Faculty of Engineering

CBE 2221B– Fluid Flow

Description
To introduce chemical engineering students to the basics of momentum transfer and fluid flow; their application to the solution of engineering problems. Topics include: conservation of mass, momentum and energy, flow of fluids, measurement of fluid flow, laminar and turbulent flow, compressible and incompressible flow, pumps, nozzles, flow meters, turbines.

Prerequisites
Applied Mathematics 1413

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

Corequisites
None

Antirequisites
None

Contact Hours
3 lecture hours; 1 tutorial, 3 lab hours, 0.5 course.

Instructor
Dr. M. Ray (TEB 443) Tel: 519-661-2111 ext. 81273, email: mbhowmic@uwo.ca

Lab Technician
Souheil Afara (SEB 1081C) 519-661-2111 ext 88457 email: safara@uwo.ca

Undergraduate Assistant
(TEB 477) Telephone: 519-661-2111 ext: 82131 email: cbeundergraduate@uwo.ca

Reference Texts
Class notes and other reading materials are provided by the instructor

1. Fluid Flow CBE2221:Selected Materials from Fluid Mechanics, Y. Cengel and J. Cimbala, Custom

Course Notes
Will be provided by the Instructor by email or posted at the website

Laboratory Notes
Will be posted at the website

Laboratory
Students are expected to attend a 3-hour weekly laboratory/tutorial period. Attendance will be taken at the laboratory/tutorials.

Units
SI units will be used most of the time, but other units will also be practiced.

General Learning Objectives

| A knowledge base for engineering | B | Individual and team work | I | Economics and project management | n.e |
| Problem analysis | I | Communication skills | n.e | Life-long learning | n.e |
| Investigation | n.e | Professionalism | B |
| Design | B | Impact of engineering on society and the environment | n.e |
| Use of engineering tools | I | Ethics and equity | n.e |

Key:
B: evaluated at introductory level
I: evaluated at intermediate level
A: evaluated at advanced level
n.e.: not evaluated

Specific Learning Objectives

Fluid Flow
At the end of this course, students will be able to understand and explain:
- Engineering unit systems, dimensionless analysis
- Fluid statics
- Newtonian and Non–Newtonian fluids, Newton's law of viscosity, shear stress
- Steady and unsteady flow
- Compressible and incompressible flow, Navier-Stokes equation
- Laminar and turbulent flow
- Bernoulli's theorem, linear momentum equations, computational fluid dynamics
- External and internal flow

Western University, Thompson Engineering Building, Room 477, 1151 Richmond Street, London, ON Canada N6A 5B9
t. 519.661.2111 ext. 82131  f. 519.661.3498  www.eng.uwo.ca/chemical/
• Fluid flow in pipes, friction factor, pressure loss
• Flow machines
• Flow measurement devices

Laboratory in fluid flow
At the end of this topic, students will be able to:
• Apply the concepts learned in the lectures to practical engineering problems dealing with compressible and incompressible fluid flow.

Evaluation
The final course mark will be determined as follows:
Assignments 10%
2- Midterms 30%
Laboratory 20%
Final Examination 40%

All exams are closed book and the final exam is 3 hours in length. Some equations are provided in the examination. Programmable calculators will be permitted.

Notes
1) Students must pass the final examination to pass this course. Students who fail the final examination will be assigned 48% if the aggregate mark is higher than 50%, or the examination mark, whichever is less.
2) Assignments are to be handed into CBE 2221b locker # C459 located in the Thompson Engineering Building on the specified due date provided by the Instructor.

Use of English
In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Attendance
Attendance in all lectures, tutorials and laboratories is mandatory. Any student who, in the opinion of the instructor, is absent too frequently from class or laboratory periods in any course, will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular examination in the course.

Cheating
University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning (see Scholastic Offence Policy in the Western Academic Calendar).
**Plagiarism**
Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar).

The University of Western Ontario has software for plagiarism checking. Students may be required to submit their work in electronic form for plagiarism checking.

**Conduct**
Students are expected to arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others.

**Sickness and Other Problems**
Students should immediately consult with the instructor or Department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see attached). The student should seek advice from the Instructor or Department Chair regarding how best to deal with the problem. Failure to notify the Instructor or Department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

**Notices**
Students are responsible for regularly checking their email and notices posted on Instructors' doors.

**Consultation**
Students are encouraged to discuss problems with their teaching assistant and/or instructor in tutorial sessions. Office hours will be arranged for the students to see the instructor and teaching assistants. Other individual consultation can be arranged by appointment with the appropriate instructor.

**Accreditation (AU) Breakdown**

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<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
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<tbody>
<tr>
<td>Engineering Science</td>
<td>70%</td>
</tr>
<tr>
<td>Engineering Design</td>
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August 3, 2012/mt