MAAE 3400: Applied Thermodynamics
Course Outline

Required Text

Additional documents and references will be provided on cuLearn throughout the course.

Calendar Description

Learning Objectives
Knowledge Base (CEAB Graduate Attribute 1)
- Understanding the application of thermodynamic principles to the design and optimization of engineering systems.
- Ability to apply the First and Second Law of Thermodynamics to (1) vapor power and refrigeration systems, (2) gas power systems, (3) applications concerning humidification, dehumidification, evaporative cooling, and (4) thermodynamics of combustion systems.

Problem Analysis (CEAB Graduate Attribute 2)
- Ability to make assumptions to solve assigned problems.

### SECTION A

**Instructor:** Prof. Cynthia Cruickshank (Office: Minto 3038)  
Email: cynthia.cruickshank@carleton.ca

**Lecture:** Wednesday, Friday  2:35 pm – 3:55 pm  Steacie Building 103

**Office Hours:** By appointment (please email me and write ‘MAAE3400’ in the subject line).

### SECTION B

**Instructor:** Prof. Junjie Gu (Office: VSIM 6214E)  
Email: junjie.gu@carleton.ca

**Lecture:** Wednesday, Friday  11:35 am – 12:55 pm  Mackenzie Building 4499

**Office Hours:** By appointment (please email me and write ‘MAAE3400’ in the subject line).

**PA Session L1:**  Monday  11:35 am – 12:25 pm  Minto Centre 5050

**PA Session L2:**  Monday  4:35 pm – 5:25 pm  Mackenzie Building 3380

* PA Sessions L1 and L2 start on Monday Jan. 16th.

**Teaching Assistant:** Johanna McPhee (email: JohannaMcphee3@cmail.carleton.ca)
Course Outline (Tentative)

<table>
<thead>
<tr>
<th>MODULE 1</th>
<th>Review of Fundamentals of Thermodynamics</th>
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<tbody>
<tr>
<td></td>
<td>The First Law of Thermodynamics for closed and open systems; properties of pure substances; perfect gases; the Second Law of Thermodynamics.</td>
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<tr>
<th>MODULE 2</th>
<th>Vapour Power Cycles</th>
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<td>Carnot Cycle, Rankine Cycle; Modifications to the basic Rankine Cycle; Reheat; Regeneration with Open and Closed Feedwater Heaters; Binary Vapour Cycles; Cogeneration.</td>
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<tr>
<th>MODULE 3</th>
<th>Gas Power Cycles</th>
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<tbody>
<tr>
<td></td>
<td>Internal Combustion Engine, Otto and Diesel Cycles, Air-Standard Brayton Cycle; Gas Turbines with Regeneration; Reheat and Intercooling; Aircraft Propulsion; Ericsson and Stirling Cycle.</td>
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<tr>
<th>MODULE 4</th>
<th>Refrigeration and Heat Pump Cycles</th>
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<tr>
<td></td>
<td>Reversed Carnot Cycle; Vapour Compression Refrigeration Cycles; Cascade and Multi-stage Vapour Compression Cycles; Absorption Refrigeration; Heat Pumps; Brayton Refrigeration Cycles.</td>
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<tr>
<th>MODULE 5</th>
<th>Mixtures and Psychrometrics</th>
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<tr>
<td></td>
<td>Gas Mixtures and Psychrometrics; Humidity Ratio; Relative Humidity; Dew Point Temperature; Adiabatic Saturation Process; Wet and Dry Bulb Temperatures; Psychrometric Chart; Dehumidification and Humidification; Evaporative Cooling; Cooling Tower Analysis.</td>
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<th>MODULE 6</th>
<th>Combustion</th>
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<tr>
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<td>Chemical Reaction Equations; Combustion with Excess and Insufficient Air; Enthalpy of Formation; Enthalpy of Combustion; Adiabatic Flame Temperature</td>
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<tr>
<th>MODULE 7</th>
<th>Principles of Turbomachinery (time permitting)</th>
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<tr>
<td></td>
<td>Compressible Flow through Nozzles and Diffusers, Shock Waves, Types of Turbomachines, Euler’s Turbine Equation, Axial Compressors and Turbines, Velocity Triangles, Degree of Reaction, Impulse and Reaction Turbines.</td>
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Marking Scheme

Your final grade for the course will be determined as follows:

<table>
<thead>
<tr>
<th>Examination</th>
<th>Weightage</th>
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<tbody>
<tr>
<td>Midterm</td>
<td>35%</td>
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<tr>
<td>Final Exam</td>
<td>65%</td>
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Second Option (if it raises your final grade):

<table>
<thead>
<tr>
<th>Examination</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm</td>
<td>20%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>80%</td>
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Midterm
- One midterm test will take place during the term. This will serve to provide feedback and examination practice to students prior to the Final Exam.
- One handwritten, double-sided, formula sheet is allowed.
- Lecture notes, course text book or problem set solutions are not permitted. **No solution manuals are allowed.** Additional details to be announced later.

Final Exam
- The final exam covers everything. The exam will cover all material presented in class and tutorials, including lecture notes and practice problems.
- Two handwritten, double-sided, formula sheets are allowed.
- Lecture notes, course text book or problem set solutions are not permitted.
- No solution manuals are allowed.

The final examination is for evaluation purposes only and answer booklets will not be returned to the students. **You must pass the final exam to pass the course.**

Lecture Notes

All PPT lecture material will be available on the cuLearn Course Page as PDF files. Lecture notes that are written on the board or tablet will not be provided to the students.

Problem Sets

The study problem sets are designed to help you learn the course material. The problem sets are not marked, however, it is to your benefit to work through the problems in order to gain an understanding of the course content. Solutions will be posted 1-2 weeks after the course material is covered during lecture.

PA Sessions

The PA sessions are designed to provide the student with extra problems that are to be solved with the guidance of the TA. The PA sessions are every week. It is to the student's benefit to attend the PA sessions and to attempt the problems. **Solutions to the PA questions will not be provided on cuLearn.**
**Missing Exams**

If you miss the midterm, you must notify the professor within 24 hours after the date of the examination. The percentage of marks allocated to the midterm will be moved to the final exam under two conditions only: illness or bereavement (documentation is required). If no documentation is provided, you will receive a grade of zero for the test.

If you miss the final exam, you must contact the Registrar office within the time period specified in the current Undergraduate Calendar. You will need to fully document your application.

**Plagiarism and Cheating**

It is an instructional offence to use or pass off as one’s own idea or product which is the work of another without expressly giving credit to that other. It is also an instructional offence to copy the work of a fellow student. If students do plagiarize or cheat, the Dean’s office will be notified and appropriate action will be taken.

**Academic Accommodations**

You may need special arrangements to meet your academic obligations during the term. For an accommodation request, the processes are as follows:

**Pregnancy Obligation:** Contact your professor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see the Student Guide. ([http://www2.carleton.ca/equity/accommodation/academic/students/](http://www2.carleton.ca/equity/accommodation/academic/students/))

**Religious Obligation:** Contact your professor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see the Student Guide. ([http://www2.carleton.ca/equity/accommodation/academic/students/](http://www2.carleton.ca/equity/accommodation/academic/students/))

**Academic Accommodations for Students with Disabilities:** The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send your course professor your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation *(if applicable)*. Requests made within two weeks will be reviewed on a case-by-case basis. After requesting accommodation from PMC, meet with your course professor to ensure accommodation arrangements are made. Please consult the PMC website ([www.carleton.ca/PMC](http://www.carleton.ca/PMC)) for the deadline to request accommodations for the formally-scheduled exam *(if applicable)*.