

UNIVERSITY OF GUELPH
SCHOOL OF ENGINEERING
ENGG*2230
FLUID MECHANICS
Winter 2010

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Text: F.M. White, 2008, *Fluid Mechanics*, 6th Edition, McGraw-Hill

Lecture Times:	Tue & Thu	11:30 – 12:50	LA 204
Tutorial Times:	Section 101 - Tue	1:00 – 1:50	---
	Section 102 – Wed	10:30 – 11:20	MACK 309
	Section 103 – Wed	12:30 – 1:20	MACK 305
	Section 104 - Thur	1:00 - 1:50	MACK 308
Lab Times:	Mon	2:30 – 4:20	THRN 1193
	Tue	2:30 – 4:20	THRN 1193
	Wed	1:30 – 3:20	THRN 1193
	Wed	3:30 – 5:20	THRN 1193
	Thurs	2:30 – 4:20	THRN 1193

Course Notes

The lectures will revolve around a sequence of “interactive” slide presentations with elaboration and examples during the lectures. These will be available on **CourseLink** no later than the evening before the lecture – it is expected that you will have a copy of these available during the lectures.

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.

Lecture 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

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 students. You may choose your own group provided the names are submitted no later than **Friday, January 15th at 12:00**. Ensure that your group has a common time slot available in one of the allotted laboratory times. After this time, we will assign the remaining students to groups.

There are 5 labs in total for the course with 10 time slots available over two weeks to complete a lab. The labs are 'self-scheduled' but you must sign up for a timeslot on the bulletin board outside of THRN 1193. All five lab experiments will be set up in the Fluids Lab. Groups will be responsible for ensuring that they complete all the labs over the course of the term. Weeks available to do the labs and due dates of each of the five labs are given below. 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 coming to the laboratory to perform an experiment, each group must have read and understood the corresponding handout. Lab manuals are available on **CourseLink** and you are expected to obtain a copy for yourself. In addition, **video instructions** are available for each lab on the course Blackboard site. You are expected to do the intermediate calculations and, in some cases, all the calculations before leaving the room. Each group is to submit a single typed 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 Director of the School of Engineering for Academic Misconduct consideration. All labs will be returned at the end of the semester.

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.

Session	Period	Due
Lab Session 1	Jan 18 – Jan 28	Fri, Feb 5
Lab Session 2	Feb 1 – Feb 11	Fri, Feb 26
Lab Session 3	Mar 1 – Mar 11	Fri, Mar 19
Lab Session 4	Mar 15 – Mar 25	Thurs, Apr 1
Lab Session 5	Mar 29 – Apr 8	Fri, Apr 9

Tutorials and Assignments

Weekly Tutorials

The tutorial session is meant to be a time to answer questions regarding the assigned problems, either from the book 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 **Thursdays at 4:00 PM** with **no late assignments accepted**. Assignments are to be done on a single side of suitable engineering paper.

A total of nine (9) assignments will be given out during the semester. You are only required to submit one assignment out of each group of three assignments, for a minimum of (3), although you are responsible for the material on all assignments.

If you hand in more assignments than the minimum required, these will be counted and reduce the grade weighting on the final exam while increasing the weighting on the assignments. If you submit all nine assignments, the grade weighting for the final exam will be reduced to 35% while the weighting on the assignments will be increased to 15%.

The format for the assignments is to be appropriate for design notes and calculations as covered in ENGG*1100. 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 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.

Method of Evaluation

Final grades will be determined in the following manner:

Assignments	5% (minimum, 3 assn)	15% (maximum, 9 assn)
NX Assignment		5%
Lab Reports		20%
Mid-term Exam		25%
Final Exam	45% (maximum)	35% (minimum)
Total		100%

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

Examinations

A mid-term examination will be given on **Tuesday, February 23rd**, during the normally scheduled class time.

The final examination is scheduled for **Friday, April 16th**.

Major Holy Days

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