



MECH 240 Thermodynamics

Term - SUMMER 2015 (201505)

Instructor

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Office Hours

Days: TWF
Time: 14:30 - 15:30
Location: ELW B152

Course Objectives

Thermodynamics deals with the description of thermal processes and devices (heating, freezing, power plants, car motors, etc.). In this course we will study the fundamental laws and relations of thermodynamics: The conservation laws for mass, momentum and energy, the balance of entropy, and property relations.

The first law--the law of the conservation of energy--, and the second law--the law of increasing disorder--are developed for closed and open systems and then applied to analyze a broad variety of thermal systems. While the main goal is to give a thorough understanding of the fundamentals of thermodynamics, some emphasis will be put on the discussion of basic processes in energy conversion devices and their limitations due to the second law. Towards the end of the course, we shall study simple technical processes, including Otto and Diesel engines, Rankine and Brayton cycle, refrigeration and heat pump cycles.

Learning Outcomes

Students who successfully complete this course will be able to:

1. *Determine and extract property data*
 - 1.1. Distinguish between thermodynamic properties that are easy to measure (pressure, temperature, volume) and those that cannot be measured directly (energy, enthalpy, entropy);
 - 1.2. Extract relevant data from property relations and property tables.
2. *Identify thermodynamic systems and describe processes therein*
 - 2.1. Distinguish between open and closed systems
 - 2.2. Describe a wide array of thermodynamic processes as change of properties, e.g., isobaric, isochoric, isothermal, isentropic.
3. *Formulate and apply the First Law of Thermodynamics to describe processes in thermodynamic systems*
 - 3.1. Formulate the energy conservation principle in the first law of thermodynamics;
 - 3.2. Explain energy transfer by heat, work, mass;
 - 3.3. Explain conversion between different forms of energy;
 - 3.4. Simplify and reduce the general form of the first law into the appropriate form for any thermodynamic system and process therein.

4. *Formulate and apply the Second Law of Thermodynamics to describe processes in thermodynamic systems*
 - 4.1. Explain irreversibility in simple examples (heat transfer, friction, mixing);
 - 4.2. State the general form of the entropy balance;
 - 4.3. Simplify and reduce the general form of the 2nd law into the appropriate form for any thermodynamic system and process therein;
 - 4.4. Distinguish between reversible and irreversible processes.
5. *Apply the first and second laws to analyze basic energy conversion systems*
 - 5.1. Explain the limitations of energy conversion due to the 2nd law;
 - 5.2. Define and determine thermal efficiency and coefficient of performance;
 - 5.3. Analyze influence of internal and external irreversible losses on performance measures.
6. *Analyze and evaluate a wide range of thermodynamic processes and cycles in closed and open systems*
 - 6.1. Apply the first and second law to analyze basic thermodynamic processes in open and closed systems (reversible and irreversible);
 - 6.2. Combine results for basic processes to analyze and evaluate thermodynamic cycles.
7. *Explain working principles of technical applications, assess their performance from thermodynamics laws and property relations, and use analysis to chose optimal working conditions*
 - 7.1. Explain and carry out detailed evaluation of the processes in standard devices: Otto and Diesel engines, Rankine and Brayton cycle, refrigeration and heat pump cycles;
 - 7.2. Assess influence of properties (e.g., pressure and temperature range), processes (reversible/irreversible), material (e.g. limitation of maximum temperature) etc. on performance characteristics.

Syllabus

Properties and states of simple substances, P-v-T processes, equations of state, ideal gas law, first law of thermodynamics, control volume and control mass analyses, first law thermal efficiency, simple steady flow devices, heat engines, refrigerators, heat pumps, Carnot cycle, entropy, principle of increase of entropy, second law of thermodynamics, reversibility.

A-Section: A01 / CRN 30535	T01 / CRN 30536	TA Drop-in help
Days: TWF	F	T
Time: 11:30 - 12:20	12:30 - 13:20	1:30 - 14:30
Location: ELL 167	ELL 167	ECS128

TAs:

Amirreza Fahim Golestaneh, golestan@uvic.ca, EOW 235

Ali Mohammadzadeh, alirezam@uvic.ca, ELW A102

Required Text

Title: Thermodynamics and Energy Conversion
 Author: Henning Struchtrup
 Publisher: Springer, 2014

Optional Text

Title: Thermodynamics
 Author: S. Bhattacharjee
 Publisher: Pearson, 2015

The lecture notes from past years are now a book, which is used for MECH240, MECH390, and MECH443. UVic students have free electronic access and they may order a soft-cover print for \$25 US through SpringerLink. The listed optional textbook is associated with the online resource The Expert System for Thermodynamics. (T.E.S.T). UVic has a site license for the site, but you will have to register individually. The site offers tutorials, solved examples, computerized tables (daemons), animations, unit converters and more. Data tables for material properties are required to complete the assignments and exams. A booklet will be posted on the course space. Please print as many copies as you need and bring them with you to the exams. Additional data for assignments may need to be found online.

Assessment:

Assignments	12 %	Due each Thursday at 11:30 pm.
Online Quizzes:	4 %	
iClicker	4 %	
Mid-terms (2)	30 %	June 12, July 24th
Final Exam	50 %	

Note: Failure to pass the final exam will result in a failing grade for the course.

The final grade obtained from the above marking scheme for the purpose of GPA calculation will be based on the percentage-to-grade point conversion table as listed in the current Undergraduate Calendar.

Assignment of E grade and supplemental examination for this course will be at the discretion of the Course Instructor. The rules for supplemental examinations can be found in the current Undergraduate Calendar.

Assignments and Online Quizzes

Thermodynamics can be a confusing discipline, and it takes time to absorb the necessary concepts and vocabulary. Weekly assignment are intended to encourage you to keep up with the course material and to allow you to prepare for the exams. We will try to provide helpful feedback on the assignments as time permits, but you are expected to review the provided solutions and ensure that you are able to solve similar problems independently on the exams. You are invited to work alone or in groups on the assignments and to seek help in the tutorial sessions and at the weekly drop in session when you need it.

Online quizzes are provided from time to time on the Course Space. These are intended to help you memorize core concepts and vocabulary. Each quiz will have a short time limit, but you may attempt it as many times as you like and your best score will be recorded. These should be attempted individually.

iClickers

iClickers will be used in the lectures. Your responses will not be graded for accuracy, but your grade for the iClickers portion of the course will be based on the number of questions

to which you respond. Up to three "free" responses will be added for each student on the assumption that everyone will have to miss one class. Generally, no more exceptions will be made unless a Request for Registration with a Time Conflict has been approved.

Note to Students:

Students who have issues with the conduct of the course should discuss them with the instructor first. If these discussions do not resolve the issue, then students should feel free to contact the Chair of the Department by email or the Chair's Secretary to set up an appointment.

Accommodation of Religious Observance

See entry in current Undergraduate Calendar

Policy on Inclusivity and Diversity

See entry in current Undergraduate Calendar

Standards of Professional Behaviour

You are advised to read the Faculty of Engineering document Standards for Professional Behaviour in current Undergraduate Calendar, which contains important information regarding conduct in courses, labs, and in the general use of facilities.

Cheating, plagiarism and other forms of academic fraud are taken very seriously by both the University and the Department. You should consult entry in current Undergraduate Calendar for the UVic policy on academic integrity.

Course Lecture Notes

Unless otherwise noted, all course materials supplied to students in this course have been prepared by the instructor and are intended for use in this course only. These materials are NOT to be re-circulated digitally, whether by email or by uploading or copying to websites, or to others not enrolled in this course. Violation of this policy may in some cases constitute a breach of academic integrity as defined in the Uvic Calendar.