

CWR 3201 HYDRODYNAMICS

CLASS MEETING: Tu 5th-6th Period (11:45 a.m. - 1:40 p.m.); FLG 270

INSTRUCTOR INFORMATION:

Dr. Mark Newman: Department of Civil & Coastal Engineering

Office: 370C Weil Hall

Office Hours: Made by appointment (see below)

E-Mail: mark.newman@essie.ufl.edu

To schedule an appointment please use: [Dr. Newman's Bookings Page](#)

(Note: This link takes you to our Civil Engineering academic advising scheduling site—you are in the right place—this is where I schedule all my appointments. You can choose either in-person or Zoom meetings).

Office hours for teaching assistants (TAs) will be posted in Canvas.

COURSE GOALS:

The goal of this course is to have students master the fundamental principles of fluid statics, fluid kinematics, the dynamic equations for fluid mass, momentum and energy conservation, and the method of dimensional analysis. Students will then be able to apply these principles to solve basic engineering problems in incompressible pipe, open channel, and viscous flows.

COURSE OBJECTIVES:

The specific objectives of the course include the ability to:

- 1) Identify and explain each of the general properties of fluids and demonstrate how each is significant in various fluid flow applications.
- 2) Calculate pressure distributions in a static fluid, evaluate the resulting forces on solid surfaces, and determine the effects of those forces in a given system.
- 3) Identify the key components of mechanical energy in flowing fluid and examine their variation along typical incompressible pipe and channel flows.
- 4) Apply mass and momentum conservation equations to solve for velocity, elevation, pressure and forces in pipe and channel flows.
- 5) Apply theoretical solutions to solve basic practical laminar flow problems.
- 6) Employ dimensional analysis methods to design a scale model to replicate a given prototype flow system.
- 7) Formulate a complete empirical solution for resistance in turbulent, incompressible pipe flow.
- 8) Select and size pipes to design a single pipe system to meet head and flow constraints.
- 9) Evaluate and optimize simple pipe system designs including pumps and turbines.
- 10) Perform laboratory experiments to reinforce physical principles and develop and refine the student's physical intuition.

OUTCOMES:

This course requires students to apply knowledge of math, science and engineering in order to enhance their ability to identify, formulate and solve engineering fluid mechanics problems. The laboratory addresses their ability to work in teams to design and conduct experiments, and also to analyze and interpret data and communicate their findings effectively in written reports. Students will also develop the ability to perform a basic design of a single pipe system.

TEXTBOOK:

Young, Munson and Okiishi's A Brief Introduction to Fluid Mechanics by Hochstein and Gerhart, 6th Edition, John Wiley and Sons, Inc, 2021. (this book is available through the UF All Access Program).

CLASS NOTES:

Formal class notes for the entire course (in "framework" style, with important equations, words, diagrams, etc. omitted) will be provided through Canvas and will be needed after the first day of class. These will be very useful for reviewing the recorded lectures.

PREREQUISITES:

Course prerequisites are statics (EGM 2511) and elementary differential equations (MAP 2302). Civil engineering students must have received a grade of C or better in both prerequisite courses.

COURSE OUTLINE

| <u>Module</u> | <u>Content</u> | <u>Notes/Text Section</u> |
|----------------------|---|----------------------------------|
| 1 | Fluid Properties | 1.1-2.1 |
| 2 | Fluid Statics | 2.2-3.1 |
| 3 | Bernoulli Equation | 3.2-3.8 |
| | EXAM 1 | |
| 4 | Fluid Kinematics | 4.1-4.4 |
| 5 | Mass, Momentum & Energy Equations | 5.1-5.3 |
| 6 | Viscous Flow & Potential Flow Theory | 6.9 |
| | Spring Break (March 15-23) | |
| 6 | Viscous Flow & Potential Flow Theory | 6.2-6.6.5 |
| | EXAM 2 | |
| 7 | Dimensional Analysis & Scale Model Design | 7.1-7.8 |
| 8 | Flow in Pipes | 8.1-8.5 |
| 9 | Pumps | 9.1-9.4 |
| | EXAM 3 | |

LABORATORY:

The Laboratory Manual will be posted in Canvas and will provide detailed expectations for each lab report. Lab reports are due at the beginning of the next lab (i.e. normally one week after your assigned lab time). Failure to appear for a scheduled lab will result in a zero for that lab, unless documentation for the absence is provided and approved by the instructor and the lab can be made up by attending another scheduled session. **You must submit all laboratory reports to earn a passing grade in this class.**

LABORATORY SCHEDULE:

Sections: M, T, W, R 8th- 9th Period (3:00 PM – 4:55PM); 254 Weil Hall

| <u>Lab</u> | <u>Week of</u> | <u>Topic</u> |
|------------|----------------|---|
| | 01/13/25 | * * NO LABS * * |
| | 01/20/25 | * * NO LABS * * |
| 1 | 01/27/25 | Forces on a Plane Surface |
| 2 | 02/03/25 | Orifice Coefficients |
| 3 | 02/10/25 | Venturi Meter |
| 4 | 02/17/25 | Jet Impact |
| 5 | 02/24/25 | Flow Over a Step |
| | 03/03/25 | * * NO LABS (ASCE Student Conference) * * |
| 6 | 03/10/25 | Hydraulic Jump |
| | 03/17/25 | * * NO LABS (Spring Break) * * |
| 7 | 03/24/25 | Friction Loss in a Pipe |
| 8 | 03/31/25 | Drag Measurements |
| 9 | 04/07/25 | * * Lab Final * * |
| | 04/14/25 | * * NO LABS * * |
| | 04/21/25 | * * NO LABS * * |

LABORATORY SAFETY:

Participation in the laboratory experiments **requires** the following:

- Long pants
- Closed-toed shoes

GRADE DISTRIBUTION:

| | |
|----------------------|------------|
| Exam 1 | 15% |
| Exam 2 | 15% |
| Exam 3 | 15% |
| Laboratory | 25% |
| Quizzes (individual) | 15% |
| Quizzes (team) | <u>15%</u> |
| | 100% |

GRADING SCALE:

| Percent | Grade | Grade Points |
|----------|-------|--------------|
| 94 - 100 | A | 4.00 |
| 90 - 93 | A- | 3.67 |
| 87 - 89 | B+ | 3.33 |
| 84 - 86 | B | 3.00 |
| 80 - 83 | B- | 2.67 |
| 77 - 79 | C+ | 2.33 |
| 74 - 76 | C | 2.00 |
| 70 - 73 | C- | 1.67 |
| 67 - 69 | D+ | 1.33 |
| 64 - 66 | D | 1.00 |
| 60 - 63 | D- | 0.67 |
| 0 - 59 | E | 0.00 |

UF GRADING POLICIES:

The UF policies for passing grades and assignment of grade points can be found at the following URL: <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

MAKE-UP POLICY:

Make-up examinations will be provided in the case of a documented illness, emergency or other extraordinary situations, in accordance with university policy.

CLASS FORMAT AND ATTENDANCE:

This class will be presented in a “flipped” format as opposed to a standard lecture-style class. In this approach, the expectation is that students will watch video lectures in preparation for attending the class meetings. Traditional homework will not be assigned in favor of in-class problems, case studies, and other practical examples of fluid mechanics in both engineering applications and in everyday life. In this manner there are three steps for reinforcement of important concepts to aid in long-term understanding:

- 1) Review of recorded lectures and completing “framework” notes.
- 2) Completion of class activities and quizzes.
- 3) Review for examinations.

As such, attendance in class is reasonably essential to success in this course. Individual and team quizzes will review material from the recorded lectures to assure that all students have come prepared for the activities of the day. **Attendance at laboratory sections is mandatory.**

HOMEWORK

There will be no homework assignments or homework grades. The only class assignments will be to watch the recorded lectures.

ACCOMMODATION FOR DISABILITIES:

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

CLASS EVALUATIONS:

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at:

<https://gatorevals.aa.ufl.edu/students/>

Students will be notified when the evaluation period opens and can complete evaluations through the email they receive from GatorEvals or in their Canvas course menu under GatorEvals.

Summaries of course evaluation results are available to students at:

<https://gatorevals.aa.ufl.edu/public-results/>

In-Class Recording:

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

Commitment to a Safe and Inclusive Learning Environment:

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination.

It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu
- Curtis Taylor, Assoc. Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Assoc. Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu