

## Course Syllabus

(NOTE: This is a preliminary draft of the course syllabus. The final version will be provided at the end of the first week of classes)

### 1. Course Information

ME 3340	Fluid Mechanics (~ 3hrs/week)	Fall Term 2023
Mondays and Wednesdays:	11:00 am - 12:15 pm	
Class Room Number:	To be confirmed xxxxxxxx	

### 2. Instructor & Grader Information

Instructor & Grader:	Dr.Louis SATYANARAYAN Ph.D.
Email :	xxxxxxxxxxxx
Office Room Number:	xxxxxxxxxxxx
Office Hours (by appointment):	Mondays: 3:00 – 4:00 PM Wednesdays: 11:00 AM – 12:00 AM

I am always available for short questions or concerns just after class.

If required you may also send an email to make an appointment or come directly to my office in the slots given above.

### 3. General Information

- Course Outline: An introduction to fluid mechanics

Topics include fluid statics, control-volume analysis, differential analysis, laminar flows, dimensional analysis, similitude, pipe flow, and external flow.

- BRING A CALCULATOR TO THE CLASS REGULARLY
- Classes will be a good mix of lectures, problem solving sessions, real-life examples and interesting discussions on the subject.
- The lectures will try to balance theoretical concepts and practical examples so that the students can appreciate both aspects.
- Many example problems will be presented during the lectures that show how to use effective problem-solving strategies in the analysis of fatigue
- Two case-studies will be included to help the students appreciate the problems faced by the industry and how a solution was arrived at.
- Repetition and practice are the best methods for developing the problem-solving skills that are a primary outcome of this course.

#### 4. Pre &/or CoRequisites

Pre-requisites:

- ME 2202 Dynamics of Rigid Bodies,
- MATH 2401 Calculus III (C or better), and
- MATH 2403 Differential Equations (C or better)

Co-requisites: ME 3322 Thermodynamics

#### 5. Syllabus/Topics covered

Chapter Number	Description
<b>1.Basic Concepts</b>	Definition and properties of Fluids, Introduction to fluid statics and kinematics, Pressure distribution in a fluid. Manometry. Force on plane and curved submerged surfaces. Buoyancy.
<b>2.Governing Equations of Fluid Motion</b>	Langragian and Eulerian description,
<b>3. Fluid flow fields:</b>	Velocity fields. Flow lines. Acceleration fields.
<b>4.Control-volume analysis:</b>	Reynolds transport theorem, mass, momentum and energy balance/ conservation equations,
<b>Quiz 1</b>	
<b>5. Local analysis: Kinematics</b>  <b>Inviscid Incompressible Flows</b>	The stream function. Derivation of continuity and Navier-Stokes equations, Euler's equation, Bernoulli's Equation, Simple viscous-flow solutions. Stream function and Velocity potential function, Circulation, Line vortex, Basic plane potential flows: Uniform stream; Source and Sink;
<b>6. Compressible Flows</b>	Speed of sound and Mach number, Basic equations for one dimensional flows, Isentropic relations, Normal-shock wave
<b>Quiz 2</b>	
<b>7. Dimensional Analysis</b>	Introduction to dimensional parameters, Buckingham pi theorem. Dimensionless groups, Non-dimensional parameter in fluid mechanics, Modeling and similitude.
<b>8. Pipe flow:</b>	Entry region. Fully developed flow. Laminar and turbulent flow. Colebrook formula. Minor losses.
<b>Quiz 3</b>	
<b>9. External flows:</b>	Laminar and turbulent boundary layers. Flow transition. Separation. Drag
<b>10. Flow Measurement Techniques</b>	Measurements Temperature, Pressure Measurements: Pressure transducers, pitot tube, Velocity/Discharge measurements: Orifice meter, Venturiemeter, Anemometer, Force Measurements: Strain gauges force balances, Flow Visualization:
<b>Final Exam</b>	

**6. Textbook:**

- Bruce R. Munson, Theodore H. Okiishi, Wade W. Huebsch, and Alric P. Rothmayer, Fundamentals of Fluid Mechanics, 7th Edition, John Wiley and Sons, 2013.

**7. Course Outcomes:**

Outcome 1: To develop a student's understanding of the basic principles of fluid mechanics.

1.1 The student will demonstrate an ability to recognize the type of fluid flow that is occurring in a particular physical system.

1.2 The student will demonstrate an ability to choose the appropriate fluid mechanical principles needed to analyze fluid-flow situations.

Outcome 2: To develop a student's skills in analyzing fluid flows through the proper use of modeling and the application of basic fluid-flow principles.

2.1 The student will demonstrate an ability to apply appropriate simplifying assumptions and basic fluid-flow principles to formulate a mathematical description of a simple fluid-flow system.

2.2 The student will demonstrate an ability to solve and analyze the mathematical equations for a simple fluidflow system.

Outcome 3: To provide the student with some specific knowledge regarding fluid-flow phenomena observed in mechanical engineering systems, such as flow in a pipe, boundary-layer flows, drag, etc.

3.1 The student will be able to recognize basic flow phenomena that are present in a typical engineering system.

3.2 The student will demonstrate knowledge of important practical results in common fluid flows and their physical implications.

**8. Correlation between Course Outcomes and Student Outcomes:**

ME3340 FLUID MECHANICS											
	Mechanical Engineering Student Outcomes										
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
Outcome 1.1	x				x						x
Outcome 1.2	x				x						x
Outcome 2.1	x				x						x
Outcome 2.2	x				x						x
Outcome 3.1	x				x						x
Outcome 3.2	x				x						x

**9. GWW School of Mechanical Engineering Student Outcomes:**

- a. an ability to apply knowledge of mathematics, science and engineering
- b. an ability to design and conduct experiments, as well as to analyze and interpret data
- c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- d. an ability to function on multidisciplinary teams
- e. an ability to identify, formulate, and solve engineering problems
- f. an understanding of professional and ethical responsibility
- g. an ability to communicate effectively
- h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- i. a recognition of the need for, and an ability to engage in life-long learning
- j. a knowledge of contemporary issues
- k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

**10. GT Academic Honor Code**

As usual the GT Academic Honor Code is followed for this class. Please check this link for clear information : <http://www.honor.gatech.edu/plugins/content/index.php?id=9>

**11. Canvas**

Your instructor uses CANVAS to send you messages and your results of homeworks and quizzes. You are supposed to check your ME3340 messages and announcements every day to make sure you don't miss anything. It is not guaranteed that the system will email you messages after being posted.

**12. GRADING****a. WEIGHT:**

- Quiz 1 : 20% (closed book, closed notes, will include Chapters 1-4, more info below)
- Quiz 2 : 20% (closed book, closed notes, will include Chapters 5-6, more info below)
- Quiz 3 : 20% (closed book, closed notes, will include Chapters 7-8, more info below)
- Final Exam: 25% (closed book, closed notes, All chapters from 1-10, more info below)
- Homework: 15% (each hw has the same weight, although some may take more time to solve than others)

You are however allowed to bring a calculator, a unit conversion sheet and also a cheat sheet maximum 2 sides of one A4-size sheet of paper, normal size letter type

**Note:** 1 cheat sheet can be made for each quiz and they can all be brought to the final exam (more precisely: 3 quizzes and one extra cheat sheet, i.e., 4 cheat sheets in total)

For each item or assignment, you will receive a numerical grade on canvas. These numbers must be interpreted as :

<b>90%-100%</b>	<b>:</b>	<b>A</b>
<b>80%-89.99%</b>	<b>:</b>	<b>B</b>
<b>70%-79.99%</b>	<b>:</b>	<b>C</b>
<b>60%-69.99%</b>	<b>:</b>	<b>D</b>
<b>below 60%</b>	<b>:</b>	<b>F</b>

Should canvas make any calculation for you, ignore it, because it does not count the above-mentioned weights for each task.

#### **b. GRADING OF HOMEWORK:**

- Homework is graded as follows: For each homework problem, you receive full marks when solved 100% correctly, 50% when solved incorrectly and 0% when not solved.
- They will all be graded on 100% and will therefore have an equal weight.
- You will receive 4 Homeworks (I will grade all the 4 HW but will take your 3 top performances)
- More precisely: Practically it means that I will ignore, for each student separately, his/her homework with the lowest marks.

#### **c. About Homeworks, Quizzes**

- All tasks will be submitted through CANVAS. The standard procedure is to upload pictures of your HW.
- A HW can be short or extensive, however each HW will have the same weight.
- A QUIZ will be turned in on paper when the exam is done.
- For homeworks you are allowed to work together and discuss with your colleagues, but you must turn in your own homework and not copy that of your colleagues or a solutions manual.

### **13. Course Expectations & Guidelines**

#### **a. BEHAVIOR IN CLASS :**

Class participation (being present, paying attention, asking questions if needed, ... ) is perfect. What is not OK is “noise”. Noise means that you disturb your teacher and also your colleague students who equally paid their tuition fees and have the right to follow my class. For urgent matters, you are excused to leave class briefly and then to return (bathroom, water fountain, something urgent, ...) – do it quietly please.

**b. Academic Integrity**

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit

<http://www.catalog.gatech.edu/policies/honor-code/> or

<http://www.catalog.gatech.edu/rules/18/>.

Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

**c. Attendance and/or Participation**

Attendance and participation in class is required. If you miss class for any reason, it is your responsibility to obtain the notes for that day from a fellow student. This includes any announcements, concerns, helpful hints, etc. given by the instructor to the class.

**d. Collaboration & Group Work**

- Discussions between students on homework problems outside of class and during in-class problem solving sessions is encouraged.
- However, quizzes and exams must be written and submitted by each student independently.
- Copying and/or cutting and pasting someone else's work and submitting it as your own is not permitted.

**e. Extensions, Late Assignments, & Re-Scheduled/Missed Exams**

- No credit will be given for the late submission of any course work.
- It is your responsibility to ensure that your work is submitted to Canvas by the appropriate time.
- Any work missed because of Institute-approved activities (e.g., field trips and athletic events) can be made up.

**14. Acknowledgements (for making the core of this syllabus):**

Sections 2-8 and 13 prepared by: Marc K. Smith with changes incorporated by Louis Satyanarayan

Sections 9-13 prepared by: N. Declercq with changes incorporated by Louis Satyanarayan