University of British Columbia
Department of Mechanical Engineering

MECH 327
Thermal System Design
2015 Course Syllabus

Lectures: Monday, Wednesday, Friday: 10:00am – 11:00am, DMP 310
Tutorials: Monday: 1:00pm – 2:00pm, GEOG 212
Monday: 3:00pm – 4:00pm, GEOG 200

Instructor

Patrick Kirchen
Office: Rusty Hut 109
Email: pkirchen@mech.ubc.ca
Office Hours: Thursday 2:00pm – 3:00pm or via email

Teaching Assistants

Office Hours: Wednesday, 1pm – 2pm, Room TBA

Babak Nasouri
Email: babak.nasouri@alumni.ubc.ca

Pooyan Kheirkhah
Email: pooyankheirkhah@gmail.com

COURSE MATERIALS AND IMPORTANT MESSAGES WILL BE POSTED ON CONNECT (connect.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 Objectives

Through this course, students will solidify their understanding of thermodynamics from prerequisite courses, including the following topics:

- Conservation of mass, energy, entropy for open and closed systems
- Concepts of state, properties, process, heat, work, and (ir)reversibility
- Numerical values of key properties for the most relevant substances
- Appropriate use of state diagrams and equations of state for characterization and analysis of thermal systems

New topics to be introduced in this course include:

- Exergy analysis of thermal system
- 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	30%
Midterm (x2)	15%, 15%
Final (open book)	40%

A minimum overall average of 50% AND a grade ≥50% on the final exam are required to pass MECH 327.

Required Textbook

Fundamentals Thermodynamics. Claus Borgnakke and Richard Sonntag. 8th edition. John Wiley and Sons, 2013.
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 tables have minor differences in numerical values.
The final exam will be open book. Laptops, tablets, etc. (and hence e-books) will not be permitted to the final, so please arrange for a hardcopy well before the exam date if you are using an e-book.

Plagiarism and Misconduct

All suspected instances of plagiarism, cheating or misconduct will be treated as outlined in the official University of British Columbia policy:

http://vpacademic.ubc.ca/integrity/ubc-regulation-on-plagiarism/

It is your responsibility to read, understand and abide by these regulations.

Late Policy

Assignments are due by 3:45pm on the due date in an assignment box in 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.

Lectures, Readings, and Tutorials

The table below provides the *approximate* lecture schedule for this term. The assigned readings correspond to chapters in the 8th edition of Borgnakke and Sonntag (S/B) and the 7th edition of Çengel and Boles (Ç/B).

Week of	Topic	Reading		Tutorial
		S/B	Ç/B	
7/9	Introduction; Properties, state, process, heat, work	1,2	1,2	No Tutorial
14/9	First law of thermodynamics, control mass and volume	3, 4	2.1-2.6, 3, 4, 5	1st Law, control mass
21/9	First law cont'd, Second law	5	5.3-5.5, 6	1st Law, control volume
28/9	Entropy	6	7	Entropy, isentropic processes
5/10	Exergy **MIDTERM #1 – October 7**	7,8	8	Exergy
12/10	Power Cycles Thanksgiving (no classes) – 12/10	10	9	Cycle Analysis (handout, no tutorial)
19/10	Vapour cycles	9	10	Power cycle
26/10	Refrigeration, Second law analysis of cycles	9.8 - 9.12, 10.6	11, 9.12, 10.7, 11.5	Vapour cycle
2/11	Gas mixtures **MIDTERM #2 – November 6**	11	13, 14	Refrigeration
9/11	Air conditioning, Humidification Remembrance Day (no classes) – 11/11	11	14	Gas mixtures
16/11	Thermochemistry	13	15	Humidification
23/11	Thermochemistry and chemical equilibrium	14	16	Thermochemistry
30/11	Environmental Impact, thermo-economics, review			Equilibrium