Syllabus

ME 1071 – Applied Fluid Mechanics

Spring Semester 2025

Lecture Time:	Tue. 13:50 – 16:25	**Classroom:**	Scupi New Bldg. N214
Instructor:	Dr. John Pien	**Office:**	Scupi New Bldg. N503
Office Hours:	Mon. 13:30 – 17:30 Tue. 09:00 – 11:30 Tue. 16:30 – 17:00	**Email:**	john.pien@scupi.cn

Teaching Assistant: Jingyi Liu **Email:** 2021141520069@stu.scu.edu.cn

Catalog Description

This 3-credit course is an advanced yet practical mechanical engineering approach to the study of fluid flow and fluid systems. Topics covered will begin with the review of basic materials from the introductory fluid mechanics class, then include internal and external flow conditions for system design and implementation, fluid machinery, open channel flow and compressible flow conditions. Students will practically apply these principles to practical use applied problems such as fluid flows in pipes systems, pump selection and application, drag and lift, open channel flows, and the design and analysis of fluid system.

Prerequisites

ME 0071: Introduction to Fluid Mechanics

Textbook

Pritchard and Mitchell, *Fox and McDonald's Introduction to Fluid Mechanics*, 9th Edition, Wiley.

Course Objectives

- Apply integral and differential equation solutions to fluid in motion applications.
- Develop an advanced understanding of fluid motion and practically apply them to engineering applications.
- Apply fluid flow characteristics to internal and external flow conditions.
- Understand problem solving techniques for Navier-Stokes equations.
- Understand compressible flow conditions and engineering applications of gas dynamics.
- Explore advanced fluid flow solution techniques to real world applications.

Applicable ABET Student Outcomes

- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- An ability to apply engineering design to produce solutions that meet specified needs with consideration of global, environmental and economic factors.
- 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, environmental and economic contexts (sustainability, for example)
- An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Course Outline

- Fluid Statics (Ch. 3)
- Fluid Motion - Integral Analysis (Ch. 4)
- Fluid Motion - Differential Analysis (Ch. 5)
- Incompressible Inviscid Flow (Ch. 6)
- Internal Incompressible Viscous Flow (Ch. 8)
- External Incompressible Viscous Flow (Ch. 9)
- Fluid Machinery (Ch. 10)
- Flow in Open Channels (Ch. 11)
- Introduction to Compressible Flow (Ch. 12)

Course Schedule (Tentative)

Week	Date	Chapter	Topics
1	02/25	 3	Introduction to Fluid Mechanics – Executive Review Fluid Statics
2	03/04	 1 4	Introduction to Fluid Mechanics – Executive Review Analysis of Experimental Error Conservation of Mass of Control Volume
3	03/11	 4 4	Introduction to Fluid Mechanics – Executive Review Momentum Equation for Inertial Control Volume Momentum Equation for Accelerated Control Volume
4	03/18	4 4 5	Angular Momentum Equation for Control Volume First Law of Thermodynamics for Control Volume Differential Analysis of Fluid
5	03/25	5 6 6	Irrotational Flow Incompressible Inviscid Flow: Euler Equation; Bernoulli Equation

6	04/01	6 6 6	Incompressible Inviscid Flow – Irrotational Flow Bernoulli Equation, Velocity Potential and Stream Function Elementary Plane Flows and the Superposition
7	04/08	 8 8	Introduction to Fluid Mechanics – Executive Review Internal Incompressible Viscous Flow Pump System Design
8	04/15		Midterm Exam-I
9	04/22	9 9	External Incompressible Viscous Flow Laminar Flat Plate Boundary Layer: Exact Solution
10	04/29	9 9	Momentum Integrated Solution Flow with Zero Pressure Gradient
11	05/06	9 9	Flow over Immersed Bodies - Drag Flow over Immersed Bodies - Lift
12	05/13	10	Fluid Machinery
13	05/20		Midterm Exam-II
14	05/27	10	Fluid Machinery
15	06/03	12	Compressible Flow
16	06/10	12 11	Compressible Flow Open Channel Flow
17	06/17		Final Exam

Course Grading

Attendance/Quiz	10%
Homework	10%
Midterm Exam I	20%
Midterm Exam II	20%
Final Exam	30%

Exam Schedule (Tentative)

Midterm Exam I	14:00 – 16:00, Tue., Apr. 15th (week 8)
Midterm Exam II	14:00 – 16:00, Tue., May 20th (week 13)
Final Exam	14:00 – 16:00, Tue., Jun. 17th (week 17)

Course Policies

Regular class attendance is essential and expected. Active participation in course activities is encouraged which would generally involve focused thinking as well as engaging with instructor and fellow students. Professional classroom demeanor is required; in particular, all cell phones and personal electronic devices must remain off or silent during the lecture. Do not conduct side conversations during the lecture as it is distracting to the lecturer and other students.

Homework Assignments

- Homework problems are assigned periodically and are due as stated in the assigned paper. All work should be submitted electronically through the Blackboard system. Late submission WILL NOT be accepted. It is students' duty to make sure that submission through Blackboard has been properly processed. If you have a compelling emergency that prevents you from turning in the homework on time, please email the instructor to get the approval for late submission. All homework scores will be used in your grade computation.
- Unless otherwise indicated, you can work with your fellow classmates, but you must submit a distinct and independent write-up to receive credit. If plagiarism is caught, the homework will receive a zero score. If you believe an error has been made in the grading of an assignment, bring it to the attention of the TA or instructor within one week (7 calendar days) after the graded materials have been made available to the student.
- All work must be shown for each solution to receive full credit and present your solution in a logical fashion while showing and explaining all important steps in detail.

Exams

- There will be three exams (two midterms and one final), all are closed-book and closed-notes. Essential equations will be provided to students during the exams to help answer exam problems. Exams will emphasize treatment of materials covered in lectures and homework assignments.
- If you cannot attend an exam due to emergencies and health issues, you MUST get the approval from the instructor to make alternative arrangements, consistent with University Policy, before the exam is given. If you miss an exam without prior approval, you will receive a score of "ZERO" for that exam except under extenuating circumstances.

Make-Up Exam

Students who have not taken either the midterm or the final exam are NOT eligible to take the make-up exam. The make-up exam grading is only to replace students' semester final exam grading. Students who pass the course after the make-up exam will receive only a passing grade as the final grade.

Evaluation Policy

Partial credit will be awarded to recognize that some portion of the work is correct. However, partial credit grading is only practical if the work is clearly developed, with clear and well-marked diagrams when fitting, with the appropriate equations prominently displayed, where the substitutions into the equations are quite clear, and the assumptions used are obvious to the grader. That is, it is the student's responsibility to present her/his work so clearly that the grader can quickly ascertain the location and nature of the error(s)

and can follow the subsequent work through. If this is not clear on the work submitted, credit cannot be given. Partial credit is assigned at the discretion of the grader. It is therefore always in your best interest to practice clarity and completeness in your solutions when working on exam and homework problems.

Copyrights

The handouts used in this course are copyrighted. By "handouts" we mean all materials generated for this class, which include but are not limited to syllabi, in-class materials, videos, slides, and problem sets. Because these materials are copyrighted, you do not have the right to copy or distribute the handouts, unless the author expressly grants permission.

Academic Integrity

All students are expected to adhere to the standards of academic honesty. Any student engaged in cheating, plagiarism, or other acts of academic dishonesty would be subject to disciplinary action. Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process, initiated at the instructor level, as outlined in the University Guidelines on Academic Integrity. This may include but is not limited to the confiscation of the examination of any individual suspected of violating the University Policy.

Remarks

- Modifications to this syllabus may occur. Please stay informed about any revisions announced during class or on the Blackboard website. Lecture materials, homework assignments, homework solutions and class announcements will also be accessible through Blackboard.
- Important dates and information will be announced during class. Students should stay informed about announcements on Blackboard.
- While emailing the instructor or TAs, please kindly include “ME 1071” in the subject line for an efficient communication. Please use your university email account (student_ID_number@stu.scu.edu.cn), as emails from other sources could be caught by the SCU spam filter.