



# ENGG\*3250 Energy Management & Utilization

01

Winter 2021

Section(s): C01

School of Engineering

Credit Weight: 0.50

Version 1.00 - January 11, 2021

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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:** ENGG\*3030

### 1.2 Course Description

This course aims at introducing the basic concepts and techniques for energy management and utilization. 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**

Monday 1:00 PM –2:20 PM, Virtual

Wednesday 1:00 PM –2:20 PM, Virtual

**Laboratory & Tutorials**

Friday 12:30 PM - 2:20 PM, Virtual

Tuesday 8:30 AM - 10:20 AM, Virtual

**1.4 Final Exam**

Monday, Apr. 26th 2021, 8:30 AM - 10:30 AM, Virtual

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**2 Instructional Support****2.1 Instructional Support Team**

**Instructor:** Syeda Tasnim  
**Email:** stasnim@uoguelph.ca  
**Telephone:** 1-519-824-4120 x 54013  
**Office Hours:** TBA on Courselink or by appointment

**Lab Technician:** Michael Speagle  
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**Telephone:** +1-519-824-4120 x56803  
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**2.2 Teaching Assistants**

**Teaching Assistant:** Hossein Mohammadi Rouzbahani  
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**Teaching Assistant:** Mahmoud Elkhaliifa  
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**Teaching Assistant:** Omar Elhang  
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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****7th Edition, Fairmont Press (Textbook)**

L. Capehart, W.C. Turner, and W.J. Kennedy, Guide to Energy Management, 2012

**Energy Management and Conservation Handbook (Textbook)**

Kreith and D.Y. Goswami, CRC Press, 2008.

**Principles of Heating, Ventilating and Air Conditioning (Textbook)**

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

**Mechanical and Electrical Equipment for Buildings (Textbook)**

W.T. Grondzik, and A.G. Kwok, B. Stein and J. S. Reynolds, 11th Edition, Wiley, 2009.

**Fundamentals of Heat and Mass Transfer (Textbook)**

Incropera and D. DeWitt, John Wiley, 7th Edition, 2011.

**Thermodynamics—An Engineering Approach (Textbook)**

Yunus A. Çengel and Michael A. Boles. 8th Edition, McGraw Hill Higher Education,

**3.3 Lecture Information**

Lecture presentations will be posted on the courselink.

**3.3 Lab Information**

The handouts for all the lab sessions will be available during the lab sections. All types of resources regarding tutorials, links to web pages can be found in this section.

**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. Watch demonstration videos for collecting and analyzing data using the appropriate sensors and instruments and write clear, concise and professional laboratory reports
7. Design and analyze energy storage systems

## 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, 7
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, 7
2.4	Execute an engineering solution	1, 2, 3, 4, 5, 7
2.5	Critique and appraise solution approach and results	1, 2, 3, 4, 5, 7
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

#	Outcome	Learning Outcome
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
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	4, 5

#	Outcome	Learning Outcome
	project or design	

### 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

## 5 Teaching and Learning Activities

### 5.1 Lecture

<b>Topics:</b>	Course overview and Introduction to Energy Management and Utilization
<b>References:</b>	Lecture notes
<b>Learning Outcome:</b>	2, 3
<b>Topics:</b>	Demand Side Management and Energy conservation in buildings
<b>References:</b>	Lecture notes
<b>Learning Outcome:</b>	1, 2, 4, 5
<b>Topics:</b>	Energy use and energy auditing
<b>References:</b>	Lecture notes
<b>Learning Outcome:</b>	2, 3, 4, 5
<b>Topics:</b>	Insulation
<b>References:</b>	Lecture notes
<b>Learning Outcome:</b>	3, 4, 5, 6
<b>Topics:</b>	Hot water and compressed air systems
<b>References:</b>	Lecture notes
<b>Learning Outcome:</b>	1, 2, 3
<b>Topics:</b>	Energy saving opportunities for heaters and boilers
<b>References:</b>	Lecture notes
<b>Learning Outcome:</b>	1, 2, 3, 4
<b>Topics:</b>	Heat recovery systems
<b>References:</b>	Lecture notes
<b>Learning Outcome:</b>	4
<b>Topics:</b>	Energy storage systems
<b>References:</b>	Lecture notes
<b>Learning Outcome:</b>	1, 2, 3
<b>Topics:</b>	Energy saving opportunities for refrigeration and cooling systems, cooling and heating load calculations in buildings
<b>References:</b>	Lecture notes
<b>Learning Outcome:</b>	2, 3, 4, 5, 6
<b>Topics:</b>	Industrial energy efficiency and energy management
<b>References:</b>	Lecture notes

**Learning Outcome:** 1, 2, 3, 4, 5, 6

**Topics:** Heat pump systems

## 5.2 Lab

### Week 3

**Topics:** 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.

**Learning Outcome:** 5

### Week 3

**Topics:** Site tour for the mechanical equipment for heating and cooling in THRN building

**Learning Outcome:** 5

### Week 5

**Topics:** Comparison of energy flow measurements between single and double pane windows

**Learning Outcome:** 6

### Week 9

**Topics:** Evaluating the performance of heat exchangers

**Learning Outcome:** 6

## 5.3 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 the rest of the weeks there will be lab only. Due to COVID-19 restrictions, all the tutorials will be virtual. Lab demonstration videos will be created and uploaded in your course website. The GTAs will upload the tutorial and lab meeting links in the course website.

## 5.4 Lab Schedule

\* A single lab report should be submitted. This lab report consists of all the 3 labs performed in week 3, 5 and 9. Lab report is due on the 10th week before the tutorial.

Section 101 will submit their report on Friday, March 26th



Section 102 will submit their report on Tuesday, March 22th

## 5.5 Other Important Dates

**Monday, 11 January 2021:** First class

**Monday, 25 January 2021:** First Lab

**Monday, 15 February 2021:** Winter Break begins. **No classes scheduled this week**

**Monday, 12 April 2021:** Last day to drop

**Monday, 12 April 2021:** **Classes conclude**

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## 6 Assessments

### 6.1 Assessment Details

**Midterm Exam (20%)**

**Date:** Mon, Feb 22, 1:00 PM - 2:20 PM, Virtual

**Learning Outcome:** 1, 3

**Labs (10%)**

**Learning Outcome:** 6

**Energy Audit Project (20%)**

**Date:** Monday, April 12, 2021

**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.

**Design and analysis of an energy storage system (10%)**

**Date:** Fri, Mar 26

**Learning Outcome:** 7

Details on the assignment will be posted on the courselink.

**Final Exam (40%)**

**Date:** Monday, Apr. 26th 2021, 8:30 AM - 10:30 AM, Online

**Learning Outcome:** 3

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## 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 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 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 book their exams at least 7 days in advance and not later than the 40th Class Day.

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 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings and academic schedules. Any such changes will be announced via CourseLink and/or class email. All University-wide decisions will be posted on the COVID-19 website (<https://news.uoguelph.ca/2019-novel-coronavirus-information/>) and circulated by email.

## 9.10 Illness

The University will not normally require verification of illness (doctor's notes) for fall 2020 or winter 2021 semester courses. However, requests for Academic Consideration may still require medical documentation as appropriate.

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