ENGG*2230 Fluid Mechanics
Fall 2014

UNIVERSITY of GUELPH

School of Engineering

(Revision 0: September 4, 2014)

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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 6:30-7:30 (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	Assignment
Ehsan Behazin	ebehazin@uoguelph.ca	Tutorial 2 and 3
James Harnum	jharnum@uoguelph.ca	Lab 1-4
Vidya Koripella	kvidya@uoguelph.ca	Lab 5-8
Graeme MacDonald	gmacdo03@uoguelph.ca	Tutorial 4 and 6
Andre Trudell	atrudell@uoguelph.ca	Tutorial 1 and 5

TA Office Hours are held in THRN 1425 on Tuesday (5:30-6:30) and on Wednesday (5:30-6:30).

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.

   An electronic version of this book can be rented at http://www.coursesmart.com

   A copy of this book is on reserve at the library.

2. iClicker

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 and Kaela Shea.

The Fluid Mechanics Focused Engineering Problem Solving (FEPS) sessions will be run in THRN 1427 every week on Mondays (6:30-7:30) and Tuesday (4:30-5:30).

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. It is recommended that you come to the lectures with the printed notes.

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 5 marked assignments posted in Courselink during the term. There will also be a number of recommended, unmarked assigned questions. It is recommended that you do as many practice problems as possible as this is the only way to master the course material. All the solutions will be posted.

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

2.5 Communication and Email Policy

Please use lectures, tutorial, and lab sessions as your main opportunity to ask questions about the course. Major announcements will be posted to the course website. **It is your responsibility to check the course website regularly.** Electronic communication should be limited to the course forum, however, topics of a personal and confidential nature should be emailed to the instructor. As per university regulations, all

students are required to check their <mail.uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

3 ASSESSMENT

3.1 Dates and Distribution

Assignments: 10% (Five assignments)
(Due: Sept 24, Oct 8, 29, Nov 12, 26 at 10:00pm in Courselink)

Clicker Quizzes*: 5% (In-class, best 5 out of 6)
(Dates: Sept 11, 30, Oct 9, 28, Nov 6, 25)

Tutorial Activities: 0% (In-seminar, 9 different activities)

CFD Project: 0% (In-seminar project must be satisfactorily completed for course credit – pass/fail)
See Section 5.3 for due dates.

Labs: 15% (5 Labs-3% each)
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*: 15-40% (Closed book, Covers material up to last lecture prior to exam)
Tuesday, Oct 21, In-class.

Final Exam*: 35-60% (Closed book, Covers entire course)
Friday, Dec 12, 7:00-9:00 pm, Room TBA

*All exams 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.

	Scheme 1	**Scheme 2**	**Scheme 3**	**Scheme 4**
Assignments	10%	10%	10%	0
Clicker Quizzes	5%	5%	5%	0
Labs	15%	15%	15%	0
Midterm	25%	15%	35%	40%
Final	45%	55%	35%	60%

Scheme 4 will be applied if it gives you a mark below 50%. (In other words, you must achieve a passing score on your tests to pass the course.)

If you complete at least 7 of 9 tutorial activities, your grade will be calculated using Scheme 1, 2, or 3, which ever gives you the best mark.

Otherwise, Scheme 1 will be used to calculate your mark.

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. (See 3.1)

Missed midterm tests: If you miss the midterm 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 Assignments: Late submissions of assignments will not be marked.

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. 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, Quizzes, Exams
2. Problem Analysis	2, 5	Assignments, Quizzes, Exams, Project
3. Investigation	6	Labs, Project
4. Design	-	-
5. Use of Engineering Tools	6	Project
6. Communication	7	Labs, Project
7. Individual and Teamwork	8	Labs, Project
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/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

5 TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Lectures:

Tuesday		1:00 – 2:20	MACN 105	
Thursday		1:00 – 2:20	MACN 105	
Seminars:				
Monday	Sec 4	9:30 – 10:20	MCKN 315	Graeme
Monday	Sec 6	4:30 – 5:20	MCKN 238	Graeme
Tuesday	Sec 2	8:30 – 9:20	MCKN 305	Ehsan
Wednesday	Sec 3	9:30 – 10:20	MCKN 318	Ehsan
Thursday	Sec 5	8:30 – 9:20	MCKN 315	Andre
Thursday	Sec 1	11:30 – 12:20	MCKN 315	Andre
Laboratory:				
Monday	Sec 01	11:30 – 1:20	THRN 1125	James
Monday	Sec 03	2:30 – 4:20	THRN 1125	James
Tuesday	Sec 04	2:30 – 4:20	THRN 1125	James
Wednesday	Sec 06	11:30 – 1:20	THRN 1125	Vidhya
Wednesday	Sec 07	2:30 – 4:20	THRN 1125	Vidhya
Thursday	Sec 02	2:30 – 4:20	THRN 1125	James
Friday	Sec 08	11:30 – 1:20	THRN 1125	Vidhya
Friday	Sec 05	3:30 – 5:20	THRN 1125	Vidhya

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

Lecture	Lecture Topics	References	Learning Objectives
1-3	Fluids and Fluid Properties	Chapter 1	1, 5
4-6	Fluid Statics and Pressure Distribution	Chapter 2	1
7-11	Fluid Flow Concepts: Control Volumes	Chapter 3	1, 2
12	Fluid Flow Concepts: Differential Analysis	Chapter 4	1, 2
13	Midterm	-	-

14-15	Dimensional Analysis	Chapter 5	1, 2
16-18	Internal Viscous Flow (Pipe Flow)	Chapter 6	1, 3
19-20	External Flow and Boundary Layer Theory	Chapter 7	1, 4
21-22	Pumps	Chapter 11	1, 2
23-24	Open Channel Flow	Chapter 10	1, 3

5.3 Seminar Schedule and Details

The seminar will include activities to reinforce material covered in lectures and will introduce problem sets not covered in lectures. The GTA will present concepts and tips related to the week's material. It is essential that you attend your scheduled seminar.

Week	Topic
1 (Sept 8-12)	Activity 1: Tutorial Introduction
2 (Sept 15-19)	Activity 2: Fluid Properties
3 (Sept 22-26)	Activity 3: Fluid Statics
4 (Sept 29-Oct 3)	Activity 4: Buoyancy
5 (Oct 6-10)	Activity 5: Conservation of Momentum
6 (Oct 13-17)	Thanksgiving Break – Open Tutorial Time
7 (Oct 20-24)	Activity 6: Bernoulli Equation / Conservation of Energy
8 (Oct 27-31)	Activity 7: Dimensional Analysis
9 (Nov 3-7)	Activity 8: Pipe Flow
10(Nov 10-14)	CFD Project – Go to THRN 1319 instead of your regular room*.
11(Nov 17-21)	Activity 9: External Flow
12(Nov 24-28)	Final Exam Prep – Open Tutorial Time

*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.

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 or 4 students during your scheduled lab times.

The first lab begins on Monday September 8. Your first lab session will be an orientation to the Fluids Lab (THRN 1125) and instructions on lab safety. You will not be allowed to conduct any experiments until you have attended the orientation session. You must also form your groups during the orientation session - sign up on the sheets posted on the wall outside of the Fluids Lab. It is critical that you have formed your lab groups before your first lab experiment. Pick your lab group wisely as you will work with the same lab group during the whole semester.

If you miss a scheduled lab and are granted academic consideration, you will perform your lab during the Open Lab Week. In this case, you will probably work with a different lab group.

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 8-12)	Lab Orientation/Safety	
3 (Sept 22-26)	Discharge over Weirs	Week 4
5 (Oct 6-10)	Flow Measurement	Week 6
7 (Oct 20-24)	Impact of a Jet	Week 8
9 (Nov 3-7)	Pipe Friction	Week 10
10 (Nov 10-14)	Minor Losses	In lab
11 (Nov 17-21)	Open Lab Week	Week 12

*The lab reports for the first 4 labs 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. The 5th lab (Minor Losses) does not require a formal lab report and you can hand in your worksheet and analysis at the end of the lab session.

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 8 pages, which includes the title page and signed data sheet.

5.5 Other Important Dates

Thursday, September 4, 2014: First day of class
Monday, October 13, 2014 Holiday: no classes scheduled
Tuesday, October 14, 2014: Fall Study Break Day – no classes scheduled
Friday, October 31, 2014: 40th class day, last day to drop
Friday, November 28, 2014: Last day of class

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.

If the laboratory rules are not followed, consequences will include removing student's 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

Refer to the Lab manual for instruction on lab safety. You must attend the lab orientation and safety session during your first lab time (September 8-12) before you can conduct any of the labs.

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.ca or see the website: http://www.csd.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