New Jersey Institute of Technology
School of Applied Engineering & Technology
MET 304 Applied Fluid Mechanics

COURSE NUMBER MET 304

COURSE NAME Applied Fluid Mechanics

COURSE STRUCTURE (2-2-3) (lecture hr/wk - lab hr/wk – course credits)

COURSE COORDINATOR/ INSTRUCTOR Dr. J. Sodhi/Dr. Mena Tawfik

COURSE DESCRIPTION An introduction to 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, including specific topics in pipe flow systems, centrifugal pumps and fans, streamlining, and fluid flow meters.

PREREQUISITE(S) MATH 238 or MATH 112, PHYS 103 or PHYS 121
COREQUISITE(S) None.

REQUIRED, ELECTIVE OR SELECTED ELECTIVE Required.

REQUIRED MATERIALS TEXT: **A Brief Introduction to Fluid Mechanics – 6th Edition,** by Young, Munson & Okiishi – John Wiley & Sons, Inc. [IBSN: 9781119611714, 9781119611172 (E-book)]

COMPUTER USAGE Word, Excel – Lab reports

COURSE OUTCOMES (CO)

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.

CLASS TOPICS

Introduction/Fluid Properties/Pressure, Hydrostatic Forces, Buoyancy, Classification of Flows, Conservation of Mass, Energy, and Momentum, Centrifugal Pumps, Dimensional Analysis and Similitude, Flow Over Immersed Bodies, Drag and Lift Forces, Flow in Pipes/Non-Circular Conduits, Open Channel Flow. Lab Experiments: Lab E1 - Flow Measurement Methods, Lab E2 - Centrifugal Pump Performance, Lab E3 - Drag & Lift Characteristics of an Airfoil, Lab E4 - Drag and Pressure Distribution on a Cylinder

STUDENT OUTCOMES

The Course Outcomes support the achievement of the following MET Student Outcomes:

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 CO – 2, 3, 4 and 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 CO – 11

Student outcome (4) - an ability to conduct standard tests, measurements and experiments and to analyze and interpret the results to improve processes
Related CO – 10

Student outcome (5) - an ability to function effectively as a member as well as a leader on technical teams
Related CLO – 10, 11, 12

GRADING POLICY

Homework	15 %
Lab reports	30%
Tests (2x15%)	30 %
Final Exam	25 %

Note: You may not pass the course if you are having failing grades (<50%) on the midterm tests and the final exam. There are two midterm tests and one final exam during the semester. Make-up exams are given only in some special cases approved by the Dean of Students.

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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 academic code of integrity policy that is found at: NJIT Academic Integrity Code.

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."

GENERATIVE AI

Student use of artificial intelligence (AI) is permitted in this course for certain assignments and activities. It is not permitted to be used in the assignments noted by the instructor, as doing so would undermine student learning and achievement of course learning outcomes. Additionally, if and when students use AI in this course, the AI must be cited as is shown within the NJIT Library AI citation page for AI. If you have any questions or concerns about AI technology use in this class, please reach out to your instructor prior to submitting any assignments.

STUDENT BEHAVIOR

- No eating or drinking is allowed at the lectures, recitations, workshops, and laboratories.
- Cellular phones must be turned off during the class hours – if you are expecting an emergency call, leave it on vibrate.
- No headphones can be worn in class.
- Unless the professor allows the use during lecture, laptops should be closed during lecture.
- During laboratory, if you are finished earlier, you must show the professor your work before you leave class
- Class time should be participative. You should try to be part of a discussion

MODIFICATION TO COURSE

The Course Outline may be modified at the discretion of the instructor or in the event of extenuating circumstances. Students will be notified in class of any changes to the Course outline.

PREPARED BY

Dr. M. Tawfik / Dr. J. Sodhi

COURSE COORDINATED BY

Dr. J. Sodhi

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CLASS HOURS

Thursday 06:00 PM – 10:00 PM FMH 305 & ME 110

OFFICE HOURS

by appointment contact in advance: **mena.tawfik.8@njit.edu**

HOMEWORK - IMPORTANT

Homework is usually **due the week following the date they are assigned, and must be submitted to the instructor.**

LABORATORY:

The laboratory experiments will be performed in Room 110-MEC. When an experiment is not scheduled, a lecture on the laboratory experiments or a problem session will be scheduled.

Experiment E1 – Viscocity of Fluids
Experiment E2 - Flow Mesurement Methods
Experiment E3 - Centrifugal Pump Performance
Experiment E4 - Drag & Lift Characteristics of an Airfoil
Experiment E5 - Drag and Pressure Distribution on a Cylinder

Laboratory Reports (30% of final grade)

1. All laboratory reports must be written on a word processor. Equations, calculations, graphs and figures must also be performed via appropriate software, e.g., MathCAD, AutoCAD, etc. Only rough sketches can be done freehand, but must be neat.

2. EXPERIMENTS E1, E2, E3 and E4 (30% of final grade)
   a. The written report for each of these experiments is due about 2 weeks after the experiment is completed. Late reports will be penalized 0.5 points per week out of a possible 10 total points.
   b. The written reports are to be concise (approximately 15/20 pages) and consist of the following:

LAB REPORTS (will be discussed more in detail)

i. **Abstruct, Theory, Summary of Procedure and Sample Calculations (35% of report grade)**
ii. **Data Tables and Results (15% of report grade)**
iii. **Graphs, Discussion of Results and conclusions (30% of report grade)**
iv. **Grammar, Spelling and overall appearance (20% of report grade)**

Each student must submit their own laboratory reports. A lab report submitted without lab attendance will not be accepted and without submitting lab reports you can't pass this course.

Grading Legend (tentative, may change depending on average final score)

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

NJIT ONLINE INFORMATION

If required, the instructor will discuss these requirements on the first day of the course and/or post on their Learning Management System (LMS). Please become familiar

- Canvas: https://canvas.njit.edu/
- Zoom: https://njit-edu.zoom.us/
- Online Proctoring: https://ist.njit.edu/online-course-exam-proctoring

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COURSE OUTLINE

WEEK	DATES	TOPICS	SECTIONS/ CHAPTERS	ASSIGNMENTS (will be posted on Canvas)
1		Introduction	Chapter 1	
2		Pressure/Hydrostatic Forces/Buoyancy	Chapter 2	
3		Elementary Fluid Dynamics – the Bernoulli Equation	Chapter 3	
4		Elementary Fluid Dynamics – the Bernoulli Equation	Chapter 3	
5		Lab E1 – Viscocity of Fluids		
6		Review (discussion) **Midterm Exam 1**	Chapters 1, 2 & 3 and Lab E1	
7		Lab E2 - Flow Measurement Methods Turbomachinery – The Centrifugal Pump	Chapter 11	
8		Lab E3 - Centrifugal Pump Performance Fluid Kinematics		
9		Fluid Kinematics Flow Over Immersed Bodies, Drag and Lift Forces	Chapters 4 & 9	
10		Lab E4 - Drag and Pressure Distribution on a Cylinder		
11		Review (discussion) **Midterm Exam 2**	Chapters 4, 9 & 11 and Labs E2 & E3	
12		Lab E5 - Drag & Lift Characteristics of an Airfoil Dimensional Analysis, Similitude and Modeling	Chapter 7	
13		Finite Control Volume Analysis -- Conservation of Mass/Conservation of Energy/Conservation of Momentum	Chapter 5	
14		Open Channel Flow + Review	Chapter 10	
15	**TBD**	**FINAL EXAM (Cumulative)**		