

UNIVERSITY OF GUELPH
SCHOOL OF ENGINEERING
ENGG*2230
FLUID MECHANICS
Winter 2012

Instructor: Dr. Ryan Clemmer (rclemmer@uoguelph.ca)

Office: THRN 1337, Ext. 52132

Teaching Assistants: Scott Dilling (sdilling@uoguelph.ca)
Jennifer Drake (jdrake@uoguelph.ca)
Rajendra Sapkota (rsapkota@uoguelph.ca)
Stephanie Shaw (sshaw@uoguelph.ca)
Idris Sule (isule@uoguelph.ca)
Tao Tao (t tao@uoguelph.ca)
Colin Weaver (cweaver@uoguelph.ca)

Lab Technician: Barry Verspagen (baverspa@uoguelph.ca), Office: THRN 1023, Ext. 58821

Text: F.M. White, 2010, Fluid Mechanics, 7th Edition, McGraw-Hill

Lecture Times: Tue & Thu 4:00 – 5:20 PM THRN1200

Tutorial Times:	Tue	10:30 – 11:20 AM	MACK 238
	Tue	11:30 – 12:20 PM	MACK 233
	Wed	8:30 – 9:20 AM	MACK 233
	Wed	10:30 – 11:20 AM	MACK 233
	Wed	2:30 – 3:20 PM	MACK 233
	Thu	8:30 – 9:20 AM	MACK 238
	Fri	10:30 - 11:20 AM	MACK 234
	Fri	12:30 - 1:20 PM	MACK 233

Lab Times:	Mon 2:30 – 4:20 PM	Tue 8:30-10:20 AM
	Tue 12:30 – 2:20 PM	Wed 12:30 – 2:20 PM
	Wed 2:30 – 4:20 PM	Thu 8:30 – 10:20 AM
	Thu 10:30 – 12:20 PM	Thu 12:30 – 2:20 PM
	Fri 12:30 – 2:20 PM	Fri 2:30 – 4:20 PM

**All Labs are in THRN 1193*

Course Description

This course introduces the fundamentals of fluid mechanics for engineers. The emphasis of the course is on the basics of fluid statics and fluid motion with applications in a variety of engineering fields. An outline of the course topics is given below.

Course Notes

The lectures will revolve around a sequence of PowerPoint slides with elaboration and examples during the lectures. These will be generally available on Courselink before the lecture – it is expected that you will have a copy of these available during the lectures.

Topics

1. Introduction

- fluid properties: viscosity, density, vapour pressure, elasticity, temperature effects
- Newtonian and non-Newtonian fluids

2. Fluid Statics

- pressure and its measurement
- hydrostatics: pressures, forces
- buoyancy and stability

3. Fluid Flow Concepts

- control volume analysis
- continuity: mass, volume, steady, unsteady flow
- energy: Bernoulli Equation.
- momentum: Navier-Stokes Equations

4. Dynamic Similitude and Dimensional Analysis

- Similarity
- Buckingham PI theorem
- modelling

5. Viscous Flow

- streamlines
- laminar vs turbulent flow
- steady vs unsteady flow

6. Pipe Flow

- friction losses: Darcy
- Darcy-Weisbach Eq, Moody Diagram
- minor losses, equivalent lengths
- piping systems

7. Pumps

- pump types, characteristics
- pump and system curves
- net positive suction head, cavitation

8. Open Channel Flow Principles

- specific energy
- Manning equation
- hydraulic jumps

9. Boundary Layer Theory

- viscous drag
- forces on 3-D objects
- lift forces

Method of Evaluation

Final grades will be determined in the following manner:

Assignments	5% (Minimum)
NX Assignment	5%
Lab Reports	20%
Mid-term Exam	25%
Final Exam	<u>45%</u> (Maximum)
Total	100%

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

Laboratory

The laboratory forms a vital part of the course; material introduced in the lab may be part of the final and mid-term exams. Labs will be done in groups of three (3) students during your scheduled lab times. Sign-up sheets will be posted outside the Fluids Lab (THRN 1193) where you may choose your group with fellow students in the same scheduled lab time. Be sure to sign-up for a group before 4:00 PM on **Thursday, January 12th** as **labs begin January 16th**. Each group will have a complete predefined lab schedule (posted on Courselink and outside the fluids lab) stating which lab will be performed in which week during the semester. Be sure to choose your group members and schedule wisely!

There are 5 labs in total for the course. Each lab apparatus will be set up for a minimum of 3 weeks and most weeks at least two different apparatus will be set up. The schedule of lab apparatus availability and the due dates for the labs are on the course website but generally the lab reports are due every two weeks. Attendance in the lab is mandatory. **No grades will be issued to any group member who is not in attendance when the lab is completed by the group.**

Before arriving to the laboratory to perform an experiment, each group must have read and understood the corresponding handout. Lab manuals are available on the course website and you are expected to obtain a copy for yourself. You are expected to do the intermediate calculations and, in some cases, all the calculations before leaving the lab. Each group is to submit a single report for each experiment. These are to be either long reports or short reports. Each group member will be responsible for one long report during the semester. For this report, the member responsible will receive a double weighting. Reports beyond the long report requirements for the group are to be short reports (*i.e.* most groups will submit 3 long reports and 2 short reports).

The format of the long report is described in the lab handout. It is to be no longer than 7 pages. Note that these 7 pages include **everything**, including one page for the title page, one page for the signed raw data sheet, and the remainder in 5 pages. Short reports should only include a short statement of the purpose of the lab, the data collected, how calculations were performed, answers to the required questions in the lab and a short conclusion section.

The laboratory reports are due in the course assignment drop box at 5:00 pm on the dates given below. A late report will be penalized by 50% per day late. The reports must be entirely original. Plagiarism, of any form, will not be tolerated and will be forwarded to the Dean of the College of Physical and Engineering Science for consideration of Academic Misconduct. All labs will be returned no later than 1 week after the due date.

Each lab report (long or short) 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 for the course before you leave the lab.

Lab Dates

Lab	Dates Apparatus Available	Report Due Date
Impact of Jet	Jan 16 - Feb 3	Mon Feb 6
Weir Flow	Jan 16 – Feb 17	Mon Feb 27
Minor Losses	Feb 6 – Mar 9	Mon Mar 12
Friction Losses	Feb 27 – Mar 30	Mon Apr 2
Flow Measurement	Mar 12 – Mar 30	Mon Apr 2

Tutorials and Assignments

The tutorial session is meant to be a time to ask questions regarding the assigned problems, either from the textbook or the weekly assignments. Attendance is not mandatory but any information given out during the tutorials will be considered part of the course material. Assignments will be posted weekly, typically on Fridays. Assignments will be due on Mondays at 9:00 AM (approximately 10 days after they are assigned) with **no late assignments accepted**. Assignments are to be done on a single side of suitable engineering paper and an example of a suitable submission is available on the course website.

A total of seven (7) assignments will be given out during the semester with only the best five (5) counted toward your final grade. Assignments will consist of 5 to 6 questions. Up to three questions will be randomly selected for marking (after the due date) with the remaining questions checked for satisfactory completeness. If you hand in all seven assignments, and they are sufficiently complete, the grade weighting for the final exam will be reduced to 40% while the weighting on the assignments will be increased to 10% (while still only counting your best 5 assignments).

Each assignment submission is to be your own original work. While you are encouraged to discuss the assignment with classmates, you are not allowed to share your solutions with anyone and to do so before the due date will be considered as plagiarism.

The format for the assignments is to be appropriate for design notes and calculations as covered in ENGG*1100. An example solution format is given on the course website. The following guidelines are to be followed:

1. Assignments are to be submitted on either engineering paper or suitable quad-ruled paper – any other type will not be accepted.
2. All work must be done on a single side of the page – work on the back of pages will not be marked.
3. Work is to be legible and neat – if it is difficult to read or follow, it will not be marked.
4. It is recommended you work in pencil so you may erase your mistakes, if you are perfect, you are welcome to use pen.
5. All assumptions are to be clearly stated and the answer clearly indicated with the appropriate number of significant figures and units.
6. A cover page is not required; however the course number, assignment number, date, and your name are required on all pages.

NX Assignment

All students will be required to submit an assignment using UGS NX, a CAD program with computational fluid dynamics (CFD) modelling capabilities. This assignment will build on earlier assignments completed as part of ENGG*2100 and ENGG*2120. Details on this assignment will be made available later in the course.

Examinations

A mid-term examination will be given on Tuesday, February 14th, during the normally scheduled class time. The final examination is scheduled for Friday, April 13th from 8:30 to 10:30 AM (room TBA)

Engineering Peer Helpers

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. Contact the Peer Helper Program at engpeers@uoguelph.ca for more information.

Major Holy Days

Students must contact the instructor within the first two weeks of class if academic consideration is to be requested because of religious reasons.

University Policy on Academic Misconduct:

Academic misconduct, such as plagiarism, is a serious offence at the University of Guelph. Please consult the Undergraduate Calendar 2011-2012 and School of Engineering programs guide, for offences, penalties and procedures relating to academic misconduct.

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

Disclaimer:

The instructor reserves the right to change any or all of the above in the event of appropriate circumstances, subject to the University of Guelph Academic Regulations.