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. Co-requisite: ENGR 3421 or PHYS 3421 - Dynamics

Prerequisites: none

Co-Requisites: ENGR 3421 or PHYS 3421 - Dynamics

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 3345 – Spring 2024
Fluid Mechanics

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

Instructor: Christopher J. Aul, PhD
Office: STEM 207D
Email: aulcj@sfasu.edu
Phone: 936-468-1512

Student Hours: MWF 10-11am, MW 1-2pm, or by appointment
Class Meetings: TR 11-12:15am
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. Co-requisite: ENGR 3421 or PHYS 3421 - Dynamics

Text and Materials
Fluid Mechanics
Frank White and Henry Xue, McGraw Hill, 9th Edition
You will need to have CONNECT access to this course https://connect.mheducation.com/class/c-aul-spring-2024-1

Connect Access Card
9781266345777
Net Price: $65

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 12%
Exam 2 12%
Exam 3 12%
Exam 4 12%
Course Project 10%
Homework & Assignments 15%
Reading Quizzes 7%
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.
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 plan for make-up work if you have an excused absence.

Course Requirements

This class assumes that you will be spending at least 6 hours per week outside of course time working on course material. A required 150 minutes of asynchronous material will be covered using course lectures and a course project.

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 is 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. 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 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 text 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.

The course may change structure at any point in the semester due to whatever the year may bring...

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 “ENGR 3345” 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.

The following is required as per policy:

Academic Integrity (4.1)
The Code of Student Conduct and Academic Integrity outlines the prohibited conduct by any student enrolled in a course at SFA. It is the responsibility of all members of all faculty, staff, and students to adhere to and uphold this policy.

Articles IV, VI, and VII of the new Code of Student Conduct and Academic Integrity outline the violations and procedures concerning academic conduct, including cheating, plagiarism, collusion, and misrepresentation. Cheating includes, but is not limited to: (1) Copying from the test paper (or other assignment) of another student, (2) Possession and/or use during a test of materials that are not authorized by the person giving the test, (3) Using, obtaining, or attempting to obtain by any means the whole or any part of a non-administered test, test key, homework solution, or computer program, or using a test that has been administered in prior classes or semesters without permission of the Faculty member, (4) Substituting for another person, or permitting another person to substitute for one's self, to take a test, (5) Falsifying research data, laboratory reports, and/or other records or academic work offered for credit, (6) Using any sort of unauthorized resources or technology in completion of educational activities.

Plagiarism is the appropriation of material that is attributable in whole or in part to another source or the use of one's own previous work in another context without citing that it was used previously, without any indication of the original source, including words, ideas, illustrations, structure, computer code, and other expression or media, and presenting that material as one's own academic work being offered for credit or in conjunction with a program course or degree requirements.

Collusion is the unauthorized collaboration with another person in preparing academic assignments offered for credit or collaboration with another person to commit a violation of any provision of the rules on academic dishonesty, including disclosing and/or distributing the contents of an exam.
Misrepresentation is providing false grades or résumés; providing false or misleading information in an effort to receive a postponement or an extension on a test, quiz, or other assignment for the purpose of obtaining an academic or financial benefit for oneself or another individual or to injure another student academically or financially.

Withheld Grades Semester Grades Policy (5.5)
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 coursework 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 to compute the grade point average. For additional information, go to https://www.sfasu.edu/policies/course-grades-5.5.pdf.

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 promptly may delay your accommodations. For additional information, go to http://www.sfasu.edu/disabilityservices/.

Student Wellness and Well-Being
SFA values students’ overall well-being, mental health and the role it plays in academic and overall student success. Students may experience stressors that can impact both their academic experience and their personal well-being. These may include academic pressure and challenges associated with relationships, emotional well-being, alcohol and other drugs, identities, finances, etc.

If you are experiencing concerns, seeking help, SFA provides a variety of resources to support students’ mental health and wellness. Many of these resources are free, and all of them are confidential.

On-campus Resources:
The Dean of Students Office (Rusk Building, 3rd floor lobby)
www.sfasu.edu/deanofstudents
936.468.7249
don@sfasu.edu

SFA Human Services Counseling Clinic Human Services, Room 202
www.sfasu.edu/humanservices/139.asp
936.468.1041

The Health and Wellness Hub “The Hub”
Location: corner of E. College and Raguet St.

To support the health and well-being of every Lumberjack, the Health and Wellness Hub offers comprehensive services that treat the whole person – mind, body and spirit. Services include:
- Health Services
- Counseling Services
- Student Outreach and Support
- Food Pantry
- Wellness Coaching
- Alcohol and Other Drug Education
www.sfasu.edu/thehub
936.468.4008
thehub@sfasu.edu

Crisis Resources:
- Burke 24-hour crisis line: 1.800.392.8343
- National Suicide Crisis Prevention: 9-8-8
- Suicide Prevention Lifeline: 1.800.273.TALK (8255)
- johCrisis Text Line: Text HELLO to 741-741

C. Aul ENGR 3345 – Fluid Mechanics aulcj@sfasu.edu
### ENGR 3345 – Fluid Mechanics Class Schedule

Course schedule is **tentative** and subject to change depending on pace of the class.

<table>
<thead>
<tr>
<th>Week</th>
<th>Date (Monday)</th>
<th>Topic</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/15/2024</td>
<td>Introduction, early concepts, dimensions and units</td>
<td>1.1 - 1.5</td>
</tr>
<tr>
<td>2</td>
<td>1/22/2024</td>
<td>Viscosity, flow patterns</td>
<td>1.6 - 1.11</td>
</tr>
<tr>
<td>3</td>
<td>1/29/2024</td>
<td>Pressure distribution in a fluid, hydrostatics, bouyancy</td>
<td>2.1 - 2.5, 2.8, 2.10</td>
</tr>
<tr>
<td>4</td>
<td>2/5/2024</td>
<td>RTT, conservation of mass, <strong>Exam 1</strong></td>
<td>3.1 - 3.3</td>
</tr>
<tr>
<td>5</td>
<td>2/12/2024</td>
<td>Linear momentum, Bernoulli equation</td>
<td>3.4 - 3.5</td>
</tr>
<tr>
<td>6</td>
<td>2/19/2024</td>
<td>Angular momentum</td>
<td>3.6</td>
</tr>
<tr>
<td>7</td>
<td>2/26/2024</td>
<td>Energy equation</td>
<td>3.7</td>
</tr>
<tr>
<td>8</td>
<td>3/4/2024</td>
<td>Differential flow, <strong>Exam 2</strong></td>
<td>4.1 - 4.6</td>
</tr>
<tr>
<td></td>
<td>3/11/2024</td>
<td>Spring Break</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>3/18/2024</td>
<td>Stream function, vorticity, irrotational flow</td>
<td>4.7 - 4.8</td>
</tr>
<tr>
<td>10</td>
<td>3/25/2024</td>
<td>Irrotational flows (potential), viscous flow</td>
<td>4.9 - 4.10</td>
</tr>
<tr>
<td>11</td>
<td>4/1/2024</td>
<td>Dimensional analysis, similarity, <strong>Exam 3</strong></td>
<td>5.1 - 5.5</td>
</tr>
<tr>
<td>12</td>
<td>4/8/2024</td>
<td>Viscous flow in ducts</td>
<td>6.1 - 6.7</td>
</tr>
<tr>
<td>13</td>
<td>4/15/2024</td>
<td>Pipe flow</td>
<td>6.8 - 6.12</td>
</tr>
<tr>
<td>14</td>
<td>4/22/2024</td>
<td>Flow past immersed bodies, boundary layers, <strong>Exam 4</strong></td>
<td>7.1 - 7.5</td>
</tr>
<tr>
<td>15</td>
<td>4/29/2024</td>
<td>Drag and Lift</td>
<td>7.6 - 7.7</td>
</tr>
<tr>
<td>16</td>
<td>5/7/2024</td>
<td>Final Exam, Comprehensive, ~50% from CH 7 (10:30am - 12:30pm)</td>
<td></td>
</tr>
</tbody>
</table>

C. Aul

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