ENGG*2230 Fluid Mechanics
Winter 2015

UNIVERSITY of GUELPH

School of Engineering

(Revision 0: January 5, 2015)

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1 INSTRUCTIONAL SUPPORT

1.1 Instructor

Instructor: Jana Levison, PhD, EIT
Office: RICH 3505, ext. 58327
Email: jlevison@uoguelph.ca
Office hours: Tuesdays from 2:00 pm to 3:00 pm or by appointment

1.2 Lab Managers

Technologist: Barry Verspagen
Office: THRN 1138, ext. 58821
Email: baverspa@uoguelph.ca

1.3 Teaching Assistants

GTA	Email	Office Hours	Primary Role
Ellen Hachborn	ehachbor@uoguelph.ca	TBA on CourseLink	Seminars
Andrew Kozyn	akozyn@uoguelph.ca	TBA on CourseLink	Seminars / CFD assignment
Nishant Mistry	nmistry@uoguelph.ca	TBA on CourseLink	Laboratories
Shoaib Saleem	saleems@uoguelph.ca	TBA on CourseLink	Laboratories

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

1. F.M. White *Fluid Mechanics* 7th Edition McGraw-Hill, 2011

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. Your peer helpers for Fluid Mechanics are Shreya Ghose, Samantha (Sam) Mehltretter and Caryn Vowles**.**

The Fluid Mechanics Focused Engineering Problem Solving (FEPS) sessions will be run in **THRN (room TBD)**. The day(s) and times will be announced in class. Contact engpeers@uoguelph.ca or http://www.uoguelph.ca/engineering/peer_helper for more information.

2.4 Additional Resources

Lecture Information: Basic 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. It is beneficial to print the slides in order to write your class notes directly on them.

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

Assignments: There will be **11 unmarked** assignments posted on CourseLink during the term. You are expected to complete each assignment on a timely (i.e., weekly) 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 assignment is posted. Additionally, there will be **2 marked** assignments that will be posted on CourseLink (see dates below).

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>@mail.uoguelph.ca).

3 ASSESSMENT

Unmarked Assignments: 0% (11 assignments to be posted weekly on CourseLink)

Marked Assignments: 5% (2 assignments)
See Section 5.3 below for dates and information.

Labs: 20% (5 Labs)
See Section 5.4 below for due dates. No grades will be issued to any group member who is not in attendance when the group completes the lab.

Midterm Exam*: 25% (Closed book; covers material up to last lecture prior to exam)
Tuesday, February 24, 2015, during class

CFD Assignment: 5%
See Section 5.5 for due dates.

Final Exam*: 45% (Closed book; covers entire course)
Thursday, April 16, 2015, 8:30-10:30 am, 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.

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 and only the exams will be used to calculate your final mark. That is, your final mark will be the average of your midterm and final exam marks.

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 week).

Late Lab Reports/CFD Assignment: Late submissions of lab reports and the CFD assignment will be penalized by 50% per day late.

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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 for the biweekly fluid mechanics labs and CFD assignment.
8. Demonstrate effective skills in teamwork during group activities (seminars, biweekly laboratories and CFD assignment) 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	Assignments, Labs, Exams
2. Problem Analysis	2, 5	Assignments, Labs, Exams
3. Investigation	6	Labs
4. Design	-	-
5. Use of Engineering Tools	6	Labs
6. Communication	7	Labs
7. Individual and Teamwork	8	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

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5 TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Lectures:			
Tuesday		16:00 – 17:20	RICH 2520
Thursday		16:00 – 17:20	RICH 2520
Seminars:			
Monday	#1	9:30 – 10:20	MCKN 238
Monday	#2	13:30 – 14:20	MINS 017
Tuesday	#3	10:30 – 11:20	MCKN 236
Thursday	#4	08:30 – 09:20	MCKN 233
Laboratory:			
Monday	#1	15:30 – 17:20	THRN 1125
Wednesday	#2	11:30 – 13:20	THRN 1125
Wednesday	#3	15:30 – 17:20	THRN 1125

Friday #4 14:30 – 16:20 THRN 1125

Students are responsible for all information presented in the class, seminars, 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
6-7	Fluid flow concepts: differential analysis	Chapter 4	1, 2
7	*Midterm Exam*	Chapters 1-5	1, 2, 5
7-8	Dimensional analysis	Chapter 5	1, 2
8	Intro to CFD	Chapter 8	1, 2, 5
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 Marked Assignment Schedule

Two marked assignments will be done throughout the semester. The intent of the marked assignments is to test your knowledge to date and to ensure that you are also keeping up to date with your weekly unmarked assignments (completing the unmarked assignments first will help you with the marked ones). You will access and the marked assignments on CourseLink. The marked assignments are due in the course assignment box **(**#17), located outside of the Machine Shop (THRN 1025) at 5:00 pm on the dates below. Additional details will be provided in class or on CourseLink.

Marked Assignment #1: Available online: Mon., Feb. 2, 2015. Due: Mon., Feb. 9, 2015.

Marked Assignment #2: Available online: Mon., Mar. 16, 2015. Due: Mon., Mar. 23, 2015.

5.4 Lab Schedule

The laboratory is a vital part of the course – material introduced in the lab may be a part of either exam. Labs will be done in groups of 3 students during your scheduled lab time.

You must attend your scheduled lab in week 1 (January 5 to 9). At that time you will be introduced to the lab, including lab safety, and you will sign up for your lab groups. There are sign-up sheets posted on

the wall outside of the Fluids Lab (THRN 1125). **It is critical that you sign up in a slot during your scheduled lab time.** Pick your lab group wisely, because you will work with the same lab group during the whole semester. If you sign up for "Section 1" you will always conduct your lab during the first week the experiment is offered, and if you sign up for "Section 2" you will always do it during the second week it is offered.

Before arriving to the laboratory to perform an experiment, **each person 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.

Week	Topic	Due*
1	Intro to the fluids lab and lab safety	-
2	Flow measurement (Section 1)	Week 3
3	Flow measurement (Section 2)	Week 4
4	Impact of a jet (Section 1)	Week 5
5	Impact of a jet (Section 2)	Week 6
6	Pipe friction (Section 1)	Week 7
-	*Winter break*	-
7	Pipe friction (Section 2)	Week 8
8	Minor losses (Section 1)	Week 9
9	Minor losses (Section 2)	Week 10
10	Discharge over weirs (Section 1)	Week 11
11	Discharge over weirs (Section 2)	Week 12
12	Open lab week**	Week 13

*The lab reports are due in the course assignment box **(**#17), located outside of the Machine Shop (THRN 1025) at 5:00 pm one week after you perform the laboratory.

Each lab report is to include 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 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 week. Labs will only be offered on Monday and Wednesday that week, because Friday, April 3, 2015 is a holiday.

5.5 Seminar Schedule

Your weekly seminars (starting in week 1) will cover background material and problem sets not covered in lectures. In most of the seminars, you will work on activities or the GTA will present concepts and tips related to the week's material and the course assignments.

During week 9 (March 9-13) you will work on a Computational Fluid Dynamics (CFD) assignment during your scheduled seminar slot (in pairs). Instead of attending your regular seminar room, meet the GTA in **THRN 1319 at your scheduled seminar time, except students in the Monday 1:30 pm seminar – you go to THRN 1313.** The CFD assignment is due by 5:00 pm one week after your scheduled seminar time. Use the assignment submission box (number provided in class) outside of the Machine Shop (THRN 1025).

Week	Topic
1	Activity 1: Tutorial Introduction
2	Activity 2: Fluid Properties
3	Activity 3: Fluid Statics
4	Activity 4: Buoyancy
5	Activity 5: Conservation of Momentum
6	Activity 6: Bernoulli Equation / Conservation of Energy
-	*Winter break*
7	Open tutorial session (work on unmarked assignments)
8	Activity 7: Dimensional Analysis
9	CFD Project – Go to **THRN 1319, except Monday 1:30 pm seminar –** go to **THRN 1313.**
10	Activity 8: Pipe Flow
11	Activity 9: External Flow
12	Final Exam Prep – Open Tutorial Time

5.6 Other Important Dates

Monday, January 5, 2015: First day of class
Monday, February 16 – Friday, February 20, 2015: Winter Break (no classes)
Friday, March 6, 2015: drop date – 40th class
Thursday, April 2, 2015: last day of class
Friday, April 3, 2015: holiday

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.

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