Course Outline (F2019)

BME516: Fluid Mechanics I

Instructor(s)	David Naylor [Coordinator] Office: EPH411 Phone: TBA Email: dnaylor@ryerson.ca Office Hours: TBA Wey Herng Leong Office: TBA Phone: TBA Email: weyleong@ryerson.ca Office Hours: TBA
Calendar Description	Dimensions and units, continuum fluid mechanics. Properties of fluids. Fluid statics, the standard atmosphere. Manometry and pressure measurement. Forces on submerged planes. Flow characteristics: laminar and turbulent flow, steady and unsteady flow, streamlines. Flow analysis: control volume/control system and differential approaches for mass, momentum and energy conservation. Applications of the conservation equation, Euler and Bernoulli equations. Dimensional analysis, similitude and model testing.
Prerequisites	BME 229, MTH 312, BME 423, CEN 199, BME 406;
Antirequisites	MEC 516
Corerequisites	None
Compulsory Text(s):	1. Fluid Mechanics, Frank. M. White, 8 th Edition, McGraw-Hill, 2016 2. MEC 516 Lab Manual, Department of Mechanical and Industrial Engineering
Reference Text(s):	
Learning Objectives (Indicators)	At the end of this course, the successful student will be able to: 1. Demonstrates an in-depth understanding of key concepts related to engineering fundamentals. Applies science knowledge, skills, and competency in modeling and solving engineering problems in components, process, and systems. (**1c**) 2. Analyze model predictions against real-world data. (**2b**) 3. Applies mathematical and scientific principles, and engineering tools to predict the behaviour of systems and processes. (**3a**) 4. Analyzes experimental results. Uses engineering tools to analyze results. Interprets results with regards to given assumptions and constraints. Draws conclusions based on results. (**5b**) 5. (5b-2) Interprets results with regards to given assumptions and constraints, and how they relate to theoretical nature or system. (**6a**) **NOTE:** *Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board (CEAB).*
Course Organization	3.0 hours of lecture per week for 13 weeks 2.0 hours of lab/tutorial per week for 12 weeks
Teaching Assistants	TBA

Course Evaluation		
	Midterm Exam	32 %
	Lab Report (4 group labs @ 2% each)	8 %
	In-class unscheduled quizzes (7 quizzes)	10 %
	Final Exam	50 %
	TOTAL:	100 %

Note: In order for a student to pass a course with **"Theory and Laboratory"** components, in addition to earning a minimum overall course mark of 50%, the student must pass the Laboratory and Theory portions separately by achieving a minimum of 50% in the combined Laboratory components and 50% in the combined Theory components. Please refer to the **"Course Evaluation"** section for details on the Theory and Laboratory components.

Examinations	Midterm exam in about Week 7, two hours, closed book + aid sheet (covers Weeks 1-6). Final exam, during exam period, three hours, closed-book + aid sheet (covers Weeks 1-13, with emphasis on the post-midterm material).
Other Evaluation Information	- Late reports receive a penalty of 5% per working day. Students must attend their regularly scheduled laboratory session based on RAMSS registration and take part in writing the group report to receive full marks for that lab. - Students must achieve an overall passing grade on the midterm and final exams to be awarded group lab/project grades, i.e., Tests >= 41 where Tests = (0.32 x Midterm%) + (0.50 x Exam%)
Other Information	None

Course Content

Week	Hours	Chapters / Section	Topic, description
1-2	4		Introduction and definitions molecular vs continuum flow dimensions and units fluid properties: viscosity density specific gravity pressure surface tension streamlines streaklines pathlines. (Chapter 1 Sections 1.1-1.9)
2-4	8		Fluid statics pressure at a point pressure gradients basic equations manometry forces on plane and curved surfaces buoyancy pressure measurement. (Chapter 2 Section 2.1-2.6 2.8 2.10)
5-7	8		Integral relations for a control volume and control surface conservation of mass conservation of linear and angular momentum conservation of energy Euler's equation incompressible flow frictionless flow Bernoulli equation. (Chapter 3 Sections 3.1-3.7)
7-10	8		Differential equations of fluid motion similarity parameters viscous flow flow in a pipe laminar and turbulent flow. (Chapter 4 Sections 4.1-4.10)

10-11	5		Dimensional analysis similarity dimensions and units dimensional homogeneity the Buckingham Pi-theorem Method of Ipsen dimensionless parameters similitude and modelling. (Chapter 5 Sections 5.1-5.5)
12-13	6		Viscous flow in ducts Reynolds number regimes laminar flows in circular ducts Darcy-Weisbach friction factor and Moody diagram minor losses lift and drag. (Chapter 6 Sections 6.1-6.5)

Laboratory/Tutorials/Activity Schedule

Week	Lab	Description
3-4	KHE031/KHE035/KHE037	Measurement of Dynamic Viscosity
5-6	KHE031/KHE035/KHE037	Reynolds Apparatus and Pipe Friction
7-8	KHE031/KHE035/KHE037	The Impact of Jets
9-10	KHE031/KHE035/KHE037	The Venturi Flow Meter

Policies & Important Information:

1. Students are required to obtain and maintain a Ryerson e-mail account for timely communications between the instructor and the students;
2. Any changes in the course outline, test dates, marking or evaluation will be discussed in class prior to being implemented;
3. Assignments, projects, reports and other deadline-bound course assessment components handed in past the due date will receive a mark of ZERO, unless otherwise stated. Marking information will be made available at the time when such course assessment components are announced.
4. Refer to our **Departmental FAQ** page for information on common questions and issues at the following link: https://www.ee.ryerson.ca/guides/Student.Academic.FAQ.html.

Missed Classes and/or Evaluations

When possible, students are required to inform their instructors of any situation which arises during the semester which may have an adverse effect upon their academic performance, and must request any consideration and accommodation according to the relevant policies as far in advance as possible. Failure to do so may jeopardize any academic appeals.

1. *Health certificates* - If a student misses the deadline for submitting an assignment, or the date of an exam or other evaluation component for health reasons, they should notify their instructor as soon as possible, and submit a Ryerson Student Health Certificate AND an Academic Consideration Request form within 3 working days of the missed date. Both documents are available at https://www.ryerson.ca/senate/forms/medical.pdf.. **If you are a full-time or part-time degree student, then you submit your forms to your own program department or school;**
2. *Religious, Aboriginal and Spiritual observance* - If a student needs accommodation because of religious, Aboriginal or spiritual observance, they must submit a Request for Accommodation of Student Religious, Aboriginal and Spiritual Observance AND an Academic Consideration Request form within the first 2 weeks of the class or, for a final examination, within 2 weeks of the posting of the examination schedule. If the requested absence occurs within the first 2 weeks of classes, or the dates are not known well in advance as they are linked to other conditions, these forms should be submitted with as much lead time as possible in advance of the absence. Both documents are available at www.ryerson.ca/senate/forms/relobservforminstr.pdf. **If you are a full-time or part-time degree student, then you submit the forms to your own program department or school;**
3. *Academic Accommodation Support* - Before the first graded work is due, students registered with the Academic Accommodation Support office (AAS - www.ryerson.ca/studentlearningsupport/academic-accommodation-support) should provide their instructors with an Academic Accommodation letter that describes their academic accommodation plan.

Academic Integrity

Ryerson's Policy 60 (the Academic Integrity policy) applies to all students at the University. Forms of academic misconduct include plagiarism, cheating,

supplying false information to the University, and other acts. The most common form of academic misconduct is plagiarism - a serious academic offence, with potentially severe penalties and other consequences. It is expected, therefore, that all examinations and work submitted for evaluation and course credit will be the product of each student's individual effort (or an authorized group of students). Submitting the same work for credit to more than one course, without instructor approval, can also be considered a form of plagiarism.

Suspicions of academic misconduct may be referred to the Academic Integrity Office (AIO). Students who are found to have committed academic misconduct will have a Disciplinary Notation (DN) placed on their academic record (not on their transcript) and will normally be assigned one or more of the following penalties:

1. A grade reduction for the work, ranging up to an including a zero on the work (minimum penalty for graduate work is a zero on the work);
2. A grade reduction in the course greater than a zero on the work. (Note that this penalty can only be applied to course components worth 10% or less, and any additional penalty cannot exceed 10% of the final course grade. Students must be given prior notice that such a penalty will be assigned (e.g. in the course outline or on the assignment handout);
3. An F in the course;
4. More serious penalties up to and including expulsion from the University.

The unauthorized use of intellectual property of others, including your professor, for distribution, sale, or profit is expressly prohibited, in accordance with Policy 60 (Sections 2.8 and 2.10). Intellectual property includes, but is not limited to:

1. Slides
2. Lecture notes
3. Presentation materials used in and outside of class
4. Lab manuals
5. Course packs
6. Exams

For more detailed information on these issues, please refer to the Academic Integrity policy(https://www.ryerson.ca/senate/policies/pol60.pdf) and to the Academic Integrity Office website (https://www.ryerson.ca/academicintegrity/).

Important Resources Available at Ryerson

1. The Library (https://library.ryerson.ca/) provides research workshops and individual assistance. Inquire at the Reference Desk on the second floor of the library, or go to library.ryerson.ca/guides/workshops
2. Student Learning Support(https://www.ryerson.ca/studentlearningsupport) offers group-based and individual help with writing, math, study skills and transition support, and other issues.