

**Mechanical Engineering 4S03: Incompressible Flow**  
McMaster University, Faculty of Engineering, Fall 2017

**Instructor:** Dr. Heba Teamah, JHE-316, [teamahhm@mcmaster.ca](mailto:teamahhm@mcmaster.ca)

**Web site:** available on avenue to learn

**Text:** “Fox and McDonald’s Introduction to Fluid Mechanics”, P.J. Pritchard, and J.W. Mitchell, 9<sup>th</sup> edition, John Wiley, 2015, 2011

**Lectures:** Tues, Thurs, Fri at 11:30-12:20 in BSB 104.

**Office hours:** Tues, Thurs 12:30-1:30.

**Assignments:** Problem sets are planned for roughly every other week.

**Midterm:** There will be one test of 2 hours duration. To be scheduled.

**Final examination:** 3 hours in duration. The final exam will cover all lecture material.

**Assessment:** The following distribution of marks will be used unless there is a valid and compelling reason to use an alternative weighting.

Problem sets:	20%
Test:	20%
Final Exam:	60%

**Course Topics:**

- development of the Navier-Stokes equations
- internal incompressible flows
- laminar and turbulent boundary layers
- lift and drag
- airfoils
- development of the energy equation
- thermal boundary layers

**Learning Outcomes:** After successfully completing this course, the student will have demonstrated the ability to:

1. Perform calculations on and describe the general properties of a convective derivative
2. Provide a physical explanation of the forces that are inherent in the Navier-Stokes equations
3. Simplify and solve the Navier-Stokes equations for simple internal incompressible flows
4. Describe the characteristics of laminar and turbulent boundary layers and derive the corresponding momentum integral equation
5. Calculate boundary layer characteristics such as local shear stress, total drag, and

boundary layer thickness.

6. Describe the requirements for flow separation and explain the impact of streamlining.
7. Calculate the lift and drag forces on objects.
8. Provide an explanation for why lift occurs on airfoils and discuss aerodynamic stall.
9. Develop the thermal energy equation from first principles and explain what each term physically represents.
10. Describe the basis of the heat and momentum transfer analogy and perform heat transfer calculations on thermal boundary layers

### **Academic Ethics:**

Students are reminded that they should read and comply with the Statement on Academic Ethics and the Senate Resolutions on Academic Dishonesty as found in the Senate Policy Statements distributed at registration and available at the Senate Office. While interaction with your fellow students is expected in learning the course, assignments and projects submitted for academic credit **must** be your own work.

### **McMaster University Statement on Academic Integrity:**

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty") and/or suspension of expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy located at [www.mcmaster.ca/academicintegrity](http://www.mcmaster.ca/academicintegrity).

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

### **Policy Reminder:**

The Faculty of Engineering is concerned with ensuring an environment that is free of all discrimination. If there is a problem that cannot be resolved by discussion among the persons concerned, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer or the Human Rights Consultant, as the problem occurs.