

# ME 320 – section 002, Winter 2016<sup>1</sup>

## Fluid Mechanics I (3 credits)

### Course objective

Fluid mechanics is a fundamental topic in mechanical engineering and many related areas. The objective of this course is to provide a qualitative and quantitative understanding of the physical mechanisms in fluid flow, in order to be able to analyze and predict flow fields of interest.

### Website

<https://canvas.umich.edu/gateway>

### Prerequisites

Math 215, MECHENG 235 and MECHENG 240.

### Lecture time/location

Mo/We 12:00-1:30pm 1017 Dow

### Instructor

Eric Johnsen, Assistant Professor of Mechanical Engineering

Office: 2015 Lay Auto Lab

Email: [ejohnsen@umich.edu](mailto:ejohnsen@umich.edu)

Phone: (734) 647-1450

Office hours: Mondays 1:30-3:00pm; Thursdays 2:30-4:00pm.

### GSI

Shahaboddin Alahyari Beig

Email: [alahyari@umich.edu](mailto:alahyari@umich.edu)

Office hours: Mondays 5-8pm (recitation 6-7pm, IOE 1680), Tuesdays 2-7pm (FLC room F), Fridays 4-6pm (recitation 4-5pm, DOW 1006).

### Recitation session

Mondays 6-7pm (IOE 1680) and Fridays 4-5pm (DOW 1006).

Recitation sessions are optional. The GSI will solve problems related to those assigned in the homework sets and answer any questions. The same problems will be solved on the Friday and Monday recitations. Note that there is an hour of office hours before and after the recitation on Mondays, and an hour of office hours after the recitation on Fridays.

---

<sup>1</sup>The syllabus and course policies are subject to change at any time and will be announced in class and by email.

## Textbook

The required textbook is *Fox & McDonald's Introduction to Fluid Mechanics*, by R. W. Fox, A. T. McDonald and P. J. Pritchard, Editor: J. Wiley & Sons 9th ed. 2015.

## Grading

Homework: 10 % (10 sets)

Online quizzes: 10 % (10 multiple choice, multiple attempts)

Midterm I: 25 % (Monday February 22, 6:30-7:50pm, FXB 1109)

Midterm II: 25 % (Wednesday March 30, 6:30-7:50pm, FXB 1109)

Final: 30 % (Thursday April 28, 10:30am-12:30pm, location TBD)

- Homework policy (due Wed)

The homeworks will be posted a week in advance and will be due at the beginning of lecture on Wednesdays. Problems will be graded on a scale of 0-2 (0: not completed; 1: mostly incorrect; 2: mostly/fully correct). Intellectual collaboration with current ME 320 students is allowed and encouraged; such discussions should be to the benefit of all parties involved. However, the actual written submission must be completed independently and must reflect your own understanding of the material. Other collaborations are not allowed. Written regrading requests will be accepted up to one week after homeworks are returned.

- Online quizzes policy (due Mon)

A total of 10 online quizzes will be posted a week in advance, to complement the material in each chapter. They will be due Mondays at 11:59pm. The quizzes will consist of up to five short multiple-choice questions, with as many attempts as needed to complete. Intellectual collaboration with current ME 320 students is allowed and encouraged; such discussions should be to the benefit of all parties involved. However, the actual written submission must be completed independently and must reflect your own understanding of the material.

- Exams policy

The midterm exams will take place in the evening; lecture on those days will be canceled. All exams will be comprehensive and will cover material up to the date of the exam, unless otherwise mentioned. The exams will be open book and a hand-written summary sheet will be permitted. Course notes, homework solutions and electronic devices will not be allowed. Written regrading requests will be accepted up to one week after exams are returned.

**Conflicts with the exam schedule must be reported by email no later than two weeks before the exam date.**

## Honor code

All class policies are governed by the CoE honor code. In summary, the honor code states that "No member of the UM community shall take unfair advantage of any other member of the UM community". For more information:

<http://www.engin.umich.edu/students/honorcode/brochure.pdf>

### Tentative course outline

Lec	Date	Read*	Topics	HW <sup>†</sup>
1	We Jan 6	Ch. 1, 2	Introduction	–
2	Mo Jan 11	Ch. 2	Fluid properties and flow regimes	
3	We Jan 13	Ch. 3	Hydrostatics: basic equation, manometry	0**
4	Mo Jan 18	Ch. 3	Hydrostatics: forces on surfaces, rigid-body motion	
5	We Jan 20	Ch. 2, 5	Kinematics: velocity and acceleration	1
6	Mo Jan 25	Ch. 2	Kinematics: Stream/streak/pathlines	
7	We Jan 27	Ch. 4	Integral analysis: control volumes, Reynolds Transport thm	2
8	Mo Feb 1	Ch. 4	Integral analysis: mass conservation	
9	We Feb 3	Ch. 4	Integral analysis: momentum conservation	3
10	Mo Feb 8	Ch. 4	Integral analysis: energy conservation, examples	
11	We Feb 10	Ch. 5	Differential analysis: fluid elements, mass conservation	4
12	Mo Feb 15	Ch. 5	Differential analysis: momentum conservation, examples	
13	We Feb 17	–	Midterm review	5
–	Mo Feb 22	–	<b>Midterm I</b> (6:30-7:50pm, FXB 1109)	
14	We Feb 24	Ch. 6	Bernoulli equation: derivation	–
–	Mo Feb 29	–	<b>Winter Recess</b> (no class)	
–	We Mar 2	–	<b>Winter Recess</b> (no class)	–
15	Mo Mar 7	Ch. 6	Bernoulli equation: examples	
16	We Mar 9	Ch. 7	Dimensional analysis	6**
17	Mo Mar 14	Ch. 7	Similitude and modeling	
18	We Mar 16	Ch. 6	Inviscid flow: potential flow theory	7
19	Mo Mar 21	Ch. 8	Viscous flow: Navier-Stokes equations	
20	We Mar 23	Ch. 8	Viscous flow: exact solutions	8
21	Mo Mar 28	–	Midterm review	
–	We Mar 30	–	<b>Midterm II</b> (6:30-7:50pm, location TBD)	9**
22	Mo Apr 4	Ch. 8	Internal flow: laminar flow	
23	We Apr 6	Ch. 9	Internal flow: turbulence, losses	10
24	Mo Apr 11	Ch. 9	External flow: boundary layers (integral)	
25	We Apr 13	Ch. 9	External flow: boundary layers (differential)	11
26	Mo Apr 18	–	Final review	12**
–	Th Apr 28		<b>Final exam</b> (10:30am-12:30pm, location TBD)	

All lectures take place at the regular location unless otherwise mentioned.

\* Readings are based on Fox & McDonald, 8th edition.

\*\* HW0, HW6, HW9 and HW11 will be assigned for self-study only. They will not be collected.

† Homeworks are due Wednesdays at the beginning of lecture.