ENGG*2230 Fluid Mechanics
Fall 2013

UNIVERSITY of GUELPH

School of Engineering

(Revision 0: September 5, 2013)

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1 INSTRUCTIONAL SUPPORT

1.1 Instructor

Instructor: Jonathan VanderSteen, Ph.D., P.Eng.
Office: THRN 2333, ext. 52040
Email: vandersj@uoguelph.ca
Office hours: Monday 4:30-5:30 (THRN 1425) or by appointment

1.2 Lab Technician

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

Technician: Ryan Smith
Office: THRN 1114, ext. 53278
Email: rsmith17@uoguelph.ca

1.3 Teaching Assistants

GTA	Email	Office Hours	Assignment
Ehsan Behazin	ebehazin@uoguelph.ca	TBA on Courselink	Seminars 1
David Hufnagel	dhufnage@uoguelph.ca	Tues 1:30-2:30, THRN 1427	Seminars 2
Graeme MacDonald	gmacdo03@uoguelph.ca	Thurs 5:30-6:30, THRN 1425	Lab 1
Andre Trudell	atrudell@uoguelph.ca	TBA on Courselink	CFD Project
Shaghayegh Vafaei	svafaei@uoguelph.ca	Tues 12:30-1:30, THRN 1427	Lab 2

2 LEARNING RESOURCES

2.1 Course Website

Course material, news, announcements, and grades will be regularly posted to the ENGG*2230 Courselink site: http://courselink.uoguelph.ca. 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, Daniel Morrant-Rolston, and Kevin Lees.

The Fluid Mechanics Focused Engineering Problem Solving (FEPS) sessions will be run in THRN 1427 every week on Mondays (4:30-5:30) and Tuesday (5:30-6:30).

Contact engpeers@uoguelph.ca or http://www.uoguelph.ca/engineering/peer_helper for more information.

2.4 Additional Resources

Lecture Information: Notes to accompany lectures will be posted on the course website (Courselink) throughout the semester.

Lab Manual: The lab manual is available on Courselink. You are responsible for printing this and having it with you during the laboratory exercises.

Assignments: There will be approximately 10 assignments posted in Courselink during the term. These assignments are not marked, but it is recommended that you do each assignment, as practice problems are the best way to learn the course. In addition, in-tutorial quizzes will be based closely on assignments. All the solutions will be posted.

Miscellaneous Information: Other information related to Fluid Mechanics is also posted on the web page.

2.5 Communication and Email Policy

Please use lectures, labs, and tutorial sessions as your main opportunity to ask questions about the course. 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

3.1 Dates and Distribution

Assignments: 0% (Approximately 10 assignments)

Quizzes*: 10% (2 In-seminar quizzes)
See Section 5.3 below for quiz dates. Quizzes must be written in assigned seminar room.

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

Midterm*: 25% (Closed book, Covers material up to last lecture prior to exam)
Thursday, Oct 24, In-class.

Project: 0% (In-seminar project must be satisfactorily completed for course credit – pass/fail)
See Section 5.5 for due dates.

Bonus Project: 5% Bonus (This bonus will result in final exam being worth 40% of final grade.)
Due by midnight, November 28.

Final Exam*: 45% (Or 40% if bonus project is completed.) Closed book, Covers entire course.
Wednesday, Dec 4, 8:30-10:30 am, Room TBA

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

3.2 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

Mark Adjustments: If you have questions about any grade, please inquire within one week of the mark being received. Re-marking requests will not be honoured more than one week after the document has been returned.

Passing Grade: In order to pass the course, you must obtain a final grade of 50% or higher.

Must pass Midterm or Final: 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.

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

Lab Work: You must attend and complete all assigned 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.

Late Lab Reports: Late submissions of lab reports 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

The motion of fluids has always delighted, inspired and, at times, frightened us. And like the artist, the engineer has been studying fluid mechanics for many 1000s of years. A deeper understanding of this 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. Differentiate fluids from other forms of matter; articulate the properties that distinguish fluids
2. Recognize the various types of fluid flow problems encountered in practice; characterize various fluid flow patterns and regimes
3. Communicate engineering calculations with correct accuracy, precision, significant digits, and dimensional homogeneity
4. Demonstrate knowledge of technical problem solving skills
5. Model engineering problems, with stated assumptions, and solve them systematically using the most appropriate tools
6. Properly apply integral and differential methods to fluid systems when applying mass, momentum, and energy conservation

7. Apply principals of dimensional analysis; interpret the meaning of fundamental non-dimensional parameters, especially the Reynolds number
8. Estimate head loss and power requirements in piping systems through the application of the most appropriate fluid models
9. Estimate the lift and drag on bodies using the boundary layer theory and other appropriate tools
10. Conduct fluid flow laboratory tests through collecting and analyzing data using the appropriate sensors and instruments
11. Write clear, concise and professional laboratory reports
12. Demonstrate effective skills in teamwork during group activities; demonstrate respectful interactions with peers, lab technician, teaching assistants, and instructor

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

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/D2L 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 will be the principal venue to provide information and feedback for tests and project.

4.6 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures, labs, and tutorials. 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.

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		4:00 – 5:20	MAC 149
Thursday		4:00 – 5:20	MAC 149
Seminars:			
Tuesday	Sec 1	12:30 – 1:20	MACK 230
Wednesday	Sec 2	1:30 – 2:20	ROZ 105
Thursday	Sec 3	11:30 – 12:20	ALEX 259
Friday	Sec 4	1:30 – 2:20	MACK 231
Laboratory:			
Tuesday	Sec 01	1:30 – 3:20	THRN 1125
Thursday	Sec 02	1:30 – 3:20	THRN 1125
Friday	Sec 03	11:30 – 1:20	THRN 1125
Friday	Sec 04	2:30 – 4:20	THRN 1125

Students are responsible for all information presented in the class, seminars, and labs and student participation is highly 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 must 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. If there is anything that may prevent your full contribution, let the instructor know as soon as possible. The learning environment must be free from harassment.

5.2 Lecture Schedule and Details

Week	Lecture Topics	References	Learning Objectives
1	Fluids and Fluid Properties	Chapter 1	1, 2, 3, 4, 5
2-3	Fluid Statics and Pressure Distribution	Chapter 2	2, 3, 4, 5
4	Fluid Flow Concepts: Control Volumes	Chapter 3	6
5	Fluid Flow Concepts: Differential Analysis	Chapter 4	6
6	Dimensional Analysis	Chapter 5	7
7-8	Internal Viscous Flow (Pipe Flow)	Chapter 6	5, 8
9	Pumps and Turbomachinery	Chapter 6, 11	5, 8
10-11	External Flow and Boundary Layer Theory	Chapter 7, 8	5, 9
12	Open Channel Flow	Chapter 10	2, 5

5.3 Seminar Schedule and Details

The seminar will cover background material and problem sets not covered in lectures. In most of the seminars, the GTA will present concepts and tips related to the week's material and the course assignments. In 2 of the seminars there will be an in-tutorial quiz that will be made up entirely of past assignment questions. It is essential that you attend your scheduled seminar.

Week	Topic
1 (Sept 9-13)	Seminar – Fluid Properties
2 (Sept 16-20)	Seminar – Fluid Statics
3 (Sept 23-27)	Quiz 1
4 (Sept 30- Oct 4)	Seminar – Control Volume Analysis
5 (Oct 7-11)	Seminar – Differential Analysis
6 (Oct 15-18)	Seminar – Dimensional Analysis
7 (Oct 21-25)	Seminar – Pipe Flow
8 (Oct 28- Nov 1)	Seminar – Pumps
9 (Nov 4-8)	Quiz 2
10 (Nov 11-15)	CFD Project – Go to THRN 2313 (Tues, Thurs) or THRN 1313 (Wed, Fri)
11 (Nov 18-22)	Seminar – External Flow
12 (Nov 25-28)	No Seminar

5.4 Lab Schedule and Details

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 times.

The first lab begins on September 10, so it is critical that you sign up for your lab groups as soon as possible and no later than 5:00pm on Friday, September 6. 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, as you will work with the same lab group during the whole semester.

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 (Sept 9-13)	Flow Measurement (Group 1)	Week 2
2 (Sept 16-20)	Flow Measurement (Group 2)	Week 3
3 (Sept 23-27)	Impact of a Jet (Group 1)	Week 4
4 (Sept 30- Oct 4)	Impact of a Jet (Group 2)	Week 5
5 (Oct 7-11)	Pipe Friction (Group 1)	Week 6

6 (Oct 15-18)	Pipe Friction (Group 2)	Week 7
7 (Oct 21-25)	Minor Losses (Group 1)	Week 8
8 (Oct 28- Nov 1)	Minor Losses (Group 2)	Week 9
9 (Nov 4-8)	Discharge over Weirs (Group 1)	Week 10
10 (Nov 11-15)	Discharge over Weirs (Group 2)	Week 11
11 (Nov 18-22)	Open Lab Week	

*The lab reports are due in the course assignment box (#3), located outside of the Machine Shop (THRN 1025) at 5:00pm 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 is to submit a single report for each experiment. It is to be no longer than 10 pages, which includes the titles page and signed data sheet. (One page for the title page, one page for the signed data sheet and up to 8 pages for the rest of the work.)

5.5 Other Important Dates

The Computational Fluid Dynamics project is designed to be completed during the seminar, but if you want more time, you have until midnight, the day of your seminar. The project will be done in groups of 2 but each partner must submit their own report.

The Bonus CFD project is due by midnight on November 28. More details will be posted on Courselink.

October 31 is the 40th day of class – the last day to drop a class.

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6 LAB SAFETY

6.1 SOE Statement

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.

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. 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 the Centre for Students with Disabilities as soon as possible

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