MET 304 - Applied Fluid Mechanics Syllabus

Spring 2025

Course Modality:
This is a hybrid course. Lectures are held asynchronously online using Canvas. Labs and recitations are held face to face, on campus, every Saturday in room ME 110, unless otherwise indicated. For more details on NJIT's modes of instruction, see here. For more information on using Canvas and other supported learning tools, visit the IST Service Desk Knowledgebase.

Instructor Information

Instructor	Email	Office Hours
Angelantonio Tafuni	atafuni@njit.edu	Available by appointment. To schedule an appointment for a one-on-one meeting with your instructor, please email your instructor.

*The instructor will respond to emails within 48 hours. Allow up to 2 weeks for feedback on submitted assignments. This feedback will be provided in Canvas.

General Information

Course Description

This course provides students with a clear understanding and a firm grasp of fluid statics and the basic laws of fluid flow: conservation of mass, momentum and energy. Applications of the basic laws to internal and external incompressible flow include specific topics in pipe flow systems, centrifugal pumps and fans, streamlining, and fluid flowmeters.

Prerequisites/Co-requisites

MATH 238 or MATH 112 and PHYS 103 or PHYS 121

Course Learning Outcomes (CLO)

By the end of the course, students will be able to:

1. Relate fluid quantities to the fundamental dimensions of mass, length, time and temperature, and evaluate their magnitudes across the different reference systems (SI, EES) using conversion factors.

2. Determine pressure within a fluid tank or pressure drop across a fluid flow section or a flow device.
3. Determine the hydrostatic pressure and force on a submerged surface, the buoyant force on floating and submerged bodies, and the density of liquids and solids.
4. Measure the flow rate and other fluid quantities via elementary fluid dynamics equations such as the Bernoulli Equation.
5. Determine the head rise, power, and efficiency of a centrifugal pump.
6. Develop functional relationships between parameters in fluid mechanics problems using the Buckingham Pi Theorem.
7. Determine the drag and lift forces on a body moving in a viscous fluid.
8. Manipulate the analytical expression of the velocity field of a fluid flow to derive the acceleration and/or determine flow incompressibility and irrotationality conditions.
9. Use mass and linear momentum conservation equations to determine the force exerted by a fluid flow on a structure and vice versa.
10. Conduct laboratory experiments, analyze data and present results.
11. Write effective lab reports following criteria provided in the lab report instructions.
12. Communicate effectively about topics related to fluid mechanics.

ABET Student Outcomes

The Course Learning Outcomes support the achievement of the following MET Student Outcomes and TAC of ABET Criterion 9 requirements:

- Student Outcome (1) - an ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly-defined engineering problems appropriate to the discipline

  (Related to CLO–2,3,4,5)

- Student Outcome (3) - an ability to apply written, oral, and graphical communication in broadly-defined technical and non-technical environments; and an ability to identify and use appropriate technical literature

  (Related to CLO–11)

- Student outcome (4) - an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes

  (Related to CLO–10)

- Student outcome (5) - an ability to function effectively as a member as well as a leader on technical teams.

  (Related to CLO–10,11,12)

Required Materials

A Brief Introduction to Fluid Mechanics – 6th Ed., by Young, Munson & Okiishi – John Wiley & Sons, Inc. 2021

Loose-leaf: ISBN: 9781119611714
E-book: ISBN: 9781119611172

Grading Policy

NJIT Graduate Grades

Final Grade Calculation

Final grades for all assignments will be based on the following percentages:

Assignments	**15%**
Discussion Forums	**10%**
Recitations and Laboratory	**30%**
Midterm Exams (2 @15% each)	**30%**
Final Exam	**15%**

Course Work

Assignments: (15% of grade) Assignments will be available at the end of certain modules to give you an opportunity to apply course concepts, as well as practice and prepare for the exams. Submitting an assignment automatically grants you 40% of the grade. The remaining 60% comes from one graded problem, which will be randomly selected by the instructor. The grading criteria will be based on the assignment rubric, located in Canvas. The same problem is chosen for every student and if a student hasn't solved it, 60% of the respective homework grade is null. Assignments must be drafted and will be graded according to the Assignment Template provided. Solutions will be provided after the deadline has passed. Late work will not be accepted under any circumstances.

Discussion Forums: (10% of grade) You are expected to participate in several discussion forums in Canvas. When all students participate in a discussion, it creates an active learning environment that will help you better understand the materials and be more successful in the class. You will post your initial response to the prompt by Fridays at 11:59pm and respond to two classmates by Sunday at 11:59pm of the week they are listed.

Recitations and Laboratory: (30% of grade) You are *required* to participate in a minimum of 5, face-to-face lab experiments on campus. Attendance of lab experiments is *mandatory*. Lab experiments are usually held on Saturday mornings, during which the students are arranged in teams and perform experiments to collect relevant data. This data must then be

organized in a written report following appropriate guidelines. Lab reports that are submitted late will not be accepted under any circumstances. Lab groups are required to present their findings from at least one experiment to the rest of the class through a PowerPoint team presentation. Regardless of whether your team has an experiment or presentation planned or not, you are encouraged to come to the Fluids lab every Saturday. During this face-to-face time you will be able to apply conceptual knowledge seen in lecture videos and laboratory experiments, and engage in problem-solving and discussion with your classmates. The "Recitations and Laboratory" portion of the final grade will be counted as follows:

- Attendance 40%
- Lab reports 40%
- Lab presentation(s) 20%

Exams: (**45% of grade**) There will be two midterm exams and a final exam, all administered online (during our scheduled lab time) and carrying equal weight. All exams will utilize the learning management system (Canvas) and Respondus LockDown Browser. Exams will occur on known dates and times in the semester, available in the Course Schedule below. Unless otherwise stated, the final exam is usually scheduled on the 1st Saturday after classes end and it is cumulative. Once students start any exam assignment on Canvas, they must complete it at their first attempt and within the maximum allotted time. If not present in the lab, it is the students' responsibility to take all exams in a quiet room with a stable internet connection. Exam solutions *must* be drafted and will be graded according to the Assignment Template provided in Canvas. Submitted exam handwork that does not comply with the Assignment Template will not be graded. Makeup exams are possible *only* in the case of a serious, *documented* illness or emergency, in which case you will need to request a formal approval from the Office of the Dean of Students . No other exceptions will be made. An approval from the Dean of Students' Office is a necessary but not sufficient condition, the final decision of a makeup exam rests entirely with the course instructor.

Feedback

Allow up to 2 weeks for feedback on submitted assignments. This feedback will be provided in Canvas.

AI usage

Except for exams, the usage of artificial intelligence (AI) is permitted in this course. If and when students use artificial intelligence in this course, the AI must be cited as is shown within the NJIT Library AI citation page for AI.

Letter to Number Grade Conversions

A	90-100
B+	85-89
B	80-84
C+	75-79
C	70-74
D	60-69
F	0-59

Exam Information and Policies

NJIT policy requires that all midterm and final exams must be proctored, regardless of delivery mode, in order to increase academic integrity. Note that this does not apply to essay or authentic based assessments. Effective beginning Fall semester 2019, students registered for a fully online course section (e.g., online or Hyflex mode) must be given the option to take their exam in a completely online format, with appropriate proctoring.

Any course that uses online proctoring for exams may require you to do an environmental scan. You are responsible for selecting a location where you are comfortable with yourself and your room being video and audio recorded. You may be asked to use your camera to scan all four walls of the room you are in, as well as the workspace, desk, and area around the computer. Ideally, your exam environment should be well-lit and free from distractions and interruptions.

In this course you will be required to use the following proctoring method to ensure academic integrity for exams:

Respondus LockDown Browser

This course will be utilizing:

- LockDown Browser: A locked browser used to prevent students from printing, copying, going to another URL, or accessing other applications during an assessment in Canvas.
- Monitor: Used in conjunction with LockDown Browser, Monitor is the usage of a webcam to record a user during the exam session.

If virtual machine software is detected on your device, you won't be able to run LockDown Browser, and you'll receive a warning, "The browser can't be used in virtual machine software such as Virtual PC, VMWare, and Parallels." You can find examples of VM software and troubleshooting steps on Respondus's FAQ page for this topic.

For information about Repondus's privacy policies, please visit their Privacy Center.

In using LockDown Browser, students need:

- High-speed internet connection
- Windows or Apple Operating System

In using Monitor, students need:

- Webcam (internal or external)
- Microphone and Audio (internal or external)
- NJIT ID or Photo-Issued ID
- To perform an environment check

Helpful Resources:

- Introduction to Respondus LockDown Browser for Students Video
- Respondus Monitor Resources
- Respondus Computer Requirements
- Questions or Problems? Contact:
    - Respondus Live Chat
    - IST Service Desk: 973-596-2900 or Help.njit.edu

Using LockDown Browser with "Classic" Quizzes in Canvas

To access a Classic Quiz in Canvas using LockDown Browser, students must:

1. Download and install the LockDown Browser link.
2. Locate the "LockDown Browser" shortcut on your desktop and double-click it. (For Mac users, launch "LockDown Browser" from the Applications folder.)
3. Log in with your NJIT UCID and password.
4. Click on the course within your "Courses" list in which you have to take the exam that requires LockDown Browser.
5. After you enter the course, find the exam and click on it.
6. Click the "Take the Quiz" button. Once a quiz has been started with LockDown Browser, you cannot exit until the "Submit Quiz" button is clicked.
7. If you are required to use a webcam (Respondus Monitor), you will be prompted to complete a Webcam Check and other Startup Sequence steps.

Policy for Late Work

Late work is not accepted and does not count for any credit, even partial. The only exceptions are serious, documented illnesses or emergencies, which will need to be formally approved by the Dean of Students Office (email: dos@njit.edu).
Please note that it is your responsibility to check the course calendar and deadlines frequently during the semester and to ensure that any work you do is submitted on time.

Academic Integrity

"Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the NJIT academic code of integrity policy.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu"

Netiquette

Throughout this course, you are expected to be courteous and respectful to classmates by being polite, active participants. You should respond to discussion forum assignments in a

timely manner so that your classmates have adequate time to respond to your posts. Please respect opinions, even those that differ from your own, and avoid using profanity or offensive language.

Weekly Expectations

This course is organized by weekly modules. For each module, you must watch lecture videos, complete any reading assignments and submit any respective exams and assignments. For the weekly discussion forums, initial posts are due by Friday at 11:59 and replies to peers are due by Sunday at 11:59 pm. Be sure to complete the reading assignments and watch the lecture videos before attending the Saturday lab meetings. See Canvas for the Laboratory schedule.

Course Schedule

Week	Topics	Reading/Assignments	Due Dates
1	Introductory Definitions and Tools in Fluid Mechanics	**Read and Review:** -Book Sections 1.1-1.9 -Slides 1.1-1.8 **Watch:** -Lectures 1.1-1.8 **Submit:** -Discussion-Peer Introductions -Respondus Practice Quiz	***Discussion*** (Initial Post)-Fr 11:59pm; (Peer Reply)-Su 11:59pm
2	Fluid Pressure and Manometry	**Read and Review:** -Book Sections 2.1-2.6 -Slides 2.1-2.8 **Watch:** -Lectures 2.1-2.8 **Submit:** -Discussion-Measuring the Effect of Fluid Pressure	***Discussion*** (Initial Post)-Fr 11:59pm; (Peer Reply)-Su 11:59pm
3	Hydrostatic Force on Surfaces	**Read and Review:** -Book Sections 2.8, 2.10, 2.11 -Slides 3.1-3.4 **Watch:** -Lectures 3.1-3.4 **Submit:** -Assignment 1	***Assignment 1*** Su 11:59 pm
4	Elementary Fluid Dynamics	**Read and Review:** -Book Sections 3.1-3.5, 3.6.1 -Slides 4.1-4.5 **Watch:** -Lectures 4.1-4.5	***Laboratory 1*** Fri 11:59 pm ***Lab 1 Presentation*** Saturday during lab time.

Week	Topics	Reading/Assignments	Due Dates
		Submit: -Laboratory 1 **Labs:** -Lab 1 Presentation	
5	Free Jets, Confined Flows, Flowmeters	**Read and Review:** -Book Sections 3.6, 3.8 -Slides 5.1-5.5 **Watch:** -Lectures 5.1-5.5 **Submit:** -Assignment 2	***Assignment 2*** Su 11:59 pm
6	**Review and Preparation for Midterm Exam 1**	**Review:** -Book sections, slides, and video lectures from modules 1-5 -Review Assignment for Midterm Exam 1 **Submit:** -Midterm Exam 1 -Laboratory 2	***Review Assignment for Midterm Exam 1*** Thu 11:59 pm ***Midterm Exam 1*** Saturday during lab time. ***Laboratory 2*** Fri 11:59 pm
7	Centrifugal Pumps	**Read and Review:** -Book Sections 11.1, 11.4.2, 11.5 -Slides 7.1-7.3 **Watch:** -Lectures 7.1-7.3 **Reflect:** -Lab 2 Presentation	***Lab 2 Presentation*** Saturday during lab time.
8	Buckingham Theorem and Dimensional Analysis	**Read and Review:** -Book Sections 7.1-7.9 -Slides 8.1-8.6 **Watch:** -Lectures 8.1-8.6 **Submit:** -Assignment 3	***Assignment 3*** Su 11:59 pm
9	Drag and Lift on Bodies Immersed in a Viscous Flow	**Read and Review:** -Book Sections 9.1, 9.2.1, 9.3, 9.4 -Slides 9.1-9.6 **Watch:** -Lectures 9.1-9.6 **Submit:**	***Discussion*** (Initial Post)-Fr 11:59pm; (Peer Reply)-Su 11:59pm ***Laboratory 3 (Groups A & B)*** Fri 11:59 pm

Week	Topics	Reading/Assignments	Due Dates
		-Discussion-Drag and Lift in Real Life -Laboratory 3 (Groups A & B)	
10	Fluid Kinematics: Velocity and Acceleration Fields, Streamlines	**Read and Review:** -Book Sections 4.1-4.3 -Slides 10.1-10.5 **Watch:** -Lectures 10.1-10.5 **Submit:** -Laboratory 3 (Groups C & D)	***Laboratory 3 (Groups C & D)*** Fri 11:59 pm
11	Differential Analysis of Fluid Flow	**Read and Review:** -Book Sections 6.1, 6.2.1, 6.3.2, 6.4.1, 6.8 -Slides 11.1-11.4 **Watch:** -Lectures 11.1-11.4 **Submit:** -Assignment 4 -Laboratory 4 (Groups A & B) **Labs:** -Lab 3 Presentation -Lab 4 Presentation	***Assignment 4*** Su 11:59 pm ***Laboratory 4 (Groups A & B)*** Fri 11:59 pm ***Presentations*** Saturday during lab time.
12	**Review and Preparation for Midterm Exam 2**	**Review:** -Book sections, slides, and video lectures from modules 7-11 -Review Assignment for Midterm Exam 2 **Submit:** -Midterm Exam 2 -Laboratory 4 (Groups C & D) -Laboratory 5 (Groups A & B)	***Review Assignment for Midterm Exam 2*** Thu 11:59 pm ***Midterm Exam 2*** Saturday during lab time. ***Laboratory 4 (Groups C & D)*** Fri 11:59 pm ***Laboratory 5 (Groups A & B)*** Fri 11:59 pm
13	Control Volume Analysis of Fluid Flow	**Read and Review:** -Book Sections 5.1, 5.2.1, 5.2.2 -Slides 13.1-13.6 **Watch:** -Lectures 13.1-13.6 **Labs:** Laboratory 5 (Groups C & D)	***Laboratory 5 (Groups C & D)*** Fri 11:59 pm

Week	Topics	Reading/Assignments	Due Dates
14	Control Volume Analysis of Fluid Flow (Continued)	**Read and Review:** -Book Sections 5.2.2, 5.3 -Slides 14.1-14.4 **Watch:** -Lectures 14.1-14.4 **Submit:** -Assignment 5	***Assignment 5*** Su 11:59 pm
15	**Final Exam**	**Review:** -Book sections, slides, and video lectures from modules 1-14 -Review Assignment for Final Exam **Submit:** -Final Exam	***Review Assignment for Final Exam*** Thu 11:59 pm ***Final Exam*** 1st Saturday after the semester's end.

Additional Information and Resources

Accessibility:

This course is offered through an accessible learning management system. For more information, please refer to Canvas's Accessibility Statement.

Requesting Accommodations:

The Office of Accessibility Resources and Services works in partnership with administrators, faculty, and staff to provide reasonable accommodations and support services for students with disabilities who have provided their office with medical documentation to receive services.

If you are in need of accommodations due to a disability, please contact the Office of Accessibility Resources and Services to discuss your specific needs.

Resources for NJIT Online Students

NJIT is committed to student excellence. To ensure your success in this course and your program, the university offers a range of academic support centers and services. To learn more, please review the "Student Services" page in Canvas, which includes information related to technical support.