University of Manitoba
Department of Biosystems Engineering

Course Details

Course Title & Number:	BIOE 2790 Fluid Mechanics (Fall 2020)
Class Times & Days of Week:	Lectures: TR 10:00-11:15 Labs: T 2:30 - 4:30
Location for classes/labs/tutorials:	Virtual Lecture using Webex accessed through UMLearn Virtual Tutorials using Webex accessed through UMLearn
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:	Dr. (Ranjan) R. Sri Ranjan, P.Eng., Professor
Office Location:	Virtual contact scheduled through WebEx
Office Hours or Availability:	By appointment
Office Phone No.	204-474-9344
Email:	Sri.ranjan@umanitoba.ca
Teaching Assistant:	Mr. Leonard Ndulue
Office Location:	via email
Office Phone No.	204-474-8234 BioEng Intercom: 46
Email:	nduluee@myumanitoba.ca

Textbook, Readings, Materials

Required textbook – The following book is 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-10: 0134675851 • ISBN-13: 9780134675855

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.

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 and Late Submission Policy

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. All assignments must be submitted to pass the course.

Important Dates

October 12:	No classes – Thanksgiving Day
November 9 - 13:	No classes – Fall term break
November 23:	Last date for Voluntary Withdrawal for Fall term courses.

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	15%	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	10%	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	15%	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	40%	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 (15%)

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 marked 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.

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 (10%)

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). The lab is located in the Hydraulics Research & Testing Facility, E3-230 EITC. Attendance will be taken. Students must attend a lab session in order to receive a grade for the lab. Lab write-ups will be basic. The order will be:

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 later at 4:30 pm the following Thursday**.

Quizzes (2 x 5%) October 15 and December 3, 2020

Two 30-minute tests worth 5% of the final mark each will be administered during the tutorial periods on October 15 and December 3, 2020.

Midterm (15%) October 29, 2020

A 90 minute Midterm test worth 10% of the final mark will be administered during the tutorial period on October 29, 2020.

Final exam (40%)

A cumulative final exam worth 40% of your grade will be administered during the final examination period.

Assessment method

Tutorials	15%
Assignments	10%
Labs	10%
Quizzes	10 %
Midterm	15 %
Final Exam (comprehensive)	40 %
	100 %

Letter Grade	Percentage out of 100
A+	92-100
A	85-91
B+	78-84
B	72-77
C+	66-71
C	60-65
D	50-59
F	Less than 50

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

2020-2021 Academic Year (Tentative Schedule)

Date	No	Topic
Sept 10	**1**	Introduction to Fluid Mechanics
15	**2**	Fluid properties: Viscosity and surface tension
17	**3**	Fluid properties: Ideal gas laws
22	**4**	Fluid statics: Pressure transmission and measurement
24	**5**	Fluid statics: Hydrostatic forces on plane surfaces
29	**6**	Fluid statics: Centre of pressure
Oct 1	**7**	Fluid statics: Hydrostatic forces on curved surfaces
6	**8**	Fluid statics: Buoyancy
8	**9**	Fluid dynamics: Introduction and terminology
13	**10**	Fluid dynamics: Frames of reference, control volume
15	**11**	Fluid dynamics: Continuity equation
20	**12**	Fluid dynamics: Steady flow
22	**13**	Fluid dynamics: Quasi-steady flow
27	**14**	Fluid dynamics: Hydraulic grade line
29	**15**	Fluid dynamics: Momentum equation, Water hammer
Nov 3	**16**	Fluid dynamics: Moment of momentum
5	**17**	Fluid dynamics: Work-energy equation
		Fall term break (No Classes Nov 11 - 15)
17	**18**	Flow in closed conduits: Turbulent flow, Moody diagram
19	**19**	Flow in closed conduits: Equivalent length
24	**20**	Flow in closed conduits: Flow in pipe network
26	**21**	Open channel flow: Specific energy and critical velocity
Dec 1	**22**	Open channel flow: Supercritical flow
3	**23**	Open channel flow: Hydraulic jump and critical velocity
8	**24**	Open channel flow: Channel transitions
10		Review

		Laboratories/Quiz/Test
Sep 17	**1**	Fluid Properties Lab + Tutorial
Oct 8	**2**	Fluid Statics Lab + Tutorial
15		**Quiz 1 (During the lab) + Tutorial**
29		**Mid-term test (During the lab)**
Nov 19	**3**	Fluid Dynamics Lab + Tutorial
23		**Voluntary Withdrawal Deadline**
26	**4**	Conduit flow Lab + Tutorial
Dec 3		**Quiz 2 (During the lab)**
10	**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.

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