ME 303 A1: FLUID MECHANICS FALL 2019

Boston University College of Engineering

Instructor:

Professor Keith A. Brown
Department of Mechanical Engineering
8 St. Mary's Street (PHO), Rm. 920
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Course schedule:

Lecture: Monday and Wednesday 10:10-11:55 (STH B19)
Office hours: Tuesdays 12:30 – 1:30 PM (Brown – PHO 920) or by appointment
Homework Help Sessions:

Review material and problems with GST Austin Thai (adthai@bu.edu)

Mon: 2:30pm-3:20pm	CAS 204B
Tue: 11:15am-12:05pm	EPC 203
Tue: 3:35pm-4:25pm	PSY B47

Labs: ENG 113B, time to be scheduled with GST Jason Lucas (jlucas@bu.edu)

Textbook:

Fundamentals of Fluid Mechanics by Munson et al., Wiley 8th edition

Course web page:

Blackboard for assignments, grades, and lab submission
Piazza.com for Q&A

Prerequisites:

ENG EK 301 or equivalent
CAS MA 226 or equivalent

Course learning objectives:

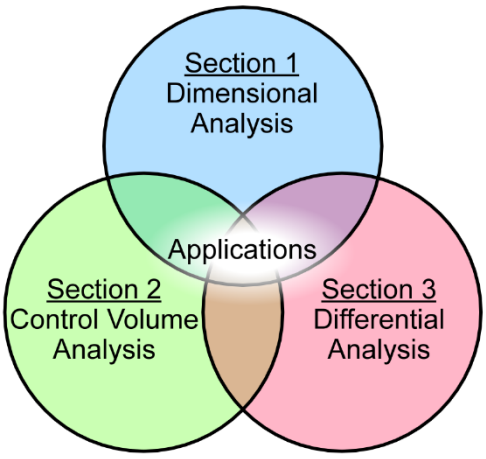
This course is designed to teach fundamental concepts of fluid dynamics through a broad range of applications. In particular, we will cover:

1) Dimensional analysis: the ability to explore a problem based upon the dimensions of the parameters. While this cannot provide exact answers, it is extremely useful for determining scaling relationships and identifying factors that can be ignored.

2) Control volume analysis: solving constitutive equations and conservation laws in integral form to understand the behavior of fluids.

3) Differential analysis: directly solving governing equations such as the Navier-Stokes equations as a means of understanding fluid behavior.

4) Applications of these problem solving approaches in disciplines including aerospace, mechanical, and biomedical engineering. A critical skill to be acquired is the ability to identify which analysis method is most appropriate for a given problem and justifying assumptions.



Grading:

Homework (20%):	2-3 problem sets per module
Lab reports (25%):	Three laboratory exercises (Lab 1 worth 5%, Labs 2 and 3 worth 10%)
Exams (45%):	Three closed-book exams; formula sheets will be provided
Analysis challenges (6%):	Results of analysis challenges, three in total
Participation (4%):	Based upon overall participation in class

Homework:

Homework assignments will be announced in class and on the course webpage. Homework can be passed in during class or at the ME front desk (110 Cummington Mall, Room 101).

- Due date and time will be specified on the assignment and will typically be Wednesday at 4 PM.
- Homework that is up to 24 hours late will be given half credit.
- Homework that is turned in 24 hours after the due date will be marked 0.

Lab exercises:

There will be three lab exercises for this course. For labs that take place in the lab room, digital sign-up sheets will be posted in advance of the labs. The exercises may be done in groups, but lab reports must be done individually.

- Reports are limited to a **strict page length**. *pages beyond the stated limit will not be graded*
- Fonts must be 11 pt or larger, margins must be 1" or larger
- Turning in a report without physically completing the lab exercises will result a deduction of 25% of the total score for the assignment.
- Lab reports must be turned in digitally through blackboard and students are responsible for making sure the file format is readable at the time of submission.
- Late reports will be marked down 10% for every hour that has passed since the deadline (rounded down).

Exams:

Each exam will take place over an entire class period. There will be three exams during the semester, each covering one module in a non-cumulative manner.

- 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 3 days in advance*** of an examination to the instructor so suitable arrangements can be made.

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.

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 a tentative schedule for the course

	Date		Topic	Reading
Dimensional Analysis	Week 1	9/4	Lec1: Overview of Fluid Properties	1
	Week 2	9/9	Lec2: Pressure and hydrostatics	2.1-6
		9/11	Lec3: Buoyancy and hydrostatic Forces	2.8-12
	Week 3	9/16	Lec4: Dimensional analysis	7.1-6
		9/18	Lec5: Internal flows [PS1 due]	8.4.1
		9/18	**Lab1 distributed – due 9/30**	
	Week 4	9/23	Lec6: External flows	9.1,3
		9/25	Lec7: Modeling and similitude [PS2 due]	7.0-7
	Week 5	9/30	Lec8: Review and analysis challenge 1	
		10/2	**EXAM 1: DIMENSIONAL ANALYSIS**	
Control Volumes	Week 6	10/7	Lec9: Introduction to control volumes	4.3-4
		10/9	Lec10: Conservation of mass	5.1
	Week 7	10/15	Lec11: Conservation of energy	5.3
		10/16	Lec12: Problem solving with the Bernoulli equations [PS3 due]	3.6
		10/17	**Lab2: exercises – due 10/28**	
	Week 8	10/21	Lec13: Conservation of momentum	5.2
		10/23	Lec14: Problem solving with control volumes [PS4 due]	
	Week 9	10/28	Lec15: Review and analysis challenge 2	
		10/30	**EXAM 2: CONTROL VOLUME ANALYSIS**	
Differential Analysis	Week 10	11/4	Lec16: Kinematics I	4.1
		11/6	Lec17: Kinematics II	4.2; 6.1
	Week 11	11/11	Lec18: Conservation of mass	6.2
		11/13	Lec19: The Navier-Stokes equations [PS5 due]	6.3,8
		11/13	**Lab3: distributed – due 12/6**	
	Week 12	11/18	Lec20: Unidirectional flow	6.9; 8.2
		11/20	Lec21: Inviscid flows [PS6 due]	6.4-5
	Week 13	11/25	Lec22: Lift and the Magnus effect	6.6-7; 9.4
	Week 14	12/2	Lec23: Boundary layers and D'Alembert's paradox	9.2
		12/4	Lec24: Turbulence [PS7 due]	8.3
	Week 15	12/9	Lec25: Review and analysis challenge 3	
		12/11	**EXAM 3: DIFFERENTIAL ANALYSIS**	