

ME 303 A2: Fluid Mechanics Fall 2020

Lead Instructor:

Professor Tommaso Ranzani
Department of Mechanical Engineering
730 Commonwealth Ave., EMA 210
Email: tranzani@bu.edu

Course schedule:

Lectures: Monday and Wednesday 2:30 – 4:15 PM (PHO 206).

I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

COVID 19 & BU Community Health Expectations:

Masks are required and face coverings must be worn over the mouth and nose at all times when in public spaces on campus, including classrooms. Students should be prepared to show proof that they are compliant with health attestations and testing in order to attend class. All students are expected to follow all university guidelines with respect to daily symptom checks, testing, social distancing, and mask wearing when they leave their dorm or home. For a detailed description of official BU policies regarding COVID, please visit: <http://www.bu.edu/dos/policies/lifebook/covid-19-policies-for-students/>

Each student participating to in class activities will be required to comply with the aforementioned COVID 19 & BU Community Health Expectations.

Instructional forms

Lectures will be uploaded on YouTube before class time. are on-line. You will be expected to have watched the videos before class starts. Class time will be devoted to discussion sections, graded quizzes, Q&A, and practice exercises.

Please note that attending class in person is not required. You are free to choose if you want to come to class in-person or not. These classes will be streamed via Zoom and recorded. You have the option to attend in-person, watch the real-time Zoom streaming from your home/dorm, or watch the Zoom recording at a later time (for students on a different time zone).

Please note that due to the limited COVID capacity of the room **the class will be divided in two groups**. You will be responsible for signing up every week to the day of your preference.

This is the sign-up sheet that you have to complete each week to be able to come to class. You need to login to your google account via BU credentials to be able to edit the Google Sheet.

To allow everyone to come to class once a week, you can register only for one of the two available days each week. If the day of the class there are still available spots on the sign-up sheet you can register for both Monday and Wednesday class.

https://docs.google.com/spreadsheets/d/16mfKE_TuwR1Q11GMbDC9r1OzZWV30YjSw7J3pbIh4jE/edit?usp=sharing

Alternatively, all classes will be streamed through zoom (see details on Blackboard)

Office hours: Wednesdays 12:00 – 1:00 PM via zoom (see Blackboard)

You need to register first on this sign-up sheet. For extra hours, please email tranzani@bu.edu

<https://docs.google.com/spreadsheets/d/13INW397U4Bz9P2RuIkV7HmwnqDF-2f1v3aLPTyv0/edit#gid=0>

GST: Allison Kaminski (allison9@bu.edu) Office Hours: TBD

Textbook: WileyPLUS: Fundamentals of Fluid Mechanics by Munson et al., Wiley 8th edition. **No need for hard copy neither e-book. Visit www.wileyplus.com/go/coursefinder Enter your course ID, 781021**
The price should be \$69 for WP access and e-text.

Google Forms: we will use Google Forms regularly to evaluate participation.

Course web page: Blackboard, WileyPLUS, Piazza (piazza.com/bu/fall2020/me303/home)

Prerequisites: ENG EK 301 or equivalent.

Course learning objectives:

This course is designed to teach fundamental concepts of fluid dynamics through a broad range of applications. Course learning objectives are:

- Develop the ability to describe a fluid qualitatively and quantitatively
- Develop the ability to analyze a fluid under static and kinetic conditions
- Develop insight into how fluids flow close to and far from boundaries
- Gain an appreciation for the value of using experimental methods to measure fluid properties and characterizing fluid flow/behavior through dimensional analysis and lab-based experiments
- Gain experience in writing technical reports on lab-based experiments
- Gain insight into the application of fluid mechanics to practical problems in a variety of disciplines, including aerospace, mechanical, and biomedical engineering

Policy on collaboration:

Collaboration is encouraged on homework and labs; however, students should turn in their own work in their own words. No collaboration is permitted on exams.

Grading:

Homework (7%):	Problem sets assigned roughly every week to be submitted through WileyPLUS
Lab reports (13%):	Two/Three laboratory exercises; must complete to pass the course
Midterms (46%):	Two closed-book exams; formula sheet will be provided, <u>no cheat sheet allowed.</u>
Final Exam (27%):	Closed book; formula sheet will be provided, <u>no cheat sheet allowed.</u>
Participation (7%):	Will be evaluated with regular quizzes

Homework:

Homework assignments will be announced in class and on the course webpage. Homework must be submitted through WileyPLUS.

- Due date and time will be specified on the assignment.
- Late homework will **not** be accepted.
- Policies on homework will be available for each assignment in WileyPLUS

Lab exercises:

There will be two lab exercises for this course. Both of them can be done without being on campus.

A dedicated GST, Sanika Barve (sdbarve@bu.edu) will coordinate this.

Lab reports will be done individually.

- Reports are limited to a **strict 4-page length limit**. *pages beyond 4 will not be graded*
- Fonts must be 11 pt or larger, margins must be 1" or larger. Using LaTeX is strongly recommended, online editors like Overleaf (<https://www.overleaf.com>) are encouraged. Plots and data analysis have to be done in Matlab.
- Students will not receive credit for turning in a laboratory report if they have not physically completed the laboratory exercise.
- Individual laboratory reports are due at 4 PM through Blackboard.
- Email submission is acceptable in cases of emergency; email both Prof. Ranzani and the GST.

- Late reports WILL NOT be accepted without prior approval from Prof. Ranzani. Points will be removed for late submissions.

Exams:

Each exam will take place over an entire class period. Each exam will cover a block of lectures as noted in the schedule. The Final Exam is cumulative.

- Missing an exam due to vacation is not excusable. Arrangements will be made on a case-by-case basis for documented emergencies or University conflicts.
- Students requiring additional time to complete examinations must supply proper documentation from the Office of Disability Services at **least 5 business days in advance** of an examination to the instructor so suitable arrangements can be made.
- All exams will be closed book tests, the only reference materials that you will be permitted to use will have been given to you.
- Exams will be done via Zoom; specific instructions will be provided beforehand.
- In cheating is suspected you may be asked to sustain an oral exam via Zoom.
- The final exam Date and location will be made available on the website

Demos:

Non-mandatory demos (two people max) will be proposed during the semester. If interested you should set up an appointment to discuss them in detail. I will grade them and give extra points on the midterm based on a two-pages report. **Only demos approved and discussed before by Prof Ranzani will be considered for extra points.**

Accommodations for Students with Documented Disabilities: If you are a student with a disability or believe you might have a disability that requires accommodations, requests for accommodations must be made in a timely fashion to Disability & Access Services, 25 Buick St, Suite 300, Boston, MA 02215; 617-353-3658 (Voice/TTY). Students seeking academic accommodations must submit appropriate medical documentation and comply with the established policies and procedures
<http://www.bu.edu/disability/accommodations/>

Each exam will take place over an entire class period. Each exam will cover a block of lectures as noted in the schedule. ***Boston University Academic Conduct Code:*** Honesty is a core value of Boston University. Any violations of BU academic honesty and integrity standards ***will be pursued*** through appropriate University channels. This includes, but is not limited to: cheating, plagiarism and misrepresentation. If you have any questions as to what constitutes an honor code violation, please ask. ***Ignorance is not an excuse for cheating.*** You may access the BU Academic Conduct Code at: <http://www.bu.edu/academics/policies/academic-conduct-code/>

Course Schedule:

The following is an approximate schedule for the course. The GST and I will work with you to schedule your labs. Lectures will be prerecorded and assigned before coming to class. Class time will be dedicated to discussion of the material presented in class, examples, and practice exercises.

Date	Topic	Reading	Class
Sep 2, 2020	Introduction (Definitions, Viscosity, Surface Tension)	1	1
Sep 9, 2020	Fluid statics I (Pressure, Manometry)	2.1-2.3	2
Sep 14, 2020	Fluid statics I (Manometry, Hydrostatics)	2.4-2.7	3
Sep 16, 2020	Fluid statics II (Buoyancy, Fluid in Rigid-Body motion)	2.8-2.12	4

Sep 21, 2020	Fluid dynamics I (The Bernoulli Equation)	3.1-3.2	5
Sep 23, 2020	Fluid dynamics I (The Bernoulli Equation)	3.3-3.4	6
	LAB I		
Sep 28, 2020	Fluid dynamics II (Examples of Use of the Bernoulli Equation)	3.4-3.6	7
Sep 30, 2020	Fluid kinematics (Reynolds Transport Theorem)	4.1-4.4	8
Oct 5, 2020	Control volume analysis I (Conservation of Mass)	5.1	9
Oct 7, 2020	Control volume analysis II (Linear Momentum)	5.2	10
Oct 13, 2020	Control volume analysis III (Energy Equation)	5.3	11
Oct 14, 2020	Midterm preparation exercises		12
Oct 19, 2020	I midterm (lect 1-12)		13
Oct 21, 2020	Differential Analysis (Kinematics)	6.1	14
Oct 26, 2020	Differential Analysis (Conservation of mass)	6.2	15
Oct 28, 2020	Differential Analysis (Inviscid Flow Equations of Motion)	6.3-6.4	16
Nov 2, 2020	Differential Analysis (Plane Potential Flows).	6.5-6.7	17
Nov 4, 2020	Differential Analysis (Plane Potential Flows).	6.5-6.7	18
Nov 9, 2020	Differential Analysis (Viscous Flow)	6.8-6.9	19
Nov 11, 2020	Differential Analysis (Viscous Flow)	6.8-6.9	20
Nov 16, 2020	Dimensional Analysis (Buckingham Pi Theorem)	7.0-7.7	21
Nov 18, 2020	Dimensional Analysis (Modeling and Similitude)	7.8-7.10	22
Nov 23, 2020	II midterm (lect 12-22)		23
	LAB II		
Nov 30, 2020	Viscous flow (Pipe flow, fully developed laminar flow)	8.1-8.2	24
Dec 2, 2020	Viscous flow (Fully developed Turbulent Flow)	8.3 - 8.5	25
Dec 7, 2020	Flow on immersed bodies (External Flow, boundary layer)	9.1, 9.2	26
Dec 9, 2020	Drag and Lift	9.3, 9.4	27
	Final exam (on lect. 1-27)		