UNIVERSITY OF GUELPH
SCHOOL OF ENGINEERING
ENGG*2230

FLUID MECHANICS

Winter 2010

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

Lecture Times: Tue & Thu 16:00 – 17:20 THRN1200

Tutorial Times:

Mon	12:30 – 12:20	MACK 305
Tue	1:00 – 1:50	MACK 305
Wed	2:30 – 3:20	MACK 304
Thu	9:30 – 10:20	MACK 304
Fri	1:30 - 2:20	MACK 306
Fri	2:30 - 3:20	MACK 304

Lab Times:

Mon 2:30 – 4:20	Tue 9:30-11:20
Tue 12:30-2:20	Wed 12:30 – 2:20
Wed 3:30 – 5:20	Thu 10:30 – 12:20
Thu 12:30-2:20	Fri 2:30 – 4:20

All Labs in LRS Basement

Course Notes

The lectures will revolve around a sequence of overheads with elaboration and examples during the lectures. These will be available on Blackboard 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.

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	45% (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 students. You may choose your own group provided the names are submitted to the course website by Thursday, January 13th. Ensure that your group has a common time slot available in one of the allotted laboratory times. After this time, I will assign the remaining students to groups. There are 5 labs in total for the course with 8 time slots available over two weeks to complete a lab. The labs are 'self-scheduled' but you must sign up for a time slot on the bulletin board outside of the Lab in the basement of the Richards Building. Each lab apparatus will be set up for a minimum of 3 weeks and most weeks at least two different apparati 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 coming 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. In addition, video instructions are available for each lab on the course website. 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 17 - Feb 4	Mon Feb 7
Weir Flow	Jan 17 – Feb18	Mon Feb 28
Minor Losses	Feb 7 – Mar 11	Mon Mar 14
Friction Losses	Feb 28 – Apr 1	Mon Apr 4
Flow Measurement	Mar 14 – Apr 1	Mon Apr 4

Tutorials and Assignments

The tutorial session is meant to be a time to ask 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 Mondays at 9:00 AM 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 nine assignments will be given out during the semester. You are only required to submit one assignment out of each group of three assignments 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%.

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 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 Thursday, February 17th, during the normally scheduled class time. The final examination is scheduled for Thursday, April 14th.

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.