Western University
Department of Mechanical & Materials Engineering

MME 3303A – Fluid Mechanics II

COURSE OUTLINE – 2025-2026

CALENDAR DESCRIPTION: Conservation of mass and linear momentum, differential analysis of the flow, centrifugal pumps, dimensional analysis, laminar and turbulent boundary layers, drag and lift forces on objects, description of turbulence.

COURSE INFORMATION:

Instructor: Christopher DeGroot, PhD, PEng

Email: christopher.degroot@uwo.ca

Lectures/tutorials/labs: See Draft My Schedule

CONSULTATION HOURS: By appointment only. To be booked using link on course website.

PREREQUISITES: MME 2273A/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.

ANTIREQUISITES: None

ACCREDITATION UNITS: Engineering Science = 100%

TOPICS:

1. Introduction
2. Differential relations for fluid flow
   - Conservation of mass
   - Conservation of momentum
   - Navier-Stokes equations
3. Dimensional analysis
   - Dimensionless parameters
   - Buckingham π theorem
   - Relationship between model and full-scale flows
4. Flow past immersed bodies
   - Boundary layer flows
   - Drag and lift on immersed bodies
5. Turbomachinery
   - Pumps
   - Pump performance curves
   - System characteristics and pump selection
6. Introduction to turbulence
   - Reynolds decomposition
   - Physical nature of turbulent flows

LEARNING OUTCOMES:

The Mechanical and Materials Engineering Program has been accredited by Canadian Engineering Accreditation Board (CEAB) of Engineers Canada. Accredited programs provide the academic requirements for licensure as a professional engineer in Canada. Western Engineering has defined indicators of the 12 Graduate Attributes (GAs) that the CEAB expects graduating engineering students to demonstrate. The connections between course learning outcomes and Western Engineering's GA Indicators are identified below.

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

1. Apply fundamental fluid mechanics principles to analyze practical engineering flow problems (KB2, KB3, KB4, PA1, PA2)
2. Derive and manipulate the differential forms of conservation of mass and momentum, including the Navier–Stokes equations, for selected geometries and boundary conditions (KB3, KB4, PA1, PA2).
3. Non-dimensionalize governing equations and use the Buckingham π theorem to identify key dimensionless groups and understand relationships between model and full-scale flows (KB3, KB4, PA1, PA2).
4. Analyze flow around immersed bodies and calculate their drag and lift coefficients (KB3, KB4, PA1, PA2).
5. Interpret pump performance curves, determine operating points, and select appropriate pumps for prescribed system requirements (KB3, KB4, PA1, PA2).
6. Explain the Reynolds decomposition and describe the basic statistical and physical characteristics of turbulent flows (KB3, KB4).
7. Analyse laboratory data, including comparing experimental results with theoretical or empirical predictions, quantify uncertainty, and draw justified conclusions (PA1, PA2, PA3, IN1, IN2, IN3, LL1).
8. Work effectively in multidisciplinary teams by contributing to group tasks, performing constructive peer evaluation, and reflecting on individual and team performance (ITW1, ITW2, ITW3).

CONTACT HOURS:

3 lecture hours/week, 2 tutorial hours/week, 8 laboratory hours in total (4 lab activities, 2 hours each), half course

TEXTBOOK:

Frank White and Henry Xue, Fluid Mechanics, 9th edition, McGraw Hill.

- Print Edition, $112.15
- Ebook, $99.00

Students are welcome to use earlier editions; however, all suggested problems and suggested readings will be based on the 9th edition.

Course topics correspond to the textbook sections as follows:

Topic	Textbook sections
Introduction	Chapter 1
Differential relations for fluid flow	Chapter 4
Dimensional analysis	Chapter 5
Flow past immersed bodies	Chapter 7

Turbomachinery	Chapter 11
Introduction to turbulence	Sections 6.5, 6.6

UNITS: SI will be used; however, English units may be introduced through examples as required.

EVALUATION: The final course grade will be determined according to the following weighting scheme:

- In-class participation (iClicker assessment): 10%
- Weekly in-tutorial assignments: 10%
- Laboratory data analysis and report: 10%
- Term test 1 (closed book): 15%
- Term test 2 (closed book): 15%
- Final exam (closed book): 40%

Tests, tutorial assignments, class participation and laboratories will be carried out according to the following *tentative* schedule:

Item	**Weight**	**Effort Type**	**Assigned**	**Due**
Class participation	10%	Individual	Weekly	During the lecture
In-tutorial assignments	10%	Individual	Weekly	End of tutorial hour in which it is assigned
Term test 1	15%	Individual	Monday October 6, 2025	
Term test 2	15%	Individual	Monday November 17, 2025	
Lab 1	2.5%	Team	Weeks of Oct. 13 and Oct. 23	End of lab period
Lab 2	2.5%	Team	Weeks of Oct. 27 and Nov. 10	End of lab period
Lab 3	2.5%	Team	Weeks of Nov. 17 and Nov. 24	End of lab period
Lab 4	2.5%	Team	Week of Dec. 1	End of lab period
Final Exam	40%	Individual	To be scheduled	

COURSE POLICIES: The following course-specific policies will be strictly enforced throughout the course:

Laboratory sessions

- The lab schedule will be posted 2-3 weeks before the beginning of labs. Students are required to sign up for a specific session and must attend the session that they signed up for. Students that do not sign up for a session by the communicated deadline will be placed into a session by the instructor (or delegate) and will be required to attend that session.

- Failure to pass the laboratory component of the course will result in automatic failure of the course. Passing of the laboratory component requires a grade equal to or higher than 50% on the laboratory component of the course and missing no more than one individual lab session.
- A make-up session will be offered to students who have missed a laboratory session **with** academic consideration.
- Missing of a laboratory session **without** academic consideration will translate into a mark of zero for that laboratory session.
- When academic consideration has been obtained for a particular laboratory session, it is the student's responsibility to contact the instructor of the course in a timely manner to seek alternate arrangements for the missed laboratory session. A timely manner is defined as a maximum of 72 hours after consideration has been obtained from the Engineering Undergraduate Services Office.

In-Tutorial Assignments

- In-tutorial assignments will take place during the second hour of the tutorials (except on September 8, October 6, November 17). The first hour of the tutorial will be conducted by the course instructor and/or the teaching assistant and will focus on solving additional problems and answering student questions.
- The in-tutorial assignment will be based on problem solving **individually** and must be completed **inside the tutorial classroom**. Attendance will be taken and any student who attempts to complete the online assignment outside the tutorial classroom will receive a grade of zero.
- No make-up sessions will be offered for those missing the in-tutorial assignment (irrespective of the reason).
- The tutorial assignment grade will be calculated as a simple average of all of the individual grades, excluding the lowest grade. Since flexibility in terms of which items are assessed has been provided through this mechanism, all academic consideration requests for in-tutorial assignments will be denied.

Term Tests

- Term tests will be closed book. A standard formula sheet will be provided along with any other tables, figures, or data that are deemed by the instructor to be required for the test. Standard scientific calculators are permitted.
- Each of the two term tests will be two hours long and will be held during the tutorial period.
- No make-up term test will be offered regardless of the circumstances for which the term test was missed. Missing a term test **without** academic consideration will result in a mark of zero for that test. Missing a term test **with** academic consideration will automatically shift the weight of the missed term test onto the final exam.
- Term test 2 is considered as the "designated assignment" in this course where self-reported absences may not be used. If a self-reported absence is submitted for this test, it will be denied.

Term work

- If a minimum of 50% is not obtained on term work (class participation, term tests, in-tutorial assignments, and laboratory sessions), the student will fail the course irrespective of the mark obtained in the final examination.
- A student will be considered ineligible to write the final examination if, in the opinion of the instructor, they have not completed sufficient term work.

Final examination

- The exam will take place during the December examination period.
- The exam will be closed book. A standard formula sheet will be provided along with any other tables, figures, or data that are deemed by the instructor to be required for the test. Standard scientific calculators are permitted.
- The length of the final exam will be three hours.
- If a minimum of 50% is not obtained on the final examination, the student will be assigned a grade of no greater than 48% for the course.
- If a student misses the Final Exam, they must follow the procedures described below in the section on "Exam Accommodation" under "General Faculty / University Policies".

Generative Artificial Intelligence (AI)

- The general policy on use of AI is described below in the section on "Faculty of Engineering AI Policy" under "General Faculty / University Policies".
- To avoid any ambiguity, the use of AI is permitted, except for activities that are conducted under a controlled environment and involve individual work. These include: in-class participation, in-tutorial assignments, term tests, and the final exam.
- Students are encouraged to use AI responsibly to assist them with the course material (for example, asking to explain concepts or help solve suggested problems). Students should be aware, however, that large language models (LLMs) tend to directly give answers to questions instead of acting like a "tutor" that would help guide the student through a problem in a pedagogically beneficial manner. Studies have shown that this results in lower levels of student learning. Students wanting to use AI should consider developing prompts that instruct the LLM to act as a tutor. Example prompts can be found here, for example. Further studies have shown that use of a custom-prompted "AI tutor" can increase student learning.

In addition, please be aware of the following suggestions and information:

1. Students who are feeling unwell are asked to refrain from coming to class, tutorials, labs, office hours, etc. This is a common courtesy to avoid transmitting illnesses to your classmates and the instructor. If students choose to come to class while ill, although this is strongly discouraged, they are asked to, at a minimum, wear a well-fitted face mask. Face masks are provided at various locations on campus at no cost. The instructor will make every effort to assist students who miss class by providing complete notes and additional office hours to help students avoid falling behind due to illness.
2. The instructor will also refrain from coming to campus in the event that he is feeling unwell. In such cases, lectures may be temporarily moved to an online format for a short time. If this occurs, students will be notified through Brightspace as soon as possible. The instructor will wear a well-fitted respirator upon returning from an illness until fully recovered.

General Faculty / University Policies

The Faculty of Engineering and Western University have overarching policies that prescribe how undergraduate courses should run. The course-specific policies described above should be considered *in addition to* those overarching policies, or as course-specific interpretations of them. In the event of contradictions or confusion between course-specific policies above and general Faculty / University policies, please contact your course instructor for clarification.

Western Engineering's undergraduate polices can be found by navigating to:
https://www.eng.uwo.ca/undergraduate/academic-support-and-accommodations/policies.html

and then clicking the "*Engineering Undergraduate Policies framework*" link.