

**Course:** PHYD37, Introduction to Fluid Mechanics

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Please use only UofT email accounts. When composing your email, please use professional language. Be sure to include the course code as part of the subject line and sign the email with your first and last name, as well as your student ID. Your email will be answered as soon as possible.

**Web:** PHYD37 maintains a Quercus web space which archives a variety of course-related information including: grades, class announcements, lecture and lab materials, contact information and links to outside resources. In addition, class emails will periodically be sent via Quercus. To receive these emails, you must have a valid “utoronto.ca” email account registered with ROSI.

**Lectures:** Zoom link will be shared via Quercus, Tuesdays 10:00–12:00, we will keep Thursdays as an option for tutorials.

**Office Hours:** Virtual via zoom; office hours: by appointment

**Marking Scheme:** Home works 25%, Midterm 1 Exam 35%, Final Exam 40%.

**To pass this course** you need to pass either the midterm or final exam and to receive a final grade of 50+.

**Course Description:** This course is an introduction to the analysis of motion of fluids such as water, air, magma, as well as an introduction to transport phenomena such as heat and mass transfer. We will cover the topics of mass, momentum and energy conservation. We will derive and discuss several important dimensionless numbers that can help us understand the type of flow and study in more detail two types of regimes: inviscid and highly-viscous flow. We will also cover the theory of waves.

**List of topics:** (tentative schedule, we'll try to cover all topics listed time permitting)

1. Introduction: Exterior Calculus, Dimensional Analysis, Buckingham-Pi Theorem
2. Heat and mass transfer
3. Derivation of governing equations, mass conservation, material derivative
4. Derivation of momentum and energy equations, constitutive equations
5. Exact solutions to Navier-Stokes (N-S) equations
6. High Reynolds number flows
7. Low Reynolds number flows (boundary layers)

8. Numerical solutions to N-S equations
9. Waves and instabilities
10. Rayleigh-Bernard Convection

**Books:**

There is no required textbook. I will provide you with notes through out the term, and coming to class and taking notes will be very important to ensure your success.

Here is a list of recommended books:

Fluid Mechanics by Pijush K. Kundu and Ira M. Cohen (recommended)

Fluid Mechanics by Frank White

An Introduction to Fluid Dynamics by G.K Batchelor

**Online resources:**

In the 60's MIT produced a series of educational fluid mechanics videos that are still highly regarded today for their quality and instructional value: <http://web.mit.edu/hml/ncfmf.html>  
You will be required to watch some of them and discuss them in class.

**Prerequisites:** It is expected that the student is familiar with vector calculus and basic solutions to ordinary and partial differential equations. Some knowledge of thermal physics may be helpful.

**Problem sets:** There will be homework assigned on a regular basis. The only ground rule is that you may not consult solutions on the Internet and that the work you turn in must be your own.

**Showing your work:** On your problem sets, make sure you show all the work that went into solving each question. This will allow the grader to follow your method, to know if you understand the material and where you are having difficulties. Don't be afraid to explain what you are doing. Your solution should look like an explanation to someone about how you solve the problem. It is not the grader's job to decipher your work, so make sure your work is neat, legible, complete and organized. A concluding statement is generally a good idea.

**Midterm:**

There will be a take-home mid-term test after the reading week. If you miss the mid-term due to a legitimate reason, you must submit appropriate documentation *within one week of your absence*. If the reason is medical, an official UTSC medical form should be downloaded from the Registrar's website [http://www.utsc.utoronto.ca/~registrar/resources/pdf\\_general/UTSCmedicalcertificate.pdf](http://www.utsc.utoronto.ca/~registrar/resources/pdf_general/UTSCmedicalcertificate.pdf) and completed by your physician. Students with a validated absence will be permitted to write a make-up exam. *If no acceptable documentation is received, you will receive a grade of zero for that test.*

## **Final Examination:**

There will be a 2-hour, *cumulative* exam written during the end of semester exam period. The exact date, time and location will be announced as soon as they are available.

***Please note that if you miss the Final Exam, you must petition the Registrar's Office to write a make-up exam in the next formal exam period.*** e.g. for a missed April Final Exam, the make-up Exam is in August. Your documentation is crucial for a successful petition and must be submitted by the last day of the exam period. Check the UTSC Calendar for instructions and deadlines.

## **On Academic Integrity:**

Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters ([www.governingcouncil.utoronto.ca/policies/behaveac.htm](http://www.governingcouncil.utoronto.ca/policies/behaveac.htm)) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

In papers and assignments:

1. Using someone else's ideas or words without appropriate acknowledgement.
2. Submitting your own work in more than one course without the permission of the instructor.
3. Making up sources or facts.
4. Obtaining or providing unauthorized assistance on any assignment.

On tests and exams:

1. Using or possessing unauthorized aids.
2. Looking at someone else's answers during an exam or test.
3. Misrepresenting your identity.

In academic work:

1. Falsifying institutional documents or grades.
2. Falsifying or altering any documentation required by the University, including (but not limited to) doctor's notes.

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what

constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources (see [www.utoronto.ca/academicintegrity/resourcesforstudents.html](http://www.utoronto.ca/academicintegrity/resourcesforstudents.html)).

**On Accommodation:**

The University provides academic accommodations for students with disabilities in accordance with the terms of the Ontario Human Rights Code. This occurs through a collaborative process that acknowledges a collective obligation to develop an accessible learning environment that both meets the needs of students and preserves the essential academic requirements of the University's courses and programs.

For more information on services and resources available to instructors and students, please contact Tanya Lewis, Director, Academic Skills and Accessibility Services at 416-978-6786; [tanya.lewis@utoronto.ca](mailto:tanya.lewis@utoronto.ca).