ENGG*3260 Thermodynamics
Fall 2013

UNIVERSITY of GUELPH
School of Engineering

(Revision 0: September 05, 2013)

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1 INSTRUCTIONAL SUPPORT

1.1 Instructor

Instructor: Animesh Dutta, Ph.D., P.Eng.
Office: THRN 3509, ext. 52441
Email: adutta@uoguelph.ca
Office hours: TBA on Courselink or by appointment

1.2 Lab Technician

Technician: Mike Speagle
Office: THRN 3502, ext. 56803
Email: mspeagle@uoguelph.ca

1.3 Teaching Assistants

GTA	Email	Office Hours
Bimal Acharya	bacharya@uoguelph.ca	TBA on Courselink
Mohammad Tushar	mtushar@uoguelph.ca	TBA on Courselink
Ronil Rabari	rrabari@uoguelph.ca	TBA on Courselink
Tijo Joseph	tjoseph@uoguelph.ca	TBA on Courselink
Poritosh Roy	poritosh@uoguelph.ca	TBA on Courselink
Harpreet Kambo	kamboh@uoguelph.ca	TBA on Courselink

2 LEARNING RESOURCES

2.1 Course Website

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

2.2 Required Resources

Property tables

2.3 Recommended Resources

Yunus A. Çengel and Michael A. Boles. Thermodynamics – An Engineering Approach, 7th edition, McGraw Hill Higher Education

2.4 Additional Resources

Lecture Information: All the lecture notes are posted on the courselink (Chapter #1-#12).

Lab Information: The handouts for all the lab sessions are within the lab section. All types of resources regarding tutorials, links to web pages can be found in this section.

Home Assignments: Download the assignments according to the schedule given in this handout. All the solutions will be posted as indicated.

Miscellaneous Information: Other information related to Thermodynamics are also posted on the web page.

2.5 Communication & Email Policy

Please use lectures and lab help sessions as your main opportunity to ask questions about the course. Major announcements will be posted to the course website. **It is your responsibility to check the course website regularly**. As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its student.

3 ASSESSMENT

3.1 Dates and Distribution

Quizzes: 12% (8% is allocated for 4 quizzes conducted during tutorials, and 4% is allocated for in class quiz scheduled on Nov 20)
Week 2, in tutorial
Week 3, in tutorial
Week 4, in tutorial
Week 5, in tutorial
Nov 20, in class (4%)

Labs: 8%
See section 5.4 below for due dates

Midterm test: 30%
Mon Oct 21, 7:00-9:00 pm,

Room RICH2520 for students who has last name start with "A" and "O", and in between

Room RICH2529 for rest of the students who has last name start "P" and "Z", and in between

Final Exam: 50%
Wed Dec 04, 2:30-4:30 pm, Room TBA on Webadvisor

3.2 Course 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.

Late Lab Reports: Late submissions of lab reports will not be accepted.

Passing Grades: The passing grade is 50%.

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4 Aims, Objectives & Graduate Attributes

4.1 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.

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

4.2 Course Aims

Ever wondered how the refrigeration process, mechanical engines, or power plants work or why chemical reactions go one way and not the other? The answer to many such curious questions is the study of "Thermodynamics". Thermodynamics is a study of energy and energy transfers. It examines thermal properties of materials and how some of the properties are changed as the substance receives or dumps energy. A good comprehension of the various thermodynamic processes is essential to the practice of engineering. A quick look around will convince you that these processes are omnipresent in our modern society: refrigerators, the power cycle in all sort of power plant, the thermal processes present in a heating, ventilation and air conditioning (HVAC) system and the simple process of phase change encountered daily.

This thermodynamics course serves as an introduction and is the first one, and perhaps the only one, that you will encounter during your undergraduate study in engineering. This course deals with the fundamentals of thermodynamics, the properties, states, processes and cycles encountered in engineering and with the laws necessary to understand them.

4.3 Learning Objectives

At the successful completion of this course, the student will have demonstrated the ability 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 134-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.

4.4 Graduate Attributes

Successfully completing this course will contribute to the following CEAB Graduate Attributes:

Graduate Attribute	Learning Objectives	Assessment
1. Knowledge Base for Engineering	1, 2, 3	Quizzes, Labs, Exams
2. Problem Analysis	4, 5, 6	Quizzes, Exams,
3. Investigation	1, 2, 3, 6	Labs
4. Design	-	-

5. Use of Engineering Tools	1, 2, 3, 6	Labs, Exams, Quizzes
6. Communication	-	Labs
7. Individual and Teamwork	-	Labs
8. Professionalism	-	-
9. Impact of Engineering on Society and the Environment	-	-
10. Ethics and Equity	-	-
11. Environment, Society, Business, & Project Management	-	-
12. Life-Long Learning	5, 6	-

4.5 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/D2L but these are not intended to be stand-alone course notes. 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 project.

4.6 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and tutorials. 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.

4.7 Relationships with other Courses & Labs

Previous Courses:

CHEM*1040: Understanding of chemical equilibrium, stoichiometry

ENGG*2230: Steady and unsteady state, 1st law and bernoulli equation.

ENGG*2400: Modeling of engineering systems

MATH*2270: Solving differential equations

Follow-on Courses:

ENGG*3370: Foundation for analysis of thermo-fluid systems

ENGG*3430: Foundation for application of heat transfer in various types of systems

ENGG*3470: Foundations of energy balances, thermal flow, thermal properties

ENGG*3830: Foundations of heat and mass balance and bioreactor design

ENGG*4230: Foundations for design of energy conversion processes

ENGG*4300: Foundations for design of food engineering process

ENGG*4330: Foundation for performance analysis of combustion systems

5 TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Lectures:

Monday		1:30 pm – 2:20 pm	THRN 1200
Wednesday		1:30 pm – 2:20 pm	THRN 1200
Friday		1:30 pm – 2:20 pm	THRN 1200
Tutorials:			
Monday	Sec 01	3:30 pm - 5:20 pm	MACK 234
Tuesday	Sec 02	11;30 am - 1.20 pm	MACK 233
Tuesday	Sec 03	2:30 pm - 4:20 pm	MACK 233
Wednesday	Sec 04	3:30 pm - 5:20 pm	MACK 238
Thursday	Sec 05	8:30 am - 10:20 am	MACK 234
Thursday	Sec 06	11:30 am - 1:20 pm	MACN 118
Thursday	Sec 07	2:30 pm - 4:20 pm	MACK 311
Friday	Sec 08	3: 30 pm - 5:20 pm	MACK 315
Laboratory:			
Monday	Sec 01	3:30 pm - 5:20 pm	THRN 3402
Tuesday	Sec 02	11;30 am - 1.20 pm	THRN 3402
Tuesday	Sec 03	2:30 pm - 4:20 pm	THRN 3402
Wednesday	Sec 04	3:30 pm - 5:20 pm	THRN 3402
Thursday	Sec 05	8:30 am - 10:20 am	THRN 3402
Thursday	Sec 06	11:30 am - 1:20 pm	THRN 3402
Thursday	Sec 07	2:30 pm - 4:20 pm	THRN 3402
Friday	Sec 08	3: 30 pm - 5:20 pm	THRN 3402

5.2 Lecture Schedule

Lectures	Lecture Topics	References	Learning Objectives
1-3	Introduction, Basic Concepts, units, dimensional homogeneity, Closed and open systems, Control volumes, Equilibrium Pressure, Temperature, manometer, atmospheric pressure	Chapter 1	1
4-6	Forms of Energy, heat, work, Mechanical forms of work, first law of thermodynamics, Energy efficiencies	Chapter 2	1,2
7-10	Properties of Pure Substances, phase change, Property diagrams and tables, Property tables, ideal gas equation, other equations of state	Chapter 3	1,3
11-14	Energy analysis of closed systems, moving boundary work, energy balance, Specific heats, internal energy, enthalpy Ideal Gas	Chapter 4	1,2,3,4

15-19	1st law control volumes, conservation of mass, flow work, Energy analysis of steady flow, SS devices, unsteady flow	Chapter 5	1,2,3,4
20-23	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
24-28	Entropy, increase of entropy principles, Entropy change in pure substances, isentropic process, Tds relations, Reversible steady-flow work, isentropic efficiencies of steady flow devices, entropy balance	Chapter 7	3,4,5
29-32	Analysis of Power Cycles, Carnot Cycle, Air standard assumptions, Otto cycle, Diesel cycle, Rankine 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
33-34	Refrigerators and heat pumps, revised Carnot cycle, Ideal and actual vapour-compression refrigeration cycles.	Chapter 11	3,4,5,6
35-36	Reviews		1-6

5.3 Tutorial Schedule

Week	Activity	References
1	Introduction on lab equipments and safety, and problem solving on Chapter 1	
2	Problem solving on Chapter 2 and quiz on chapter 1	
3	Problem solving on Chapter 3 and quiz on chapter 2	
4	Problem solving on Chapter 4 and quiz on chapter 3	
5	Problem solving on Chapter 5 and quiz on chapter 4	
6	Reviews for midterm and 5and quiz on chapter 5	
7	Labs	
8	Labs	
9	Labs	
10	Labs	
11	Problem solving on Entropy (Chapter 6 and 7)	
12	Problem solving on cycles (Chapter 9 and 10)	

5.4 Lab Schedule

Week	Topic	*Due
1	Introduction to Lab Equipment and Safety Training	
7, 8, 9, 10	Experiments on conservation of energy	Next day by 8 am
7, 8, 9, 10	Experiments on calculation of higher heating value of fuel using bomb calorimeter	Next day by 8 am
7, 8, 9, 10	Experiment on calculation of Coefficient of Performance (COP) of heat pump	Next day by 8 am
7, 8, 9, 10	Experiments on finding saturation pressure of water at various temperature	Next day by 8 am

*In class submission is preferred; otherwise drop your report at box no 6 (near machine shop THRN 1025) by 8 am next day

5.5 Other Important Dates

Thursday, 5 September 2013: First class

Monday, 14 October 2013: Thanks giving holiday

Thursday, 31 October 2013: drop date – 40th class

Thursday, 28 November 2013: last class (Monday Schedule in effect)

6 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.

6.1 Specific for ENFF3260:

You must read safety rules posted on the door of the Sustainable Energy Lab (THRN3402). You also read the manual carefully, follow the safety rules, and wear safety glasses during lab time.

7 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.

7.1 Resources

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:
http://www.academicintegrity.uoguelph.ca/

Please also review the section on Academic Misconduct in your Engineering Program Guide.

The School of Engineering has adopted a Code of Ethics that can be found at:
http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

8 ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact the Centre for Students with Disabilities as soon as possible

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.csd.uoguelph.ca/csd/