Toronto Metropolitan University

Faculty of Engineering and Architectural Science
Department of Mechanical, Industrial, and Mechatronics Engineering

MEC 511: Thermodynamics and Fluids

Course Outline (Fall 2025)

Instructor Information

- **Instructor Name:** Dr. Scott Tsai, P.Eng.
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- **Instructor Name**: Dr. Babak Gheynani, P.Eng
- **Office Location:** EPH 312E
- **Office Hours:** TBA
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Prerequisites

CEN 199, CHY 102, (CPS 125 or CPS 188), (ELE 202 or MTE301), (MTH 312 or MTH 425), PCS 211, PCS 224 or MEC323).

Compulsory Texts

- Young, Munson and Okiishi's A Brief Introduction to Fluid Mechanics, 6th Ed.; John I. Hochstein; Andrew L. Gerhart; Wiley, 2021.
  ($135 e-book; $154 hardcopy)

- Fundamentals of Engineering Thermodynamics, 9th Ed.; M. J. Moran, H. N. Shapiro, D. D. Boettner and M. B. Bailey; Wiley, 2018.
  ($122 e-book; $143 hardcopy)

- MEC 511 – Laboratory Manual. To be distributed on the D2L course website.

Calendar Description

The scope and limitations of thermodynamics, macroscopic-approach heat, work, energy and first law. Properties and state of simple substances and fluids. Control-mass and control-volume energy analysis. The second law of thermodynamics, entropy limiting cycle efficiencies, criteria for equilibrium. Conservation equations for the flow of fluids. Application to one dimensional fluid flow.

Learning Objectives

At the end of this course, the successful student will have demonstrated that s/he:

1. Demonstrates an in-depth understanding of key concepts related to university level natural sciences (e.g. by explaining engineering ideas using natural sciences). Shows appropriate engineering interpretation of scientific terms. Properly applies scientific theories to simple engineering problems. (1a)
2. Formulates mathematical models using scientific and engineering principles; Justifies model assumptions and understands their limitations. Evaluates the effect of uncertainty in model parameters. (2b)
3. Analyzes errors, uncertainty, and sensitivity in measurement and simulation. Constructs mathematical models consistent with known information constraints, and assumptions. (3b)
4. Manages time effectively to achieve individual and team goals. (6b)
5. Produces documents using appropriate format. Cites evidence to construct and support an argument. Reads and appropriately responds to written instructions. (7a)

Note: Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board. See the CEAB Graduate Attributes and Indicators document for more information.

Course Organization

- 3 hours of lecture per week
- 2 hours of lab/tutorial alternate weeks

Note - the lecture, lab/tutorial and assessment will be carried out in person. If this condition is changed, the logistics for online delivery will be posted on D2L.

Course Evaluation

Evaluation Component	Percentage of Final Grade
Group[a] lab reports	10% (attendance[b] plus report[c] are mandatory[d])
Midterm test	40%
Final exam	50%
Total:	**100%**

[a]In this course, group lab work must be carried out independently. Students within the same group may work with each other but are not allowed to work with individuals outside their own group. Each group must prepare their own report and use only materials prepared by their own group. Students may use course materials distributed by the instructor to the class at large but must use proper referencing.

[b] Students arriving more than 10 minutes late are marked *absent*. All absences must be documented in writing to receive academic consideration.

[c]Except where requests for Academic Consideration are granted, late reports receive a penalty of 50% per calendar day for the first two days of late submission, and a zero mark will be awarded if the submission is late for more than 2 calendar days.

[d]Students must attend their regularly scheduled laboratory session based on MyServiceHub registration and take part in writing the group report to receive full marks for that lab. (Failure to meet either of these two requirements will result in a zero mark for the lab.)

The grading turnaround time for the lab and midterm exam will be approximately 10 business days or less.

To pass the course, a student must:

- achieve a minimum overall grade of 50%,
- achieve at least 50% in the weighted combination of the midterm test and the final exam,
- achieve at least 50% in the weighted combination of all lab work, and
- complete all exams and lab work.

Examinations

- Midterm exam (approximately in Week 7), 1 hour and 50 minutes, covers fluid mechanics. Closed book, and one 8.5" x 11" independently hand-written aid sheet (both sides can be used) will be allowed.

- Final exam, during exam period, 3 hours, covers all course material from lectures, notes, assignments, and labs. Closed book, and one 8.5" x 11" independently hand-written aid sheet (both sides can be used) will be allowed.

Course Content

Chapter	Sections	Hours	Fluid Mechanics - Topics, description
1	1.1-1.6	3	**Introduction:** Dimensions and units; mass, weight, density; Ideal gas law; viscosity.
2	2.1-2.9	4	**Fluid Statics:** Pressure at a point, pressure variation in a fluid at rest, measurement of pressure, manometry, pressure measuring devices, hydrostatic forces on plane surfaces, pressure prism.
3	3.1-3.2, 3.4-3.8	4	**Fluid Dynamics:** Newton's second law; static, stagnation, dynamic, and total pressure; Bernoulli energy equation; energy and hydraulic grade lines.
4	4.1, 4.2.1-4.2.3, 4.3-4.4	4	**Fluid Kinematics:** Definitions of flows in one, two, and three dimensions; steady and unsteady flows; streamlines, streaklines, and pathlines; the material

Chapter	Sections	Hours	Fluid Mechanics - Topics, description
			derivative; control volumes; Reynolds transport theorem.
5	5.1.1-5.1.2	3	**Conservation of Mass – The Continuity Equation:** Derivation and examples for steady and time varying flows.

Chapter	Sections	Hours	Thermodynamics - Topics, description
1	1.1-1.7	2	**Introduction:** Open, closed, isolated systems; property, state, and process; extensive and intensive properties; SI and US systems of units; pressure units; temperature measurement and units.
2	2.1-2.6	4	**First Law of Thermodynamics:** Work, kinetic, and potential energy; conservation of energy; power, evaluating work, polytropic processes; energy balance; processes for closed systems; energy analysis of cycles; power, refrigeration, and heat pump cycles.
3	3.1-3.6, 3.8.1	3	**Evaluating Properties - Vapors:** Steam tables and properties, saturation tables, superheat tables.
3	3.9-10, 3.12-13.1, 3.14.2, 3.15	3	**Evaluating Properties – Gases:** Ideal gas law; internal energy, enthalpy, and specific heats; ideal gas law and constant specific heats; polytropic gas processes.
4	4.1-4.10	4	**Control Volume Analysis Using Energy:** Conservation of mass, conservation of energy, analyzing control volumes at steady state.
5	5.1	2	**Second Law of Thermodynamics:** Statements and use of the second law of thermodynamics.

This schedule is tentative. Any changes will be announced in a timely manner via D2L.

Laboratory Sessions

Week[e]	Lab Title	Room
3, 4	1. Measurement of Dynamic Viscosity.	In-person (KHE31)
5, 6	2. The Venturi Flow Meter.	In-person (KHE31)
7, 8	3. Steam Pressure/Temperature Relationship.	In-person (KHE27-29)
9, 10	4. Steam Quality Measurement.	In-person (KHE27-29)

This schedule is tentative. Any changes will be announced in a timely manner via D2L.

[e]Students must check their lab schedule posted on D2L as well as on MyServiceHub.

Faculty Course Survey

Students may be required to complete this survey during the week of 10, 11 or 12 of the term.

University Policies

All students are expected to read, understand, and abide by the MIME Course Management Policy, and all specific TMU Policies linked into that document.

Approved by,

Dr. Der Chyan (Bill) Lin
Associate Chair, Mechanical Engineering