University of British Columbia
Department of Mechanical Engineering

MECH 327
Thermodynamics II
2019-W1 Course Syllabus

Lectures: Monday, Wednesday, Friday: 5-6pm
Tutorials: Monday: 10:00am – 11:00am
Wednesday: 11:00am – 12:00pm

Instructor

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COURSE MATERIALS AND IMPORTANT MESSAGES WILL BE POSTED ON CANVAS (canvas.ubc.ca)

Course Description (UBC Calendar)

Air standard cycles; first and second law of cycles. Gas mixtures. Energy conservation. Equilibrium. Reacting systems. Fluid flow, heat transfer, and material considerations. Economic and environmental impact of energy use. Application to thermofluid systems such as power plants.

Course Structure

Course instruction will take place through lectures (3hr/week) and a 1 hour weekly tutorial. Lectures will discuss content according to the schedule below, and will use a combination of handwritten notes, slides, and handouts. Handouts and slides will be made available on Canvas. Tutorials will guide students through the solution of sample problems and provide an opportunity to apply and reinforce material discussed during lectures. Students are strongly encouraged to review and attempt the tutorial problems prior to attending the tutorial session. Tutorial materials will be available on Canvas.

Students will be assessed using weekly assignments, two midterm examinations, and one final examination. Assignments will be graded; however not all questions will be weighted equally.

Learning Objectives

Through this course, students will solidify their understanding of thermodynamics from prerequisite courses, and will be able to:

- Apply the concepts of conservation of mass, energy, entropy to open and closed systems
- Explain the concepts of state, properties, process, heat, work, and (ir)reversibility and apply the correct approach to determining each of these
- Recall approximate numerical values of key properties for the most relevant substances
- Identify and apply the appropriate state diagram and/or equations of state for characterization and analysis of thermal processes and cycles

New topics to be introduced in this course include:

- Exergy analysis of thermal systems
- Multi-component, moist, and reacting working fluids
- Thermochemistry
- Chemical and phase equilibrium

Ultimately, students will be able to select, design and apply an appropriate problem solving methodology and the above principles for the design and analysis of thermal systems.

Evaluation Criteria

Students will be evaluated on their ability to apply engineering fundamentals to the analysis of thermal systems, as well as to develop a familiarity with thermal design parameters and properties. Assignments and exams will include conventional calculation and design-type questions to asses these abilities.

Grade Weighting

Assignments	20%	~Weekly
Midterm (x2)	15%, 15%	TBA
Final	50%	TBA (during final exam period)

NOTE: In undergraduate MECH courses where at least 50% of the final grade is assigned to examinations, students may only pass the course if they achieve a weighted average examination grade of at least 50%. The "examination grade" includes scores from the final examination, midterms, and other tests done individually in a classroom setting. This policy applies unless it is explicitly waived by the instructor in the course syllabus. This policy is also available in the *Vancouver Academic Calendar* at http://www.calendar.ubc.ca/vancouver/index.cfm?tree=12,195,272,43.

Required Textbook

Fundamentals of Thermodynamics. Claus Borgnakke and Richard Sonntag. 10th edition. John Wiley and Sons, 2019.

Other editions are acceptable, though questions and examples may not agree. Please also put a note on your assignment if you are using a different edition, as some of the property tables have minor differences in numerical values.

Lectures, Readings, and Tutorials

The table below provides the *approximate* lecture schedule for this term. The assigned readings correspond to chapters in the 10th edition of the Borgnakke and Sonntag textbook.

Week	Topic	Readings	Tutorial
1	Introduction; Properties, state, process, heat, work	1,2	No Tutorial
2	First law of thermodynamics, control mass and volume	3,4	1st Law (control mass)
3	First law cont'd, steady/unsteady	4	1st Law (heat release rate)
4	2nd law, entropy	5, 6	2nd Law, entropy
5	Entropy **MIDTERM #1 – October 4**	6,7	Entropy
6	Exergy	7, 8	Power cycle, Exergy
7	Exergy cont'd, power cycles Thanksgiving (no classes) – 10/14	8, 10	-
8	Vapour cycles	9	Power cycle
9	Refrigeration, Second law analysis of cycles	9	Vapour cycle
10	Gas mixtures **MIDTERM #2 – November 8**	11	Refrigeration
11	Air conditioning, Humidification Remembrance Day (no classes) – 11/11	11	-
12	Thermochemistry	13	Thermochemistry
13	Thermochemistry and chemical equilibrium	14	Equilibrium

Academic Integrity

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences. Further information can be found in the UBC Calendar at: http://www.calendar.ubc.ca/Vancouver/index.cfm?tree=3,54,111,959

The consequences of academic misconduct can range from a grade of zero on the work in question, to expulsion from your program. It is your responsibility to read, understand and abide by these regulations. Note that plagiarism detection tools are used on submitted projects and reports (UBC uses turnitin.com). If it is not clear to you what constitutes plagiarism, it is your responsibility to review the above calendar section and/or consult the course instructor – *prior to submitting work*.

Late Policy

Assignments are due by 3:45pm on the due date in an assignment box in front of CEME 2054. After this, the following penalties will apply: -25% if received one day after due date, -50% if received two days after due date. Assignments received three or more days after due date will not be graded. Late assignments will be excused, or extensions granted for special circumstances (medical reasons, emergencies, etc.) if requested well in advance of the due date, when appropriate.

Policies and Resources to Support Student Success

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious and cultural observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available at https://senate.ubc.ca/policies-resources-support-student-success.

Mechanical Engineering also has a Student Services Office (students@mech.ubc.ca), located in CEME 2205, where there are staff who can provide support and refer students to the appropriate resources.