>
<td>R</td>
<td>3/21/2019</td>
<td>Spring Break</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>3/26/2019</td>
<td>CH 7: Differential analysis, Euler &amp; Bernoulli</td>
<td>7.1 - 7.6</td>
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<tr>
<td>R</td>
<td>3/28/2019</td>
<td>CH 7: Stream and Potential functions, 2D flow</td>
<td>7.7 - 7.9</td>
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<tr>
<td>T</td>
<td>4/2/2019</td>
<td>CH 7: Superposition of flows, Navier-Stokes, CFD</td>
<td>7.10 - 7.12</td>
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<td>T</td>
<td>4/9/2019</td>
<td>CH 8: Similitude</td>
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<tr>
<td>T</td>
<td>4/16/2019</td>
<td>CH 9: Pipe flow - fully developed, laminar, turbulent (smooth)</td>
<td>9.6 - 9.8</td>
</tr>
<tr>
<td>R</td>
<td>4/18/2019</td>
<td>Easter Holiday</td>
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<tr>
<td>R</td>
<td>4/25/2019</td>
<td>CH 10: Pipe flow, Moody diagram</td>
<td>10.1-10.3</td>
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<tr>
<td>R</td>
<td>5/2/2019</td>
<td>CH 11: Laminar &amp; turbulent BLs, drag &amp; lift, pressure gradients</td>
<td>11.4 - 11.7</td>
</tr>
<tr>
<td>T</td>
<td>5/7/2019</td>
<td>CH 11: Drag, airfoils</td>
<td>11.8 - 11.11</td>
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<tr>
<td>R</td>
<td>5/9/2019</td>
<td>CH 11: External viscous flow review</td>
<td></td>
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<tr>
<td>R</td>
<td>4/23/2019</td>
<td>Final Exam, Comprehensive, ~50% from CH 9-11 (8:00am - 10:00am)</td>
<td></td>
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</tbody>
</table>
See table below for homework problems assigned by chapter. Dates for homework submission will be communicated to the student in class.

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<td>5.1-5.5</td>
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<td>8.1-8.5</td>
<td>8-6, 8-41, 8-51, 8-56, 8-59</td>
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<td>9</td>
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<td>10</td>
<td>10.1-10.3</td>
<td>10-10, 10-23, 10-41, 10-51, 10-59, 10-63</td>
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