

**Western University
Faculty of Engineering
Department of Mechanical and Materials Engineering**

**MME 2273B: INTRODUCTION TO FLUID MECHANICS
AND HEAT TRANSFER**

Course Outline 2021-22

Description: An introduction to fluid mechanics and heat transfer. The fluid mechanics part covers fluid properties, fluid statics including buoyancy and stability, one-dimensional fluid dynamics including conservation of mass and energy and losses in pipe networks. Heat transfer covers development of the general energy equation for three dimensions and steady-state conduction in one and two dimensions.

Upon successful completion of this course students will be able to:

- (1) Combine and apply the concepts learned to accurately solve engineering calculation problems based on the fluid mechanics and heat transfer topics covered in the course.
- (2) Conduct laboratory experiments in fluid mechanics and heat transfer, analyze the data obtained and critically evaluate the results, including an assessment of sources of experimental uncertainty.

Instructor: Dr Kelly Ogden
SEB 3091, 519-661-2111 ext. 84554, UWO e-mail: kogden3@uwo.ca
Consultation hours: To be determined

Academic Calendar Copy:

Contact Hours: 3 lecture hours, 2 tutorial hours, 0.5 laboratory hours per week (laboratory hours are two 3 hour sessions), 0.5 course. Lectures: Monday 10:30-11:30 am (SEB-1059), Tuesday 1:30-2:30 pm (HSB-40), Wednesday 12:30-1:30 pm (NS-7). Tutorial: Tuesday 2:30-4:30 pm (HSB-40).

Anti-requisite: None

Pre-requisites: NMM 2270A/B or the former Applied Mathematics 2270A/B

Co-requisite: NMM 2270A/B or the former Applied Mathematics 2270A/B

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will 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.

CEAB Academic Units: Science = 50%, Engineering Science = 50%.

Required Textbooks:

For Fluid Mechanics: *Fluid Mechanics*, White F and Xue H, 9th Edition, McGraw Hill, ISBN 978-1-260-57554-5.

For Heat Transfer: *Fundamentals of Heat and Mass Transfer*, Bergman T L, Lavine A S, 8th Edition, John Wiley and Sons, ISBN: 978-1-119-32042-5.

Other Required References: Some additional material will be posted on the course OWL site.

General Learning Objectives (CEAB Graduate Attributes)

Knowledge Base	I	Use of Engineering Tools		Impact on Society and the Environment	
Problem Analysis		Individual and Teamwork	I	Ethics and Equity	
Investigation	I	Communication Skills		Economics and Project Management	
Design		Professionalism		Life-Long Learning	

Notation: where *x* be *I*: Introductory, *D*: Intermediate, *A*: Advanced, or empty. *I* – The instructor will introduce the topic at the level required. It is not necessary for the student to have seen the material before. *D* – There may be a reminder or review, but the student is expected to have seen and been tested on the material before taking the course. *A* – It is expected that the student can apply the knowledge without prompting (e.g. no review).

Course Topics and Specific Learning Outcomes	CEAB Graduate Attributes Indicators
<p>1. Fluid statics</p> <p>At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a. Identify the fluid properties required to solve a problem and determined their magnitude. b. Determine the pressure at a point in a static fluid from a measurement taken at another point. c. Quantify hydrostatic forces and moments acting on a system. d. Determine whether a partially submerged body will float and whether it will be stable. 	<p>KB2</p> <p>KB2</p> <p>KB3</p> <p>KB2</p>
<p>2. Fluid dynamics</p> <p>At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a. Apply the mass and energy conservation (Bernoulli) equations to solve idealized fluid flow problems. b. Determine flow rates and or pressure losses in a realistic pipe system. c. Successfully conduct and report on laboratory measurements taken on a pipe flow system. 	<p>KB2, KB3</p> <p>KB2, KB3</p> <p>I2, I3</p>
<p>3. Introduction to heat transfer modes</p> <p>At the end of this section, students will be able to:</p> <ul style="list-style-type: none"> a. Identify the modes of heat transfer associated with a given heat transfer problem. 	<p>KB2</p>

b. Calculate heat transfer rates and/or material/fluid temperatures for simple problems involving two or three heat transfer modes.	KB3
4. Steady state conduction	
At the end of this section, students will be able to:	
a. Apply the heat diffusion equation to solve 1-D conduction problems in Cartesian, cylindrical and spherical co-ordinate systems.	KB3
b. Successfully conduct and report on laboratory measurements of linear conduction heat transfer	I2, I3
c. Determine the heat transfer characteristics of a finned surface.	
d. Use shape factors to solve simple multi-dimensional heat transfer problems.	KB3

Evaluation

Course Component	Weight
In-tutorial Questions	10% (1.43% each)
Quizzes	25% (12.50% each)
Laboratory	5% (2.50% each)
Final Examination	60%

In-tutorial Questions:

- In-tutorial Question #1: Tuesday 18th January 2022
- In-tutorial Question #2: Tuesday 25th January 2022
- In-tutorial Question #3: Tuesday 8th February 2022
- In-tutorial Question #4: Tuesday 15th February 2022
- In-tutorial Question #5: Tuesday 8th March 2022
- In-tutorial Question #6: Tuesday 15th March 2022
- In-tutorial Question #7: Tuesday 22nd March 2022

Quizzes:

- Quiz #1: Tuesday 1st February 2022, 2.40 pm – 4.10 pm
- Quiz #2: Tuesday 1st March 2022, 2.40 pm – 4.10 pm

Laboratories:

- Laboratory experiment 1: Losses in pipe networks (Weeks 9 – 11)
- Laboratory experiment 2: Linear heat conduction (Weeks 10 – 12)

Final Examination: The final examination will take place during the regular examination period.

Course Policies

General: Students are responsible for regularly checking their Western e-mail and the OWL course website (<https://owl.uwo.ca/portal/>) in order to make themselves aware of any information that is posted about the course. If a student fails to act on information that has been posted on the

OWL course website and does so without a legitimate explanation (i.e. those covered under the illness/compassionate form), then there are no grounds for an appeal.

Quizzes: Both Quizzes will be closed book and an equation sheet will be provided in the exam. Only non-programmable calculators will be allowed. Students arriving more than 10 minutes late for the Quiz will not be allowed to write the Quiz and will receive zero marks. If a student is excused from writing a Quiz by academic consideration (e.g. due to illness or for religious or other accepted personal reasons) the weighting of that Quiz may be placed onto other assessed work. If a student is excused from writing Quiz #1 its weight will be placed onto Quiz #2. If a student is excused from writing Quiz #2 its weight will be placed onto the Final Exam. If a student is going to miss a Quiz for religious reasons, they must inform the instructor in writing within 1 week after the start of term or they will be required to write the Quiz. Even with academic consideration (see above) a student must attend and submit work for at least 1 of the 2 Quizzes in order to be eligible to sit the final exam.

Weekly In-tutorial Questions: The In-tutorial Questions are open-book and students should work in a group of 4 students, submitting a single report with all the group members' names and ID numbers on it. Students arriving more than 10 minutes late for an In-tutorial question will not be allowed to be included on a submitted solution and will receive zero marks. Even with any academic considerations (see above), a student must attend and submit work for a minimum of 4 out of the 7 In-tutorial questions in order to be eligible to sit the final exam. The total possible course grade for In-tutorial questions is based on submission of work for all 7 In-tutorial questions (e.g. submission of the minimum 4 pieces of work can only attract a maximum of 4/7 of the total available marks in this category. If a student submits the minimum 4 pieces of work and misses one In-tutorial question with academic consideration, the missed work is re-weighted such that they may achieve a maximum of 4/6 of the total available marks in this category).

Laboratories: Laboratory reports are to be submitted during the laboratory class. Attendance at both of the designated laboratory sessions is compulsory (even with academic consideration). Failure to attend and complete both laboratory sessions will mean that the student will not be allowed to sit the final exam. If a laboratory is missed, without academic consideration, there is no guarantee of a make-up laboratory session.

Final Exam: The Final Exam will be Closed Book and an equation sheet will be provided. Only non-programmable calculators will be allowed. If a minimum mark of 50% is not obtained on the Final Exam the student cannot receive a final course mark greater than 48%.

Summary of Attendance and Coursework Submission Policies: Even taking into account any academic considerations, in order to be able to sit the Final Exam a student must:

- (1) Attend and submit solutions for at least 4 of the 7 In-tutorial questions;
- (2) Attend and submit work for at least 1 of the 2 Quizzes and
- (3) Attend and submit work for both of the laboratory sessions.

Any student not meeting these requirements will be forbidden to write the Final Exam and so will fail the course. In the absence of academic consideration, it is necessary to submit work for 7 In-tutorial questions and sit both Quizzes in order to have the opportunity to gain full marks in those categories. Any coursework that is submitted late will attract a penalty of 10% (of the graded mark) per day it is late.

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 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: Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the department, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Absence Due to Illness or Other Circumstances: 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 the attached “Instructions for Students Unable to Write Tests or Examinations or Submit Assignments as Scheduled”). 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.

For more information concerning medical accommodations, see the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

For more information concerning accommodations for religious holidays, see the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

Cheating and 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. University policy states that cheating, including plagiarism, 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.

All required papers may be subject to submission for textual similarity review to commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

Students may not upload course materials to the internet. In particular, students are prohibited from submitting course questions to on-line tutoring services, discussion boards, etc. Violation of this rule will be considered a scholastic offence.

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

Remote Learning: If remote instruction or assessment must occur, on-line proctoring software such as Proctortrack may be used at the discretion of the university, faculty, department, and/or instructor. Students may be required to turn on their cameras during live remote lessons or tutorials. Other policies and changes to the syllabus may be implemented as appropriate.

Use of Electronic Devices: Only a non-programmable calculator may be used in the Quizzes and in the Final Exam.

Use of Personal Response Devices (“Clickers”): None

Policy on Repeating All Components of a Course: Students who are required to repeat an Engineering course must repeat all components of the course. No special permissions will be granted enabling a student to retain laboratory, assignment, or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted by the student for grading in subsequent years.

Internet and Electronic Mail: Students are responsible for regularly checking their Western e-mail and the course web site (<https://owl.uwo.ca/portal/>) and making themselves aware of any information that is posted about the course.

Accessibility: 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 519-661-2111 ext. 82147 for any specific question regarding an accommodation.

Support Services: Office of the Registrar, <http://www.registrar.uwo.ca/>
Student Development Centre, <http://www.sdc.uwo.ca/>
Engineering Undergraduate Services, <http://www.eng.uwo.ca/undergraduate/>
USC Student Support Services, <http://westernusc.ca/services/>

Students who are in emotional/mental distress should refer to Mental Health @ Western, http://www.health.uwo.ca/mental_health/, for a complete list of options about how to obtain help.

INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED

If, on medical or compassionate grounds, you are unable to write term tests or final examinations or complete course work by the due date, you should follow the instructions listed below. You should understand that academic relief will not be granted automatically on request. You must demonstrate to your department (or the Undergraduate Services Office) that there are compelling medical or compassionate grounds that can be documented before academic relief will be considered. Different regulations apply to term tests, final examinations and late assignments. Please read the instructions carefully.

NEW: Requests for Academic Consideration using the Self-Reported Absence Form

If you experience an unexpected illness or injury or an extenuating circumstance (48 hours or less) that is sufficiently severe to temporarily render you unable to meet academic requirements (e.g., attending lectures or labs, writing tests or midterm exams, completing and submitting assignments, participating in presentations) you should self-declare using the online Self-Reported Absence portal. This option should be used in situations where you expect to resume academic responsibilities within 48 hours or less.

Each student will be allowed a maximum of two self-reported absences between September and April and one self-reported absence between May and August. Self-reporting may not be used for final exams or assessments (e.g. midterm exams, tests, reports, presentations, or essays) worth more than 30% of any given course.

For full instructions about the Self-Reporting System refer to the Academic Calendar link [here](#).

A. GENERAL REGULATIONS & PROCEDURES (other than self-reported absences)

1. All first year students will report to the Undergraduate Services Office, SEB 2097, for all instances.
2. If you are an upper year student and you are missing a test/assignment/lab or examination that is worth LESS THAN 10% of your mark, you should report to your department office to request relief. If your course work is worth MORE THAN 10% of your final grade, you will report to the Undergraduate Services Office, SEB 2097.
3. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.
4. Documentation must be provided as soon as possible. If no one is available in your department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.
5. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

B. TERM/MIDTERM TESTS (other than self-reported absences)

1. If you are in first year and you are unable to write a midterm/term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.
2. If you are an upper year student and you are unable to write a midterm/term test, inform your instructor PRIOR to the scheduled date of the test. If the instructor is not available, leave a message for him/her at the department office. If the test is worth LESS THAN 10% of your mark, you should report to your department office to request relief. If the test is worth MORE THAN 10% of your final grade you will report to the Undergraduate Services Office, SEB 2097 to request relief.
3. Be prepared to provide supporting documentation to the Department Chair and/or the Undergraduate Services Office (see next page for information on documentation).
4. Discuss with the instructor if and when the test can be rescheduled. **N.B.** The approval of the Chair or the Undergraduate Services Office is required when rescheduling midterm/term tests.

C. FINAL EXAMINATIONS (cannot be self-reported)

1. If you are unable to write a final examination, contact the Undergraduate Services Office **PRIOR TO THE SCHEDULED EXAMINATION TIME** to request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number.
2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, headache, sleeping in, misreading timetable and travel arrangements.
3. In order to receive permission to write a Special Examination, you must obtain the approval of the Chair of the Department **and** the Associate Dean and in order to apply you must sign a "Recommendation for a Special Examination Form" available in the Undergraduate Services Office. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.

D. LATE ASSIGNMENTS

1. Advise the instructor if you are having problems completing the assignment on time (**prior** to the due date of the assignment).
2. Be prepared to provide documentation if requested by the instructor (see reverse side for information on documentation).
3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Assistant Dean, First Year Studies, if you are in first year) is not required if assignments will be completed prior to the last day of classes.
4.
 - i) Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean, Undergraduate Studies. Documentation is mandatory.
 - ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean, Undergraduate Studies.

E. SHORT ABSENCES

If you miss a class due to a minor illness or other problem, check your course outlines for information regarding attendance requirements and make sure you are not missing a test, laboratory or assignment. Cover any readings and arrange to borrow notes from a classmate.

F. EXTENDED ABSENCES

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You are strongly encouraged to seek advice from your Academic Counsellor in the Undergraduate Services Office.

G. DOCUMENTATION

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, **you must provide the doctor with a Student Medical Certificate** to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office). **This note must contain the following information: severity of illness, effect on academic studies and duration of absence. Regular doctor's notes will not be accepted; only the Student Medical Certificate will be accepted.**

In Case of Serious Illness of a Family Member: Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

In Case of a Death: Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

For Other Extenuating Circumstances: If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

Note: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

H. ACADEMIC CONCERNS

1. You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).
2. **You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.**
3. If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your Academic Counsellor.

Calendar References: Check these regulations in your 2021 Western Academic Calendar available at www.westerncalendar.uwo.ca.

[Self-Reporting Absences](#)
[Absences Due to Illness](#)
[Academic Accommodations for Students with Disabilities](#)
[Academic Accommodations for Religious or Holy Days](#)
[Course Withdrawals](#)
[Examinations](#)
[Scheduling of Term Assignments](#)
[Scholastic Offences](#)
[Student Medical Certificate](#)
[Engineering Academic Regulations](#)

Note: These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

Add Deadlines:

First term half course (i.e. "A" or "F")	September 16, 2021
Full courses and full-year half course (i.e. "E", "Y" or no suffix)	September 16, 2021
Second term half course (i.e. "B" or "G")	January 11, 2022

Drop Deadlines:

First term half course (i.e. "A" or "F")	November 12, 2021
Full courses and full-year half courses (i.e. "E", "Y" or no suffix)	November 30, 2021
Second term half or second term full course (i.e. "B" or "G")	March 7, 2022

Contact Information:

Undergraduate Services Office	SEB 2097 Phone: 519-661-2130	E-mail: engugrad@uwo.ca
Chemical & Green Process Engineering	TEB 477 Phone: 519-661-2131	E-mail: cbeugrad@uwo.ca
Civil Engineering:	SEB 3005 Phone: 519-661-2139	E-mail: civil@uwo.ca
Computer, Electrical, Mechatronic Systems & Software Engineering	TEB 279 Phone: 519-661-3758	E-mail: eceugrad@uwo.ca
Integrated Engineering	ACEB 2410 Phone: 519-661-6725	E-mail: engceli@uwo.ca
Mechanical Engineering	SEB 3002 Phone: 519-661-4122	E-mail: mmeundergraduate@uwo.ca

Revised 08/04/21