ENGG*2230 Fluid Mechanics

Fall 2017

UNIVERSITY of GUELPH

School of Engineering

(Revision 0: September 7, 2017)

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1 INSTRUCTIONAL SUPPORT

1.1 Instructor

Instructor: Bill Van Heyst, Ph.D., P.Eng.
Office: THRN 1333, ext. 53665
Email: bvanheys@uoguelph.ca
Office hours: TBA on Courselink or by appointment

1.2 Lab Tech

Technologist: Ryan Smith
Office: THRN 1114, ext. 53278
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1.3 Teaching Assistants

GTA	e-mail	Office Hours
Etta Gunsolus	egunsolu@uoguelph.ca	TBA on CourseLink
Steph Shaw	stephanie.shaw@uoguelph.ca	TBA on CourseLink
Spencer Walls	swalls@uoguelph.ca	TBA on CourseLink
Rachel Walton	waltonr@uoguelph.ca	TBA on CourseLink

2 LEARNING RESOURCES

2.1 Course Website

Course material, news, announcements, and grades will be regularly posted to the ENGG*2230 CourseLink site. You are responsible for checking the site regularly.

2.2 Required Resources

White, F.M., 2015, *Fluid Mechanics*, 8th Edition, McGraw-Hill

2.3 Recommended Resources: Engineering Peer Helpers (Voluntary)

The peer helper program, staffed by upper year engineering students, offers regular workshops aimed at developing problem solving skills and new learning tools specific to core engineering courses such as Fluid Mechanics. For more information on the Peer Helper program, visit:

https://www.uoguelph.ca/engineering/content/current/peer-helper

2.4 Additional Resources

Lecture Information: Lectures will be presented through a combination of PowerPoint slides and Document Camera notes. The slides for the lectures will be posted on the course website (CourseLink). These slides are augmented with in-class examples. You are thus expected to take notes during class, which includes the examples and supplementary information the professor provides while lecturing.

Lab Manual: The lab manual is available on CourseLink. You are responsible for reviewing this and having an electronic or hard copy with you during your laboratory sessions. You must read the laboratory manual to prepare for each experiment prior to your scheduled laboratory.

Problem Sets: There will be **weekly unmarked** problem sets posted on CourseLink during the term. You are expected to complete each problem set on a timely basis. Most students find that practice problems are the best way to learn the course. The solutions will be posted on CourseLink approximately two weeks after the unmarked problem set is posted.

Tutorials: There will be 5 tutorials in which cooperative learning exercises will take place. During these tutorials, you will work in groups to solve problems on the white boards in the tutorial rooms. Peer and self evaluations on your problem analysis skills as well as instructor and GTA evaluations on the solution process will be used to determine an individual grade for the cooperative learning exercise. Your best **4 out of 5** grades will be considered for your final grade assessment. Please refer to Section 5.3.2 for a detailed schedule.

Miscellaneous Information: Other information related to Fluid Mechanics is also posted on CourseLink.

2.5 Communication and Email Policy

Please use lectures, labs, and seminar sessions as your main opportunity to ask questions about the course. It is your responsibility to check the course website regularly for announcements. Electronic communication should be limited to the course forum. However, topics of a personal and confidential

nature should be emailed to the instructor. Please note that all email communication must be made through your university email account (<username>@uoguelph.ca).

3 ASSESSMENT

Assessment of your final grade will be evaluated against four different assessment schemes as described in the table below with your **final grade assigned being the maximum calculated by the four schemes**. Schemes #2 and #4 allows students who performed poorly on the midterm to diminish the weight of the midterm by putting more weight on the final exam. Schemes #3 and #4 allows students to not participate in the Tutorial Cooperative Learning Exercises by assigning more weight to the final exam.

Unmarked Problem Sets: 0% (Weekly problem sets to be posted on CourseLink)

Labs: 20% (5 Labs)
See Section 5.3.2 below for the lab schedule and Section 5.3.3 for due dates. No grades will be issued to any group member who is not in attendance when the group completes the lab.

Tutorial Cooperative Learning Exercises: maximum of 10% (4 out of 5 exercises will be considered for the final grade assessment of this component). See Section 5.3.2 below for schedule of dates.

Midterm Exam*: maximum of 25%
Tuesday, October 17, 2017, during class (11:30 to 12:50)

Final Exam*: minimum of 45%
Wednesday, December 6, 2017, 11:30 to 13:30, room TBA

*The midterm and final exams will be closed book tests. Necessary equations and information will be provided or announced prior to each exam. Calculators are permitted, but they must be non-communicating devices.

If you fail (< 50%) both the midterm and the final, you will receive a failing grade in the course equal to the highest of your midterm or final assessment.

Assessment Unit	Scheme #1	Scheme #2	Scheme #3	Scheme #4
Assignments	0%	0%	0%	0%
Labs	20%	20%	20%	20%
Tutorial Cooperative Learning Exercises	10%	10%	0%	0%
Midterm Exam	25%	10%	25%	10%
Final Exam	45%	60%	55%	70%

3.1 Course Grading Policies

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Passing Grade: In order to pass the course, you must obtain a final grade of 50% or higher. If you fail (<50%) **both** the midterm and final exams, you will receive a failing grade in the course equivalent to your to the highest of your midterm or final assessment.

Mark Adjustments: If you have questions about any grade during the semester, you must inquire within one week of the mark being received or posted on CourseLink (whichever comes first).

Missed Midterm Exam: If you miss the midterm due to grounds for granting academic consideration or religious accommodation, the weight of the missed assessment will be added to the final exam. There will be no makeup midterm exam.

Lab Work: You must attend and complete all laboratories. If you miss a laboratory due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to complete a makeup lab (i.e. during open lab days).

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4 AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

4.1 Calendar Description

Analysis of steady ideal and viscous fluid flow systems using the Continuity, Bernoulli and Momentum equations. Boundary layer theory is treated in terms of viscous and pressure drag, lift and its importance in heat and mass transfer. Dimensional analysis and dynamic similitude are studied to provide an understanding of flow systems analysis and modeling. Introduction to pipe flow and open channel flow.

Prerequisite(s): ENGG*1210, MATH*1210

4.2 Course Aims

Engineers have been studying fluid mechanics for many 1000s of years. A deeper understanding of fluid motion opens the door to many applications and other fields of study, including energy, transportation, and environmental protection. The main goals of this course are (1) to teach the student the fundamental concepts and analytical techniques in classical fluid mechanics and (2) to prepare the student for future applications of these tools.

4.3 Learning Objectives

At the successful completion of this course, the student will have demonstrated the ability to:

1. Describe the physical and flow properties of fluids and their impact on engineered systems and structures.
2. Characterize and analyze fluid mechanics problems through the use of the appropriate tools, including conservation of mass, conservation of momentum, and the conservation of energy, and using the appropriate approaches, including integral (control volume), differential, or dimensional approaches.
3. Estimate head loss, required power, sizing, or flow rates in internal and open flow systems.
4. Estimate lift and drag forces on submerged bodies.
5. Model fluid engineering problems, with stated assumptions, and solve them systematically with clearly communicated solutions complete with correct accuracy, precision, significant digits, and dimensional homogeneity.
6. Use appropriate apparatus, sensors and instruments to collect data and analyze fluid flow by conducting laboratory and computational tests.
7. Write clear, concise and professional laboratory reports.
8. Demonstrate effective skills in teamwork during group activities (tutorials and biweekly laboratories) and respectful interactions with peers, lab technicians, graduate teaching assistants, and instructor during lectures, weekly seminars and biweekly laboratories.

4.4 Graduate Attributes

Successfully completing this course will contribute to the following CEAB Graduate Attributes:

Graduate Attribute	Learning Objectives	Assessment
1. Knowledge Base for Engineering	1, 2, 3, 4	Cooperative Learning, Labs, Exams
2. Problem Analysis	2, 5	Cooperative Learning, Labs, Exams
3. Investigation	6	Labs
4. Design	-	-
5. Use of Engineering Tools	6	Cooperative Learning, Labs
6. Communication	7	Cooperative Learning, Labs
7. Individual and Teamwork	8	Cooperative Learning, Labs
8. Professionalism	-	-
9. Impact of Engineering on Society and the Environment	-	-
10. Ethics and Equity	-	-
11. Environment, Society, Business, & Project Management	-	-
12. Life-Long Learning	-	-

4.5 Instructor's Role and Responsibility to Students

The instructor's role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on CourseLink but these are not intended to be stand-alone course notes. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes, seminars and labs will be the principal venue to provide information and feedback for tests and assignments.

4.6 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and seminars. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate. Each student is expected to make substantial effort to succeed in this course.

4.7 Relationships with other Courses & Labs

Previous Courses:

ENGG*1210: Mechanical system fundamentals such as force, torques, friction, moments, free body diagrams, equilibrium, centroids

MATH*1210: Limits, differentiation, integration, series expansion

Follow-on Courses:

ENGG*2660 & ENGG*3160: Fluid, energy flows in biological systems

ENGG*3180: Transport, diffusion, boundary layers in atmospheric air

ENGG*3260: Foundations of energy balances, thermal flow, thermal properties of fluids

ENGG*3370: Applications of fluid flow for power generation, refrigeration, propulsion, pumps, heating and cooling

ENGG*3430: Heat and mass transfer through fluid flow (convection), thermal fluid properties, heat exchangers

ENGG*3470: Mass transfer through fluid flows (convection), thermal fluid properties

ENGG*3590: Fluid mechanics in water treatment applications

ENGG*3650: Natural water movement, mass and energy flows

ENGG*3670: Soil/water interaction

ENGG*3830: Fluid mechanics in mixing and processing of biological products

5 TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Lectures:			
Tuesday		11:30 – 12:50	RICH 2520
Thursday		11:30 – 12:50	RICH 2520
Tutorials/Labs[1]:	Section #		
Tuesday	1	08:30 – 10:20	THRN 1002 / THRN 1125
Thursday	2	08:30 – 10:20	THRN 1002 / THRN 1125
Friday	3	09:30 – 11:20	THRN 1002 / THRN 1125
Friday	4	11:30 – 01:20	THRN 1002 / THRN 1125
Monday	5	11:30 – 01:20	THRN 1002 / THRN 1125
Friday	6	03:30 – 05:20	THRN 1002 (was MCKN 312) / THRN 1125

[1] For tutorials and labs, each section will be divided into an "A" and "B" group. Each of the A and B groups will alternate weekly between conducting a lab and having a tutorial cooperative learning exercise.

Students are responsible for all information presented in the class, tutorials, and labs and student participation is encouraged. The dynamics of each learning activity should be based on professionalism and mutual respect. Cell phones are to be turned off during the class, ear buds are to be put away, and the use of laptops and tablets in class is restricted to taking class notes. Everyone in the classroom has the right to participate and contribute.

5.2 Lecture Schedule

Week	Lecture Topics	References	Learning Objectives
1	Fluids and fluid properties	Chapter 1	1, 5
2-4	Fluid statics and pressure distribution	Chapter 2	1
4-5	Fluid flow concepts: control volumes	Chapter 3	1, 2
6	Midterm Exam	Chapters 1-3	1, 2, 5
7	Fluid flow concepts: differential analysis	Chapters 4	1, 2
7-8	Dimensional analysis	Chapter 5	1, 2
8-9	Internal viscous flow (pipe flow)	Chapter 6	1, 3
10	External flow and boundary layer theory	Chapter 7	1, 4
11	Pumps and turbomachinery	Chapter 11	1, 2
12	Open channel flow	Chapter 10	1, 3

5.3 Lab and Tutorial Schedules

The labs and tutorials will be conducted in alternating weeks during the same two-hour time blocks (Labs in THRN 1125 and tutorials in THRN 1002). **Everyone must attend your scheduled lab during the week of September 11 – 15, 2017 (THRN 1125).** During this lab time, students will be familiarized with the Fluids Lab and the required safety procedures. In addition, the sections will be

divided into two groups of students of approximately equal size (designated as “A” and “B” groups). This A and B group designation will indicate which weeks you have a lab and which weeks you have a tutorial as per the schedule given below. Also during the first lab meeting, you will be able to sign up with your lab teams. Labs will be done in teams of three students during your scheduled lab time. There will also be sign-up sheets posted on the wall outside of the Fluids Lab (THRN 1125).

For labs, each student must have read and understood the corresponding information in the lab manual (available on CourseLink) and must have watched the corresponding video (also available on CourseLink). You are expected to do the intermediate calculations and, in some cases, all of the calculations before leaving the lab.

5.3.1 Tutorials and Labs

During the course of the term, there will be five tutorial cooperative learning exercises and five lab experiments. In addition, the first full week of the semester will be used for lab orientation and group/team assignment. The topics covered in the tutorials will closely following the weekly assignments and the topics for the labs are given below.

Lab #	Topic
0	Intro to the Fluids Lab, lab safety and group/team assignment
1	Flow measurement
2	Impact of a jet
3	Pipe friction
4	Minor losses
5	Discharge over weirs

5.3.2 Lab Schedule

	Monday	Tuesday	Thursday	Friday
Sept. 11-15	**Section 05** Groups A&B – THRN 1125: Intro to the Fluids Lab	**Section 01** Groups A&B – THRN 1125: Intro to the Fluids Lab	**Sections 02** Groups A&B – THRN 1125: Intro to the Fluids Lab	**Sections 03, 04 & 06** Groups A&B – THRN 1125: Intro to the Fluids Lab
Sept. 18-22	**Section 05** Group A – Lab #1 Group B – Tut #1	**Section 01** Group A – Lab #1 Group B – Tut #1	**Sections 02** Group A – Lab #1 Group B – Tut #1	**Sections 03, 04 & 06** Group A – Lab #1 Group B – Tut #1
Sept. 25-29	**Section 05** Group A – Tut #1 Group B – Lab #1	**Section 01** Group A – Tut #1 Group B – Lab #1	**Sections 02** Group A – Tut #1 Group B – Lab #1	**Sections 03, 04 & 06** Group A – Tut #1 Group B – Lab #1
Oct. 2-6	**Section 05** Group A – Lab #2 Group B – Tut #2	**Section 01** Group A – Lab #2 Group B – Tut #2	**Sections 02** Group A – Lab #2 Group B – Tut #2	**Sections 03, 04 & 06** Group A – Lab #2 Group B – Tut #2
Oct. 09-13	**Section 05** Thanksgiving – No Classes	**Section 01** Fall Study Break – No Classes	**Sections 02** Group A – Tut #2 Group B – Lab #2	**Sections 03, 04 & 06** Group A – Tut #2 Group B – Lab #2
Oct. 16-20	**Section 05** Group A – Tut #2 Group B – Lab #2	**Section 01** Group A – Tut #2 Group B – Lab #2	**Sections 02** Group A – Lab #3 Group B – Tut #3	**Sections 03, 04 & 06** Group A – Lab #3 Group B – Tut #3
Oct. 23-27	**Section 05** Group A – Lab #3 Group B – Tut #3	**Section 01** Group A – Lab #3 Group B – Tut #3	**Sections 02** Group A – Tut #3 Group B – Lab #3	**Sections 03, 04 & 06** Group A – Tut #3 Group B – Lab #3
Oct. 30 – Nov. 3	**Section 05** Group A – Tut #3 Group B – Lab #3	**Section 01** Group A – Tut #3 Group B – Lab #3	**Sections 02** Group A – Lab #4 Group B – Tut #4	**Sections 03, 04 & 06** Group A – Lab #4 Group B – Tut #4
Nov. 6 - 10	**Section 05** Group A – Lab #4 Group B – Tut #4	**Section 01** Group A – Lab #4 Group B – Tut #4	**Sections 02** Group A – Tut #4 Group B – Lab #4	**Sections 03, 04 & 06** Group A – Tut #4 Group B – Lab #4
Nov. 13 - 17	**Section 05** Group A – Tut #4 Group B – Lab #4	**Section 01** Group A – Tut #4 Group B – Lab #4	**Sections 02** Group A – Lab #5 Group B – Tut #5	**Sections 03, 04 & 06** Group A – Lab #5 Group B – Tut #5
Nov. 20-24	**Section 05** Group A – Lab #5 Group B – Tut #5	**Section 01** Group A – Lab #5 Group B – Tut #5	**Sections 02** Group A – Tut #5 Group B – Lab #5	**Sections 03, 04 & 06** Group A – Tut #5 Group B – Lab #5
Nov. 27 – Dec. 1	**Section 05** Group A – Tut #5 Group B – Lab #5	**Section 01** Group A – Tut #5 Group B – Lab #5	**Open lab day for makeup labs**	**Open lab day for makeup labs**

Note: It is critical that you sign up in a slot during your scheduled lab time.

5.3.3 Lab Report Submissions

The lab reports are to be submitted electronically in drop boxes in CourseLink that will be created based on your lab teams. The due date will be one week after you perform the laboratory at 11:59 pm.

Each lab report is to include a scanned version of the raw data sheet used to record the data while doing the experiment. This sheet is to be signed and dated by either the lab technician or the GTA before you leave the lab.

Each group must submit a single electronic report for each experiment. The report is to be no longer than 10 pages, which includes the title page and signed data sheet. (That is, one page for the title page, one page for the signed data sheet and up to 8 pages for the rest of the work.) Additional report information is in the laboratory manual.

If you miss a laboratory **due to grounds for granting academic consideration** or **religious accommodation**, arrangements must be made with the teaching assistant to complete a makeup lab during open lab days.

5.4 Other Important Dates

Thursday, September 8, 2016: First class
Monday, October 10, 2016: Thanksgiving holiday – no classes
Tuesday, October 11, 2016: Fall Study Break – no classes
Friday, November 04, 2016: drop date – 40th class
Friday, December 02, 2016: last class (Monday Schedule in effect)

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6 LAB SAFETY

6.1 SOE

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

If the laboratory rules are not followed, consequences will include removing access to the lab. If this results in lab work not being completed, the student will receive a grade of 0.

6.2 Fluid Mechanics Lab

You must familiarize yourself with the lab equipment by reading the manual and watching the accompanying video prior to your lab, in addition to attending the safety orientation during the first lab session (week 1). There is to be no food or drinks from outside in the Fluids Lab. Pay especial attention to the labs rules for appropriate attire.

7 ACADEMIC MISCONDUCT

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community faculty, staff, and students to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member.

7.1 Resources

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:
http://www.academicintegrity.uoguelph.ca/

Please also review the section on Academic Misconduct in your Engineering Program Guide.

The School of Engineering has adopted a Code of Ethics that can be found at:
http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

8 ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact Student Accessibility Services as soon as possible.

For more information, contact SAS at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.uoguelph.ca/csd/

9 RECORDING OF MATERIALS

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, classmate or guest lecturer.

Material recorded with permission is restricted to use for that course unless further permission is granted.

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10 RESOURCES

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs: http://www.uoguelph.ca/registrar/calendars/index.cfm?index