ENGG*3260 Thermodynamics

Fall 2021
Section(s): C02

School of Engineering
Credit Weight: 0.50
Version 1.00 - September 09, 2021

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1 Course Details

1.1 Calendar Description

This course covers macroscopic thermodynamics and its applications to engineering practice. Topics include properties of pure substances and equilibrium, the First Law of thermodynamics (energy transfer and energy balance in closed and flow systems), the Second Law of thermodynamics and its applications (entropy analysis of closed and flow systems, quantification of irreversibilities and inefficiencies, quality of energy, etc.), thermodynamic cycles and exergy.

Pre-Requisites: CHEM*1040, ENGG*2230, ENGG*2400, MATH*2270

1.2 Timetable

Lectures:

Days	Time	Location
Tuesday	8:30 AM - 9:50 AM	WMEM, Room 103 (Online until Sept 28th) [Virtual Classroom on Courselink]
Thursday	8:30 AM - 9:50 AM	Online [Virtual Classroom on Courselink]

Tutorials/Labs:

Days	Time	Location*	GTA
Tuesday	03:30 PM - 05:20 PM	Online	TBA

Days	Time	Location*	GTA
Thursday	03:30 PM - 05:20 PM	Online	TBA
Tuesday	11:30 AM - 01:20 PM	Online	TBA
Wednesday	08:30 AM - 10:20 AM	Online	TBA
Friday	08:30AM - 10:20AM	Online	TBA

**Weeks with Lab activity (weeks # 5 & 11), the tutorials will be uploaded in the course website.*

1.3 Final Exam

Tuesday **December 07, 2020**. Time: 08:30 am – 10:30 am, Room TBA

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2 Instructional Support

2.1 Instructional Support Team

Instructor: Yasser Selima (Section 02)
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Lab Technician: Michael Speagle
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2.2 Teaching Assistants

Teaching Assistant (GTA): Jacob Jamnicky
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Teaching Assistant (GTA): Bassel Abdelkader
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Teaching Assistant (GTA): Shahriyar Ghazanfari Holagh
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Teaching Assistant (GTA): Albert Jiang
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Office Hours: TBA

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3 Learning Resources

3.1 Required Resources

Property Tables (Readings)
Property tables will be posted on CourseLink as PDF file and you can print it to be used in quizzes and tests.

3.2 Recommended Resources

Course Website (Website)
Course material, news, announcements, and grades will be regularly posted to the ENGG*3260 Courselink website. You are responsible for checking the website regularly.

Yunus A. Çengel and Michael A. Boles. Thermodynamics–An Engineering Approach, 9th edition, McGraw Hill Higher Education (Textbook)

3.3 Additional Resources

Lecture Information: Lecture presentations will be posted on CourseLink.

Lab Information:

The handouts for the labs will be available on CourseLink and during the lab time.

Home Assignments:

Download the assignments according to the schedule given in this course outline. All the solutions will be posted as indicated.

Communication and Email Policy:
Please use lectures and tutorials as your main opportunity to ask questions about the course. Electronic communication should be limited to the discussion forum on Courselink, however, topics of a personal and confidential nature (e.g. marks) should be emailed to the respective instructor. Please note that all email communications must be made through your University of Guelph email account.

Miscellaneous Information:

Lectures are the main source of material and include important discussions and worked examples that might not be found elsewhere. Other information related to Thermodynamics are also posted on Courselink.

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4 Learning Outcomes

This course aims at familiarizing the students with fundamental principles of thermodynamics, thermodynamic tools, and their applications for real world energy systems. The overall theme of this course is the application of the first and second laws of thermodynamics to engineering applications related to flow devices, power generation, and air-conditioning. Students are also expected to understand how thermodynamic properties are related to each other. In the analysis of steady flow devices, students shall be able to make necessary simplifications and be able to apply correctly both the First Law and Second Law of thermodynamics. In the analysis of power generation cycles, students are expected to formulate appropriate idealized thermodynamic process models and analyze cycle efficiency. In the analysis of heating, ventilation, and air conditioning systems, the students are expected to simply analyse heating, ventilation, and air-conditioning systems based on the first and second law of thermodynamics.

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. State the First Law and to define heat, work, thermal efficiency and the difference between various forms of energy.
2. Identify and describe energy exchange processes (in terms of various forms of energy, heat and work) in thermodynamic systems.
3. Determine properties of real substances, such as steam and refrigerant R134-a, and ideal gases from either tabular data or equations of state.
4. Analyze processes involving ideal gases and real substances as working fluids in both closed systems and open systems or control volumes to determine process diagrams, apply the first law of thermodynamics to a system of thermodynamic components (heaters, coolers, pumps, turbines, pistons, etc.) to perform energy balances, and determine heat and work transfers.
5. Analyze systems and control volumes through the application of the second law and

explain the concepts of path dependence/independence and reversibility/irreversibility of various thermodynamic processes, to represent these in terms of changes in thermodynamic state, and to cite examples of how these would impact the performance of energy systems.

6. Analyze ideal gas and steam power cycles and refrigeration cycles to determine system components and process diagrams, perform energy balances, determine heat and work transfers, calculate the cycle efficiency or coefficient of performance and design power/refrigeration cycles or processes for cycle components.
7. Use appropriate apparatus, sensors and instruments to collect data and analyze a system by conducting laboratory tests. There will be no lab work for Fall 2020. Lab demonstration videos will explain how to conduct a lab, what are the equipment needed, how to collect data, and how to analyze the results, etc.
8. Demonstrate effective skills in teamwork during group activities (tutorials and in-class group quizzes) and respectful interactions with peers, lab technicians, graduate teaching assistants, and instructor during lectures, and weekly tutorials.

4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

#	Outcome	Learning Outcome
1	Knowledge Base	1, 2, 3, 4, 5
1.1	Recall, describe and apply fundamental mathematical principles and concepts	1, 2, 3, 4, 5
1.2	Recall, describe and apply fundamental principles and concepts in natural science	1, 2, 3, 4, 5
1.3	Recall, describe and apply fundamental engineering principles and concepts	1, 2, 5
1.4	Recall, describe and apply program-specific engineering principles and concepts	1, 2, 5
2	Problem Analysis	1, 2, 3, 4, 5, 6
2.1	Formulate a problem statement in engineering and non-engineering terminology	5
2.2	Identify, organize and justify appropriate information, including assumptions	1, 2, 3, 4, 5, 6

#	Outcome	Learning Outcome
2.3	Construct a conceptual framework and select an appropriate solution approach	1, 2, 3, 4, 5, 6
2.4	Execute an engineering solution	1, 2, 3, 4, 5, 6
2.5	Critique and appraise solution approach and results	1, 2, 4, 5
3	Investigation	7
3.3	Analyze and interpret experimental data	7
5	Use of Engineering Tools	1
5.1	Select appropriate engineering tools from various alternatives	1
6	Individual & Teamwork	8
6.2	Understand all members' roles and responsibilities within a team	8
6.3	Execute and adapt individual role to promote team success through, for example, timeliness, respect, positive attitude	8

5 Teaching and Learning Activities

5.1 Lecture Schedule

Week #	Lecture Topics	References	Learning Objectives
0	Introduction and course outline	Outline	1
1	Basic concepts, closed and open systems, equilibrium, pressure, temperature, and atmospheric pressure. Forms of energy, heat, work, mechanical forms of work, first law of thermodynamics, and energy efficiency	Chapter 1 Chapter 2	1, 2
2	Properties of pure substances, phase change, property diagrams and tables, property tables, ideal	Chapter 3	1,3

5.2 Tutorial/Lab/Quiz Schedule

	gas equation, other equations of state		
3	Energy analysis of closed systems, moving boundary work, energy balance, specific heats, internal energy, and enthalpy.	Chapter 4	1,2,3,4
4, 5	1st law control volumes, conservation of mass, flow work, Energy analysis of steady flow and application to some devices.	Chapter 5	1, 2, 3, 4, 6
6, 7	Intro to 2nd law of thermodynamics, Thermal reservoirs, heat engines, Refrigeration & heat pumps, perpetual motion machines, reversible and irreversible processes, Carnot cycle, Carnot heat engine, Carnot reversed heat engine.	Chapter 6	3,4,5
8	Entropy, increase of entropy principle, Entropy change in pure substances, isentropic process, T- s relations, Reversible steady-flow work, isentropic efficiencies of steady flow devices, entropy balance	Chapter 7	3,4,5
9	Vapor power cycles, Rankine cycle, Reheat Rankine cycle, Regenerative Rankine cycle	Chapter 10	3,4,5,6
10	Refrigerators and heat pumps, Ideal and actual vapour-compression refrigeration cycles.	Chapter 11	3,4,5,6
11	Gas power cycles, Air standard assumptions, Otto cycle, Diesel cycle, Brayton cycle	Chapter 9	3,4,5,6
12	Reviews on cycles	Ch. 9 – 11	1-6

Week #	**Tutorial Activity**	**Lab Activity**

1	Problem solving on Chapter 1	
2	Problem solving on Chapter 2	Quiz 1 from Ch. 1
3	Problem solving on Chapter 3	Quiz 2 from Ch. 2
4	Problem solving on Chapter 4	Quiz 3 from Ch. 3
5	Problem solving on Chapter 5	Lab 1 (Lab 1 report)
6	Review and solve problems on Chapter 5	Lab 2 (Lab 2 report)
7	Problem solving on Chapter 6	-
8	Problem solving on Chapter 7	Quiz 4 from Ch. 6
9	Problem solving on Chapters 6 & 7	Quiz 5 from Ch. 6 & 7
10	Problem solving on Chapter 10	Quiz 6 from Ch. 7
11	Problem solving on Chapter 11	Lab 3 (Lab 3 report)
12	Problem solving on Chapter 9	Quiz 7 from Ch. 11

5.3 Important Dates

- Thursday, September 9, 2021: First day of classes
- Monday, October 11, 2021: Thanksgiving holiday (no classes)
- Tuesday, October 12, 2021: Fall break study day (no classes)
- Friday, December 3, 2021: Make up for Thanksgiving Day (Monday Schedule)
- Thursday, December 2, 2021: Make up for Study Day (Tuesday Schedule)

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6 Assessments

6.1 Marking Schemes & Distributions

Assignments: 0%

Ten (10) unmarked assignments will be posted on CourseLink

Quizzes: 14%

Six (6) quizzes conducted during lecture time, and scheduled in weeks 2, 3, 4, 8, 9, and 10

Labs: 6%

Three (3) labs scheduled in weeks 5, 6 and 11

Mid-term Test: 35%

The mid-term exam is scheduled on Saturday 23rd October 2021, Time: 11:30 am -1:00 pm, Online

Final Exam: 45%

Tuesday 7th December 2021. Time: 08:30 - 10:30 pm, In Class (Room TBA)

Important Note Regarding Exams: A formula sheet will be provided in the exams.

6.2 Assessment Details

Quiz 1 (2%)
Date: Week 2, Lecture time, online
Learning Outcome: 1
Quiz 1 on Chapter 1

Quiz 2 (2%)
Date: Week 3, Lecture time, online
Learning Outcome: 2
Quiz 2 on Chapter 2

Quiz 3 (2%)
Date: Week 4, Lecture time, online
Learning Outcome: 3
Quiz 3 on Chapter 3

Quiz 4 (2%)
Date: Week 8, Lecture time, online
Learning Outcome: 5
Quiz 4 on Chapter 6

Quiz 5 (2%)
Date: Week 9, Lecture time, online
Learning Outcome: 6
Quiz 5 on Chapter 7

Quiz 6 (2%)
Date: Week 10, Lecture time, online
Learning Outcome: 6
Quiz 6 on Chapter 6 & 7

Quiz 7 (2%)
Date: Lecture time, online
Learning Outcome: 6
Quiz 7 on Ch. 11

Lab Report (6%)
Date: Lab
Learning Outcome: 7, 8, 8
Lab 1 (Week 5) , Lab 2 (Week 6) & Lab 3 (Week 11) 3 Lab reports, (each worth 2%)

Midterm Test (35%)
Date: Sat, Oct 23, 11:30 AM - , 1:00 PM, Online
Learning Outcome: 1, 2, 3, 4

Final Exam (45%)

Date: Tue, Dec 7, 8:30 AM - , 10:30 AM, Room TBA
Learning Outcome: 4, 5, 6

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7 Course Statements

7.1 Grading Policies

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Missed midterm test: If you miss a test due to grounds for granting academic consideration or religious accommodation, the weight of the missed test will be added to the final exam . There will be no makeup midterm tests.

Lab Work: You must attend and complete all laboratories. If you miss a laboratory due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to complete a makeup lab.

Lab Reports: Lab reports should be submitted online to CourseLink Dropbox folder. The report submission due is 1 week after the lab scheduled day. Any reports submitted later will not be accepted.

Passing Grades: The passing grade is 50%.

Questions Concerning Grades: If you have questions about the grade of your test received, please ask your TA within one week of the document being returned. However, all requests for re-marking must be made to the instructor. Any item that is re-marked will be re-marked entirely. Therefore, it is strongly suggested that you thoroughly review your entire document before making a re-marking request. Pencil-written works will not be re-marked. Re-marking requests will not be honoured more than one week after the document has been returned.

8 School of Engineering Statements

8.1 Instructor's Role and Responsibility to Students

The instructor's role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on Courselink but these are not intended to be stand-alone course notes. Some written lecture notes will be presented only in class. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and labs.

8.2 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and lab sessions. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

8.3 Lab Safety

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

9 University Statements

9.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

9.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Graduate Calendar - Grounds for Academic Consideration
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions
https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml

9.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Graduate Calendar - Registration Changes
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml

Associate Diploma Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml

9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance and not later than the 40th Class Day.

For Guelph students, information can be found on the SAS website
https://www.uoguelph.ca/sas

For Ridgetown students, information can be found on the Ridgetown SAS website
https://www.ridgetownc.com/services/accessibilityservices.cfm

9.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community-faculty, staff, and students-to be aware of what constitutes academic misconduct and to do as much as

possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Graduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

9.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

9.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars
https://www.uoguelph.ca/academics/calendars

9.9 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (https://news.uoguelph.ca/2019-novel-coronavirus-information/) and circulated by email.

9.10 Illness

Medical notes will not normally be required for singular instances of academic consideration,

although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).

9.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

- https://news.uoguelph.ca/return-to-campuses/how-u-of-g-is-preparing-for-your-safe-return/
- https://news.uoguelph.ca/return-to-campuses/spaces/#ClassroomSpaces

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.
