ENGG*3260 Thermodynamics

Fall 2018
Section(s): C02

School of Engineering
Credit Weight: 0.50
Version 1.00 - September 05, 2018

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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-Requisite(s): CHEM*1040, ENGG*2230, ENGG*2400, MATH*2270

1.2 Timetable

Lectures:

Tuesday	5:30 pm - 6:50 pm	MACN, Room 113
Thursday	5:30 pm - 6:50 pm	MACN, Room 113

Tutorials:

Monday	Sec 01	8:30 am - 10:20 am	MCKN, Room 306
Friday	Sec 02	8:30 am - 10:20 am	MCKN, Room 304
Wednesday	Sec 03	8:30 am - 10:20 am	MCKN, Room 317
Thursday	Sec 04	2:30 pm - 4:20 pm	MCKN, Room 310
Tuesday	Sec 06	8:30 am - 10:20 am	MCKN, Room 316
Thursday	Sec 07	8:30 am - 10:20 am	MCKN, Room 309
Friday	Sec 08	12:30 pm - 2:20 pm	MCKN, Room 309
Wednesday	Sec 09	12:30 pm - 2:20 pm	MCKN, Room 309

Monday	Sec 10	12:30 pm - 2:20 pm	MCKN, Room 309

Laboratory:

Monday	Sec 01	8:30 am - 10:20 am	THRN, Room 3402 and 3404
Friday	Sec 02	8:30 am - 10:20 am	THRN, Room 3402 and 3404
Wednesday	Sec 03	8:30 am - 10:20 am	THRN, Room 3402 and 3404
Thursday	Sec 04	2:30 pm - 4:20 pm	THRN, Room 3402 and 3404
Tuesday	Sec 06	8:30 am - 10:20 am	THRN, Room 3402 and 3404
Thursday	Sec 07	8:30 am - 10:20 am	THRN, Room 3402 and 3404
Friday	Sec 08	12:30 pm - 2:20 pm	THRN, Room 3402 and 3404
Wednesday	Sec 09	12:30 pm - 2:20 pm	THRN, Room 3402 and 3404
Monday	Sec 10	12:30 pm - 2:20 pm	THRN, Room 3402 and 3404

1.3 Final Exam

Monday, Dec. 3, 2018 from 11:30 am to 1:30 pm, location will be posted on CourseLink

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2 Instructional Support

2.1 Instructor(s)

Mostafa Elsharqawy (Section 01)
Email: melsharq@uoguelph.ca
Telephone: +1-519-824-4120 x54017
Office: RICH 3513

Syeda Tasnim (Section 02)
Email: stasnim@uoguelph.ca
Telephone: +1-519-824-4120, ext. 54013
Office: THRN-2413
Office Hours: Friday 3:30 pm to 5:00 pm

2.2 Instructional Support Team

Lab Technician: Michael Speagle
Email: mspeagle@uoguelph.ca
Telephone: +1-519-824-4120 x56803
Office: RICH 1102

2.3 Teaching Assistant(s)

Teaching Assistant: Baljeet Kaur
Email: baljeet@uoguelph.ca
Office Hours: TBA on Courselink

Teaching Assistant: Perry Taneja
Email: ptaneja@uoguelph.ca
Office Hours: TBA on Courselink

Teaching Assistant: Ramandeep Sandhu
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Office Hours: TBA on Courselink

Teaching Assistant: Shakirudeen Salaudeen
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Teaching Assistant: Soroush Ebadi
Email: sebadi@uoguelph.ca
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Teaching Assistant: Nikunj Chaudhari
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Office: TBA on Courselink

Teaching Assistant: Md. Rafsan Nahian
Email: mnahian@uoguelph.ca
Office: TBA on Courselink

Teaching Assistant: Miguel Vigil Fuentes
Email: mvigilfu@uoguelph.ca
Office: TBA on Courselink

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3 Learning Resources

3.1 Recommended Resource(s)

Yunus A. Çengel and Michael A. Boles. Thermodynamics–An Engineering Approach, 8th or 9th edition, McGraw Hill Higher Education (Textbook)

3.2 Additional Resources

Lecture Information: Lecture presentations will be posted on the courselink.

Lab Information:

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

Home Assignments:

Download the assignments according to the schedule given in this handout. 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: stasnim@uoguelph.ca. Please note that all email communication must be made through your University of Guelph email account.

Miscellaneous Information:

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

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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 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 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.

8. Write clear and concise laboratory reports for the labs.
9. Demonstrate effective skills in teamwork during group activities (tutorials and laboratories) and respectful interactions with peers, lab technicians, graduate teaching assistants, and instructor during lectures, weekly tutorials and laboratories.

4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

#	Outcome Set Name	Course 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
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	9
6.2	Understand all members’ roles and responsibilities within a team	9
6.3	Execute and adapt individual role to promote team success through, for example, timeliness, respect, positive attitude	9

#	Outcome Set Name	Course Learning Outcome
7	Communication Skills	8
7.2	Interpret technical documentation such as device specification sheets, drawings, diagrams, flowcharts, and pseudocode	8
7.3	Construct the finished elements using accepted norms in English, graphical standards, and engineering conventions, as appropriate for the message and audience	8
7.5	Demonstrate ability to process oral and written communication by following instructions, actively listening, incorporating feedback, and formulating meaningful questions	8

5 Teaching and Learning Activities

5.1 Lecture Schedule

Lectures	Lecture Topics	References	Learning Objectives
1	Introduction, Basic Concepts, units, dimensional homogeneity, closed and open systems, control volumes, equilibrium Pressure, temperature, manometer, atmospheric pressure	Chapter 1	1
2-3	Forms of energy, heat, work, mechanical forms of work, First law of thermodynamics, energy efficiencies	Chapter 2	1,2
4-5	Properties of pure substances, phase change, property diagrams and tables, property tables, ideal gas equation, other equations of state	Chapter 3	1,3
6-8	Energy analysis of closed systems, moving boundary work, energy balance, specific heats, internal energy, enthalpy of ideal gas	Chapter 4	1,2,3,4
9	Reviews		1-4
10-12	First law for control volumes, conservation of mass, flow work, energy analysis of steady flow, SS devices, unsteady flow	Chapter 5	1,2,3,4
13-15	Intro to 2nd law of thermodynamics, thermal reservoirs, heat engines, refrigeration & heat pumps, perpetual motion machines, reversible and irreversible processes, Carnot cycle, principles, temperature scale, Carnot heat engine, Carnot Refrigeration and heat pump	Chapter 6	3,4,5

16-18	Entropy, increase of entropy principles, entropy change in pure substances, isentropic process, T- ds relations, reversible steady-flow work, isentropic efficiencies of steady flow devices, entropy balance	Chapter 7	3,4,5
19-21	Analysis of power Cycles, Carnot Cycle, air standard assumptions, Otto cycle, Diesel cycle, Brayton cycle, Rankine cycle, deviations from ideal efficiency, ideal reheat Rankine cycle, ideal Regenerative Rankine cycle, Combined gas-power cycles	Chapter 9-10	3,4,5,6
22-24	Refrigerators and heat pumps, reversed Carnot cycle, ideal and actual vapour-compression refrigeration cycles. Review of Chapter 5-11	Chapter 11	3,4,5,6

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6 Assessments

6.1 Marking Schemes & Distributions

Important Note Regarding Exams: Formula sheet will be provided to you with the exams

Tutorial/Lab Schedule

Week	Tutorial Activity	Lab Activity
1	Problem solving involving unit conversion	Lab safety
2	Problem solving on Chapter 2	-
3	Problem solving on Chapter 3 and **quiz 1** (Chapter 2)	-
4	Problem solving on Chapter 4 and **quiz 2** (Chapter 3)	-
5	Reviews for midterm	-
6	Problem solving on Chapter 5	Lab 1 (Saturation line)
7	Problem solving on Chapter 6 and **quiz 3** (Chapter 5)	-
8	Problem solving on Chapter 7 and **quiz 4** (Chapter 6)	-
9	Problem solving on Chapter 9 and **quiz 5** (Chapter 7)	-
10	Problem solving on Chapter 10, **quiz 6** (Chapter 6&7)	-
11	Problem solving on Chapter 11	Lab 2 (Heat pump)
12	Reviews for the final exam	-

Other Important Dates

Thursday, September 6, 2018: First day of class

Monday, 10 September 2018: First Lab

Monday, October 8, 2018: Thanksgiving holiday

Tuesday, October 9, 2018: Fall study day, no classes

Friday, November 2, 2018: 40th class day, last day to drop classes

Thursday, November 29, 2018: Make up for Study Day (Tuesday Schedule)

Friday, November 30, 2018: Make up for Thanksgiving Day (Monday Schedule)

6.2 Assessment Details

Quiz 1 (2.5%)
Date: Week 3, in tutorial

Quiz 2 (2.5%)
Date: Week 4, in tutorial

Quiz 3 (2.5%)
Date: Week 7, in tutorial

Quiz 4 (2.5%)
Date: Week 8, in tutorial

Quiz 5 (2.5%)
Date: Week 9, in tutorial

Quiz 6 (2.5%)
Date: Week 10, in tutorial

Lab Report (10%)
2 labs, each lab is worth 5%

Midterm Test (25%)
Date: Sat, Oct 13, 12:00 PM - , 1:30 PM, MACN-113

Final Exam (50%)
Date: Monday, December 03 from 11:30 am to 1:30 pm
Location will be announced on Webadvisor

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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: Late submissions of lab reports will not be accepted. Please note that you will be submitting your lab report online to your course website. Submission should be done by 5 pm next day and any reports submitted later will not be accepted. If you have a lab on Friday, the lab reports will be due on the following Monday by 5 pm.

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.

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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.

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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 regulations and procedures for Academic Consideration are detailed in the Undergraduate Calendar.

9.3 Drop Date

Courses that are one semester long must be dropped by the end of the fortieth class day; two-semester courses must be dropped by the last day of the add period in the second semester. The regulations and procedures for Dropping Courses are available in the Undergraduate Calendar.

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.

More information: www.uoguelph.ca/sas

9.6 Academic Misconduct

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 discourages misconduct. 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.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar.

9.7 Recording of Materials

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate 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 which apply to undergraduate, graduate and diploma programs.
