



University of Manitoba Department of Biosystems Engineering

Course Details

Course Title & Number:	BIOE 2790 Fluid Mechanics (Fall 2022)
Class Times & Days of Week:	Lectures: TR 10:00-11:15 AM Tutorial/Labs: R 2:30 - 5:15 PM
Location for classes/labs/tutorials:	Lecture: 133 Frank Kennedy Centre Tutorials/Labs: E2-125 EITC
Pre-Requisites:	ENG 1440 (or ENG 1441) and (MATH 1710 or MATH 1700 or MATH 1701). Not to be held with CIVL 2790.

Course Description:

Definition of fluid; fluid properties; variation of pressure in a fluid; hydrostatic forces; buoyancy; kinematics of flow; control volumes; continuity; Bernoulli's equation; energy equation; flow in closed conduits; open channel flow.

Instructor Information

Instructor(s) Name:	Ms. Ella Morris, EIT, Instructor
Office Location:	E1-330 EITC
Office Hours or Availability:	Tuesday 1:00 – 2:00 PM or by appointment
Office Phone No.	204-474-7919
Email:	Ella.Morris@umanitoba.ca
Teaching Assistant:	Mahdi Alaei Varnosfaderani
Office Location:	via email
Email:	alaeivam@myumanitoba.ca

Textbook, Readings, Materials

Required textbook – The following book will be available from the University of Manitoba Bookstore. Students are responsible for reading the material in the textbook in preparation for the lectures and tutorials throughout the semester. Please make sure that you get the 2nd Edition.

Fluid Mechanics, Student Value Edition Plus Mastering Engineering with Pearson eText -- Access Card Package, 2/E

Russell C. Hibbeler
ISBN-13: 9780134628776

Supplementary material – Mastering Engineering online resource comes with the purchase of the textbook. It is a very good resource for solving additional problem assignments. Students are responsible for the content covered in the textbook and the Mastering Engineering online resource for the tests and examination. The best way to understand the material covered in this course is to work through problems at the end of the chapters for practice.

Practice, Practice, and more Practice! Working through the end-of-chapter problems is the best way to master the subject matter in Fluid Mechanics, which is essential to becoming a successful engineer.

Course Goals

The intent of this course is:

- To provide a theoretical background in the area of fluid mechanics.
 - To help provide the fundamental knowledge that can be used as a basis for areas such as hydraulics, hydrology, groundwater hydrology, irrigation and drainage, biomedical engineering and others.
 - To provide an opportunity for students to practice their critical thinking and problem-solving skills.
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Intended Learning Outcomes

At the conclusion of the course, the student should be able to:

1. Understand fundamental concepts of fluid properties, Fluid Statics, and fluid mechanics.
2. Have a solid understanding of the concepts of conservation of mass, momentum and energy as it relates to fluids.
3. Understand common assumptions made when working in Fluid Mechanics.

Expected Level of Development in Course **

Learning Outcome	Attribute*											
	KB	PA	IN	DE	ET	IT	CS	PR	IE	EE	EP	LL
1	I	I	I									
2	I	I	I									
3	I	I	I									

***Attributes:**

- KB** A knowledge base for engineering
- PA** Problem analysis
- IN** Investigation
- DE** Design
- ET** Use of engineering tools
- IT** Individual and team work
- CS** Communication skills
- PR** Professionalism
- IE** Impact of engineering on society/ environment
- EE** Ethics and equity
- EP** Economics and project management
- LL** Life-long learning

****Expected Level of Development:**

- I – Introductory
- D – Developed
- A – Advanced

Assignment Extension, Late Submission Policy and Missed Tests

Deadlines are a reality in the world of engineering; we expect assignments to be completed on time to the UMLearn portal. Assignments submitted after the due date will be docked 10% per day. Assignments will not be accepted after one week from the date assigned. All assignments must be submitted to pass the course. There will be no make-up quizzes or midterm test. The weight of the final exam will be adjusted to compensate for a quiz or midterm test missed for valid, documented medical or compassionate reason.

Important Dates

- November 7 - 10: No classes – Fall term break
 - November 22: Last date for Voluntary Withdrawal for Fall term courses.
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Course Evaluation

All courses in the Biosystems Engineering program are expected to contribute, in some way, to the development of one or more of the 12 graduate attributes that have been identified by the Canadian Engineering Accreditation Board. The table below shows the graduate attributes covered in BIOE 2790 in relation to the assessment element that contributes to your overall grade in the course. The final column indicates the approximate level of development in graduate attributes that is anticipated in this course.

Assessment Element	Value	Attributes Covered	Indicators being assessed	Level*
Tutorials	12%	Problem Analysis	PA.1 – Identifies and defines complex engineering problems. PA.2 – Develops and/or implements a strategy to analyze complex engineering problems. PA.3 – Analyzes and solves complex engineering problems	I
Labs	8%	Investigation	IN.1 – Gathers information (literature review, measurements, experiments, laboratory exercises) and analyzes data. IN.2 – Devises and/or implements an appropriate plan / methodology for gathering information required to solve a complex engineering problem. IN.3 – Interprets results and reaches appropriate conclusions	I
Two Quizzes	10%	Knowledge Base	KB.3 – Recalls and defines, and/or comprehends and applies information, first principles and concepts in fundamental engineering science	I
Online-Assignments	10%	Problem Analysis	PA.1 – Identifies and defines complex engineering problems. PA.2 – Develops and/or implements a strategy to analyze complex engineering problems. PA.3 – Analyzes and solves complex engineering problems	I
Mid-term Test	10%	Problem Analysis Knowledge Base (60:40)	KB.3 – Recalls and defines, and/or comprehends and applies information, first principles and concepts in fundamental engineering science PA.3 – Analyzes and solves complex engineering problems	I
Final Examination	50%	Problem Analysis Knowledge Base (60:40)	KB.3 – Recalls and defines, and/or comprehends and applies information, first principles and concepts in fundamental engineering science PA.3 – Analyzes and solves complex engineering problems	I

*Level of Development of Graduate Attributes (I = Introductory; D = Intermediate; A = Advanced)

Grading

Tutorials (12%)			
Each Thursday we will have a tutorial, which is due five days later at 4:30 pm on Tuesday . Students will lose 10% of their mark per additional late day. Once the marks of assignments are posted to UMLearn no further assignment submissions will be allowed. Students will be given questions in order to practice their problem-solving skills. During tutorials, students will have two hours to work on the questions, asking questions of the TA/instructor when needed. Please upload a clearly scanned .pdf file to the UMLearn site for grading. Scanners are available in the Engineering Library or you can use the free Microsoft Office Lens App on your smart device to scan as a .pdf file for upload to UMLearn.			
Online Assignments (10%)			
Online assignments will be given on Tuesdays to supplement the tutorials to provide additional practice problems. (These will be automatically graded online.) Online assignments are due five days later at 4:30 pm on Sunday .			
Labs (8%)			
Five labs will be completed throughout the term. Students will complete the lab and write-up as a group (One write-up per group). Labs will be completed during the tutorial sessions (3 to 4 lab groups at a time). Students will leave to attend a lab session in order to receive a grade for the lab. Lab write-ups will be basic. The order will be:			
<ol style="list-style-type: none"> 1. Provide all measured data in an appropriate format. (Typically summarized in an Excel Spreadsheet) 2. Provide sample calculations for calculated cells. This can be done in pencil directly on the Excel sheet. 3. Answer all given questions in order. (Type written. Equations can be handwritten.) 			
All group members must sign their name, beside which should be indicated their percentage contribution to the lab. Individual lab marks will be weighted according to this percentage. The group lead should upload a scanned .pdf file on behalf of the group to the UMLearn site. Scanners are available in the Engineering Library. Lab reports are due one week after on Thursday at 4:30 pm .			
Quizzes (2 x 5%) October 13 and December 1, 2022			
Two 30-minute tests worth 5% of the final mark each will be administered during the tutorial periods on October 13 and December 1, 2022.			
Midterm (10%) October 27, 2022			
A 90-minute Midterm test worth 10% of the final mark will be administered during the tutorial period on October 27, 2022.			
Final exam (50%)			
A cumulative final exam worth 50% of your grade will be administered during the final examination period.			
Assessment method			
Tutorials	12%	Letter Grade	Percentage out of 100
Assignments	10%	A+	92-100
Labs	8%	A	85-91
Quizzes	10 %	B+	78-84
Midterm	10 %	B	72-77
Final Exam (comprehensive)	<u>50 %</u>	C+	66-71
	100 %	C	60-65
		D	50-59
		F	Less than 50

DEPARTMENT OF BIOSYSTEMS ENGINEERING
UNIVERSITY OF MANITOBA
BIOE 2790 Fluid Mechanics (4 credits)

2022-2023 Academic Year (Tentative Schedule)

Date	No.	Topic
Sept	1	Introduction to Fluid Mechanics
13	2	Fluid properties: Viscosity, surface tension, & ideal gas laws
15	3	Fluid statics: Pressure transmission
20	4	Fluid statics: Manometers
22	5	Fluid statics: Hydrostatic forces on plane surfaces
27	6	Fluid statics: Hydrostatic forces on curved surfaces
29	7	Fluid statics: Buoyancy & Stability
Oct 4	8	Fluid dynamics: Introduction & continuity equation, Frames of reference, control volume
6	9	Fluid dynamics: Reynolds transport theorem. Bernoulli Eq.
11	10	Fluid dynamics: Euler's equation. Application of Bernoulli's Eq.
13	11	Fluid dynamics: Hydraulic grade line, Momentum Equation
18	12	Fluid dynamics: Momentum equation
20	13	Fluid dynamics: Water hammer, Moment of momentum
25	14	Fluid dynamics: Work-energy equation
27	15	Flow in closed conduits: Laminar and Turbulent flow
Nov 1	16	Flow in closed conduits: Moody diagram problem solving
3	17	Flow in closed conduits: Minor losses
		Fall term break (No Classes Nov 7 - 11)
15	18	Flow in closed conduits: Equivalent length, pipe systems
17	19	Flow in closed conduits: Pipe systems
22	20	Open channel flow: Specific energy and critical velocity
24	21	Open channel flow: Supercritical flow and hydraulic velocity
29	22	Open channel flow: Hydraulic jump and critical velocity
Dec 1	23	Open channel flow: Channel transitions
6	24	Open channel flow: Channel transitions cont.
8	25	Review

Laboratories/Quiz/Test

Sep 15	1	Fluid Properties Lab + Tutorial
Oct 6	2	Fluid Statics Lab + Tutorial
13		Quiz 1 (During the lab) + Tutorial
27		Mid-term test (During the lab)
Nov 17	3	Fluid Dynamics Lab + Tutorial
22		Voluntary Withdrawal Deadline
24	4	Conduit flow Lab + Tutorial
Dec 1		Quiz 2 (During the lab)
8	5	Hydraulic Jump Lab

Policies

The Faculty of Engineering expects regular attendance of all students at lectures, laboratories, and tutorials. If the number of unexcused absences recorded against a student in any one course exceeds 10 percent of the number of course hours (including mandatory lectures, laboratories, and tutorials), the course instructor may report the case to the Dean of Engineering and inform the student of potential debarment. If the student's attendance or work continues to be unsatisfactory, the instructor has the authority to initiate procedures to debar the student from attending classes, handing in assignments, and from final examinations and/or from receiving credit. Such cases shall be reported to the Faculty Council of Engineering at the first opportunity. Students so debarred will have failed that course and will have to repeat the course in the case that the course is compulsory. (University of Manitoba General Academic Regulations 7.1 & Faculty of Engineering Academic Regulations 3.2)

The undergraduate calendar defines plagiarism as taking ideas or words of another person and passing them off as one's own. In short, it is stealing something intangible rather than an object. It will be considered plagiarism and/or cheating if you copy the answers of another student in any examination or take-home assignment. Plagiarism or any other form of cheating in tests, examinations or take-home assignments is subject to severe academic penalty (e.g. suspension or expulsion). A student found guilty of contributing to cheating is also subject to serious academic penalties.

All unclaimed assignments become property of the Faculty of Engineering and are subject to destruction. If students miss a midterm or quiz for legitimate medical or compassionate reasons the weight of the test will automatically be transferred to the final exam. An official physician's note will be required if a midterm or quiz is missed for medical reasons. Compassionate reasons must be discussed with, documented and approved by the instructor prior to the midterm or quiz.

Self-declaration forms may be completed for missed tests, exams, or assignments during short-term absences (≤ 72 hours) for extenuating circumstances. This form cannot be used for planned absences like vacations. It is also not to be used for longer-term absences, or ongoing circumstances (e.g., Authorized Withdrawals, Leaves of Absence, or other accommodations), which will still require additional documentation

[Self-Declaration Form for Brief or Temporary Absence](#)

[Self-Declaration Policy for Brief or Temporary Absence](#)

Additional information

University regulations **prohibit the use of Smartphones** during tests/exams. Some of you may not own a proper calculator. I encourage you to purchase and learn how to use a calculator to quickly solve for the roots of equations such as: $x^3 + 5x^2 - 15 = 25$

In addition, you should be able to use the GoalSeek or Solver functions in EXCEL to solve such equations.

If you are experiencing difficulties with your studies or assignments, or have a disability or illness which may affect your course of study, you should discuss these issues with your instructor and/or one of the following Student Affairs offices as soon as possible:

Disability Services, 155 University Centre, Ph: 474-6213

Student Counseling and Career Centre, 474 University Centre, Ph: 474-8592

Learning Assistance Centre, 520 University Centre, Ph: 474-9251