

# MAE 643 (CEN 643): Fluid Dynamics (3 credits) Syllabus – Fall 2022



## Instructor

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## Course Information

Courses: Link Hall 105, Tuesday and Thursday 2:00 - 3:20 PM  
Office hours: open-door policy and by appointments (the best way to get in touch is through email)

## Course Objectives

The purpose of this course is to provide a fundamental understanding of incompressible flow at a graduate level. After completing the course, students should be able to understand fluid dynamics principles of continuity, momentum, and energy, and apply their knowledge to analyze various flow problems.

## Prerequisite Courses

*MAE 341: Fluid Mechanics*

It is assumed that you have taken undergraduate fluid mechanics and have knowledge of calculus, ordinary and partial differential equations, and complex variables.

## Textbook

- R. L. Panton: Incompressible Flow (required)
- P. K. Kundu & I. M. Cohen, Fluid Mechanics (suggested)

You may also find the following books useful for this course.

- G. K. Batchelor: An Introduction to Fluid Dynamics
- I. G. Currie: Fundamental Mechanics of Fluids
- F. M. White: Viscous Fluid Flow
- L. D. Landau & E. M. Lifshitz: Fluid Mechanics
- R. A. Granger: Fluid Mechanics
- H. Schlichting: Boundary-Layer Theory
- R. Aris: Vectors, Tensors and the Basic Equations of Fluid Mechanics

## Course Topics

This course will cover the following topics:

- INTRODUCTION: mathematical preliminaries, continuum hypothesis, kinematics, Eulerian and Lagrangian description.

- BASIC LAWS: Reynolds transport theorem, equations of motion (mass/momentum/energy balance), integral and differential forms, Navier–Stokes equations, Euler equations, Bernoulli’s equation, constitutive relations, vorticity, dimensional analysis.
- POTENTIAL FLOW: complex analysis, velocity potential and streamfunction, circulation, airfoil.
- VISCOUS FLOW: exact solutions to the Navier–Stokes equations, low-Reynolds number flow, vortex dynamics, boundary layer theory.
- OTHER TOPICS (TIME PERMITTING): turbulence, hydrodynamic stability.

### **Instructional Methods**

Lectures, homework, examinations, and others if necessary.

### **Grading**

- Homework: 30% (see below)
- Midterm Exam: 30% (date to be announced in class)
- Final Exam: 40% (date to be announced in class)

Grading Scale: A: 90-100, B: 80-89, C: 70-79, D: 60-69, F:0-59

### **Homework**

Homework will be assigned regularly and will be collected for grades a week later in class (at the beginning of class). Problems will be graded on a scale of 0-3 (0: not completed; 1: mostly incorrect; 2: mostly correct; 3: perfect). Solutions will be posted online and can be discussed in class. Collaboration is encouraged only with students *currently enrolled in class*. However, the write-up should reflect your understanding of the material. *Do not copy someone else’s work. Late submissions are not accepted.*

### **Examinations**

The mid-term and final (comprehensive) exams will be closed books/notes and will only require a pencil/pen and an eraser.

### **Make-up Assignments**

In case of emergency, situation beyond one’s control, or for other valid reasons, students will be given an opportunity for making up the missed assignments or examinations. Valid excuses include documented illness (including illness of a dependant child), death of an immediate family member, military service obligation, observance of religious holy days, and official university activities. You must notify me in advance when the excused absence is a planned event such as the observance of a religious holy day or an official university activity. Proof of valid reason may be required.

### **University Attendance Policy:**

Attendance in classes is expected in all courses at Syracuse University. Students are expected to arrive on campus in time to attend the first meeting of all classes for which they are registered. Students who do not attend classes starting with the first scheduled meeting may be academically withdrawn as not making progress toward degree by failure to attend. Instructors set course-specific policies for absences from scheduled class meetings in their syllabi.

It is a federal requirement that students who do not attend or cease to attend a class to be reported at the time of determination by the faculty. Faculty should use “ESPR” and “MSPR” in Orange Success to alert the Office of the Registrar and the Office of Financial Aid. A grade of NA is posted to any student for whom the Never Attended flag is raised in Orange SUccess. More information regarding Orange SUccess can be found at <http://orangesuccess.syr.edu/getting-started-2/>.

Students should also review the University’s religious observance policy and make the required arrangements at the beginning of each semester.

### **Syracuse University Policies:**

Syracuse University has a variety of other policies designed to guarantee that students live and study in a community respectful of their needs and those of fellow students. Some of the most important of these concern:

**Diversity and Disability** (ensuring that students are aware of their rights and responsibilities in a diverse, inclusive, accessible, bias-free campus community) can be found here, at: <https://www.syracuse.edu/life/accessibilitydiversity/>.

**Religious Observances Notification and Policy** (steps to follow to request accommodations for the observance of religious holidays) can be found here, at: [http://supolicies.syr.edu/studs/religious\\_observance.htm](http://supolicies.syr.edu/studs/religious_observance.htm).

**Orange SUccess** (tools to access a variety of SU resources, including ways to communicate with advisors and faculty members) can be found here, at: <http://orangesuccess.syr.edu/getting-started-2/>.

### **Disability-Related Accommodations:**

Syracuse University values diversity and inclusion; we are committed to a climate of mutual respect and full participation. There may be aspects of the instruction or design of this course that result in barriers to your inclusion and full participation in this course. I invite any student to meet with me to discuss strategies and/or accommodations (academic adjustments) that may be essential to your success and to collaborate with the Center for Disability Resources (CDR) in this process.

If you would like to discuss disability-accommodations or register with CDR, please visit Center for Disability Resources. Please call (315) 443-4498 or email [disabilityresources@syr.edu](mailto:disabilityresources@syr.edu) for more detailed information.

CDR is responsible for coordinating disability-related academic accommodations and will work with the student to develop an access plan. Since academic accommodations may require early planning and generally are not provided retroactively, please contact CDR as soon as possible to begin this process. <https://disabilityresources.syr.edu/>.

### **Academic Integrity Policy:**

Syracuse University’s Academic Integrity Policy reflects the high value that we, as a university community, place on honesty in academic work. The policy defines our expectations for academic honesty and holds students accountable for the integrity of all work they submit. Students should understand that it is their responsibility to learn about course-specific expectations, as well as about university-wide academic integrity expectations. The policy governs appropriate citation and use of sources, the integrity of work submitted in exams and assignments, and the veracity of signatures on attendance sheets and other verification of participation in class activities. The policy also prohibits students from submitting the same work in more than one class without

receiving written authorization in advance from both instructors. Under the policy, students found in violation are subject to grade sanctions determined by the course instructor and non- grade sanctions determined by the School or College where the course is offered as described in the Violation and Sanction Classification Rubric. SU students are required to read an online summary of the University's academic integrity expectations and provide an electronic signature agreeing to abide by them twice a year during pre-term check-in on MySlice.