ENGG*3250 Energy Management and Utilization

01

Winter 2024
Section(s): 01

School of Engineering
Credit Weight: 0.50
Version 1.00 - January 08, 2024

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1 Course Details

1.1 Calendar Description

This course introduces notions of energy conservation and efficiency, an integrated approach to energy auditing and examples of typical applications (examples include: steam generation and distribution, process or comfort cooling, pumping and compressed air, human needs for modern living, energy consumption in buildings and industry). It also covers pinch technology and its application for energy recovery in industry, and methods to achieve low energy buildings.

Co-Requisites:	ENGG*3430
Restrictions:	Non-BENG students may take a maximum of 4.00 ENGG credits.

1.2 Course Description

This course aims at introducing the basic concepts and techniques for energy management andutilization. Multiple subjects will be discussed in the course to strengthen these concepts including energy distribution, supply and demand, energy pricing, scope of the energy problem and approaches to provide solutions, energy auditing, improving energy utilization in space, mechanical and electrical equipment in buildings such as air conditioning, heating, steam, hot water and compressed air systems, energy saving opportunities in refrigeration and cooling systems, insulation, and finally energy conservation. Both practical and analytical approaches integrated with basic analysis of thermo-fluids and heat transfer systems will be employed in this course to provide a deep understanding of the energy subject.

1.3 Timetable

Lectures
Tuesday 11:30 AM –12:50 PM, ANNU 204

Thursday 11:30 AM –12:50 PM, ANNU 204

Laboratory & Tutorials

Section 1 Mondays 11:30 AM - 1:20 PM, THRN 2336 Or THRN 3404

Section 2 Fridays 2:30 PM - 4:20 PM, THRN 2336 Or THRN 3404

1.4 Final Exam

Thursday, April 11th 2024, 8:30 AM - 10:30 AM. Location TBA

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2 Instructional Support

2.1 Instructional Support Team

Instructor:	Wael Ahmed
Email:	ahmedw@uoguelph.ca
Telephone:	x53674
Office Hours:	TBA on Courselink or by appointment
Lab Technician:	Michael Speagle
Email:	mspeagle@uoguelph.ca
Telephone:	+1-519-824-4120 x56803
Office:	THRN 1102

2.2 Teaching Assistants

Teaching Assistant (GTA):	Shahriyar Ghazanfari Holagh
Email:	ghazanfs@uoguelph.ca
Office Hours:	TBA on the Courselink

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3 Learning Resources

3.1 Required Resources

Course Website (Website)

https://courselink.uoguelph.ca

Course material, news, announcements, and grades will be regularly posted to the ENGG*3250 Courselink site. You are responsible for checking the course website regularly.

3.2 Recommended Resources

8th Edition, Fairmont Press (Textbook)
L. Capehart, W.C. Turner, and W.J. Kennedy, Guide to Energy Management, 2016

2nd Edition, Energy Management and Conservation Handbook (Textbook)
F. Kreith and D.Y. Goswami, CRC Press, 2017.

7th Edition Principles of Heating, Ventilating and Air Conditioning (Textbook)
American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE), 2013.

11th Edition, Mechanical and Electrical Equipment for Buildings (Textbook)
W.T. Grondzik, and A.G. Kwok, B. Stein and J. S. Reynolds, Wiley, 2009.

7th Edition, Fundamentals of Heat and Mass Transfer (Textbook)
F. Incropera and D. DeWitt, John Wiley, 2011.

9th Edition, Thermodynamics–An Engineering Approach (Textbook)
Yunus A. Çengel and Michael A. Boles. McGraw Hill Higher Education, 2016

3.3 Lecture Information

Lecture presentations will be posted on the courselink.

3.3 Lab/Tutorials Information

The handouts for all the lab sessions will be available during the lab sections. All types of resources regarding tutorials, will be available on the Courselink

3.3 Miscellaneous Information

Other information related to Energy Management and Utilization materials may be posted on the courselink.

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4 Learning Outcomes

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Identify inefficiencies in energy systems and their components
2. Evaluate energy use and Energy Auditing
3. Perform energy conservation analysis and characterize simple energy systems
4. Analyze and design waste heat recovery systems
5. Evaluate energy conservation in space conditioning, refrigeration, and cooling
6. Conduct laboratory tests, collecting and analyzing data using the appropriate sensors and instruments and write clear, concise and professional laboratory reports

4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

#	Outcome	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, 3, 4, 5
1.4	Recall, describe and apply program-specific engineering principles and concepts	1, 2, 3, 4, 5
2	Problem Analysis	1, 2, 3, 4, 5
2.1	Formulate a problem statement in engineering and non-engineering terminology	1, 2, 3, 4, 5
2.2	Identify, organize and justify appropriate information, including assumptions	1, 2, 3, 4, 5
2.3	Construct a conceptual framework and select an appropriate solution approach	1, 2, 3, 4, 5
2.4	Execute an engineering solution	1, 2, 3, 4, 5
2.5	Critique and appraise solution approach and results	1, 2, 3, 4, 5
3	Investigation	6
3.3	Analyze and interpret experimental data	6
3.4	Assess validity of conclusions within limitations of data and methodologies	6
5	Use of Engineering Tools	4, 6
5.1	Select appropriate engineering tools from various alternatives	4, 6
5.2	Demonstrate proficiency in the application of selected engineering tools	4, 6
5.3	Recognize limitations of selected engineering tools	6
6	Individual & Teamwork	6
6.1	Describe principles of team dynamics and leadership	6
6.2	Understand all members’ roles and responsibilities within a team	6

#	Outcome	Learning Outcome
6.3	Execute and adapt individual role to promote team success through, for example, timeliness, respect, positive attitude	6
6.4	Apply strategies to mitigate and/or resolve conflicts	6
7	Communication Skills	6
7.1	Identify key message(s) and intended audience in verbal or written communication as both sender and receiver	6
7.2	Interpret technical documentation such as device specification sheets, drawings, diagrams, flowcharts, and pseudocode	6
7.3	Construct the finished elements using accepted norms in English, graphical standards, and engineering conventions, as appropriate for the message and audience	6
7.4	Substantiate claims by building evidence-based arguments and integrating effective figures, tables, equations, and/or references	6
7.5	Demonstrate ability to process oral and written communication by following instructions, actively listening, incorporating feedback, and formulating meaningful questions	6
8	Professionalism	6
8.3	Demonstrate professional behaviour	6
11	Economics and Project Management	4, 5
11.1	Apply project management techniques and manage resources within identified constraints	4, 5
11.2	Identify risk and change management techniques, in the context of effective project management	4, 5
11.3	Estimate economic impact and feasibility of an engineering project or design using techniques such as cost benefit analysis over the life of the project or design	4, 5

4.3 Relationships with other Courses & Labs

Previous Courses:

ENGG*2230: Steady and unsteady state; 1st law and Bernoulli equation; fluid flow rate and friction; laminar and turbulent flows; non-dimensional parameters (e.g., Reynolds number)
ENGG*2400: Modeling of engineering systems
MATH*2270: Solving differential equations
ENGG*3260: System and control volume; work and heat and their interaction with the boundary and direction; energy efficiency and effectiveness of systems; thermodynamic losses.

Current Courses:

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

Follow-on Courses:

ENGG*3370: Foundation for analysis of thermo-fluid systems
ENGG*3470: Foundations of energy balances, thermal flow, thermal properties; Mass transfer through fluid flows (convection), thermal fluid 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

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5 Teaching and Learning Activities

5.1 Lecture

Topics:	Review of Thermofluids subjects and Introduction to Energy Management and Utilization
References:	Lecture notes
Learning Outcome:	2, 3
Topics:	Energy conservation in buildings
References:	Lecture notes
Learning Outcome:	1, 2, 4, 5
Topics:	Energy use and energy auditing
References:	Lecture notes

Learning Outcome: 2, 3, 4, 5

Topics: Insulation
References: Lecture notes
Learning Outcome: 3, 4, 5, 6

Topics: Hot water and compressed air systems
References: Lecture notes
Learning Outcome: 1, 2, 3

Topics: Energy saving opportunities for heaters and boilers
References: Lecture notes
Learning Outcome: 1, 2, 3, 4

Topics: Heat recovery systems
References: Lecture notes
Learning Outcome: 4

Topics: Steam distribution systems

References: Lecture notes
Learning Outcome: 1, 2, 3

Topics: Energy saving opportunities for refrigeration and cooling systems, cooling and heating load calculations in buildings

References: Lecture notes
Learning Outcome: 2, 3, 4, 5, 6

Topics: Industrial energy efficiency and energy management

References: Lecture notes
Learning Outcome: 1, 2, 3, 4, 5, 6

5.2 Lab

Week 1

Topics: Introduction to Lab Equipment and Safety Training.

Demo: Infrared scanning to detect thermal defects and air leakage In building envelopes and demo of blower door testing to measure the air tightness of buildings.

Week 3

Topics: Thermal conductivity measurements

Week 6

Topics:	Comparison of energy flow measurements between single and double pane windows
Learning Outcome:	6

Week 7

Topics:	Evaluating the performance of heat exchangers
Learning Outcome:	6

5.3 Tutorials-PROBLEM ANALYSIS EXERCISES

The tutorials will be conducted in Room THRN 2336. These tutorial sessions will be running through problem analysis exercises. During the two-hour time blocks (assigned for each section), the TA will divide the section into random group rooms and assigned a problem for each group. The group will work on solving the problem together and with some discussion with the TA. The instructor will be joining the activities and encourage the discussion and explain how problem analysis is performed. Students can choose to present their answers to the rest of the section if larger discussion is needed. **Students must attend their scheduled Tutorial sessions in order to keep the record for the participants.**

Schedule	Activities
Week 2	Thermodynamics and Fluid Review
Week 4	Problem Analysis Exercise
Week 5	Review
Week 8	Problem Analysis Exercise
Week 9	Problem Analysis Exercise
Week 10	Problem Analysis Exercise
Week 11	Problem Analysis Exercise
Week 12	Review

5.4 Tutorial and Lab Schedule

This is a two hour lab session. All the tutorial and lab sessions will be conducted by the GTAs. In certain weeks there will be tutorial only and other weeks there will be lab only. A group lab reports should be submitted. **Lab reports will be submitted one week after finishing each experiment.** The labs will be explained and the TA will be available during the office hours and tutorials session to answers any questions. The report will be submitted electronically in the assigned dropbox.

5.5 Other Important Dates

Monday, January, 8th 2024: First day of Labs

Tuesday, January, 9th 2024: First day of Lectures

Week of February 19-23, 2024: Winter break - no lectures, labs or tutorials

Friday, April, 5th 2024: **Classes conclude**

Monday, April, 8th 2024: Last day to drop the course

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6 Assessments

6.1 Assessment Details

Unmarked Problem Sets (0%)
These problems sets will be posted on the course link

Labs (15%)
Learning Outcome: 6
Due dates is listed in the course outlines. A grade of zero will be issued to any team member who did not included in the lab reports as per the assigned groups. If you are unable to contribute to writing a lab report due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to complete a makeup lab report at the end of the semester (last week of classes).

Energy Debate Presentation and Discussion (15%)
Date: Week 4
Only class presentations will be required. Student groups will be asked to create 15-min presentation videos on selected Energy source. Details on the assignment will be posted on the Courselink.

Energy Audit Project (20%)
Date: Week 5
Learning Outcome: 1, 2, 3, 6
Details on the course project will be posted on the Courselink. This will be a group project for 4-5 students. Activities of this project are expected to start from Week-5 until the end of the semester. Project reports will be submitted online to the Courselink dropbox folder.

Problem Analysis Exercises (15%)
Date: Mon, Jan 9, 2:30 PM - Fri, Apr 7, 3:30 PM, Tutorials Sessions
Learning Outcome: 1, 3

Final Exam (35%)
Date: Thursday, Apr. 11th 2024, 8:30 AM - 10:30 AM, TBA
Learning Outcome: 3

7 Course Statements

7.1 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 instructorwithin 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 tests: 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%.

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.

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 grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Graduate Calendar - Grounds for Academic Consideration
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions
https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml

9.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Graduate Calendar - Registration Changes

https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml

Associate Diploma Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml

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 make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

For Guelph students, information can be found on the SAS website
https://www.uoguelph.ca/sas

For Ridgetown students, information can be found on the Ridgetown SAS website
https://www.ridgetownc.com/services/accessibilityservices.cfm

9.6 Academic Integrity

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 encourages academic integrity. 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.

Undergraduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Graduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

9.7 Recording of Materials

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

Academic Calendars
https://www.uoguelph.ca/academics/calendars

9.9 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).