CIV300H1 F, ENV346H1 F

Terrestrial Energy Systems

Fall 2024 Syllabus

Course Meetings

Section	Day & Time
Lectures	Monday, 9:00 AM - 11:00 AM Wednesday, 9:00 AM - 10:00 AM
Tutorials	Tuesday, 6:00 PM - 8:00 PM

Refer to ACORN for the most up-to-date information about the location of the course meetings.
Full Course Schedule is provided below.
First lecture is Wednesday **4th September 2024.**
Last lecture is Monday **2nd December 2024.**

Course Contacts

Instructor: Sherry-Ann Ram, PhD, P.Eng., PMP
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Teaching Assistants
Jennifer (Jay) Gordon
Nehul Agarwal
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Shuping Wang
Jingzhi (Amanda) Liang

The syllabus is designed to provide the pertinent information for the course. There will be discussion boards set-up which may be used for general questions where everyone can benefit and learn from each other. If additional information and/or assistance is needed that goes beyond the scope of the syllabus and discussion boards, students can reach out to the course instructor personally through Quercus or via email. Students will also have contact time with teaching assistants during tutorial sessions.

Course Overview

Core Course in the Sustainable Energy Minor Various earth systems for energy transformation, storage and transport are explored. Geological, hydrological, biological, cosmological and oceanographic energy systems are considered in the context of the Earth as a dynamic system, including the variation of solar energy received by the planet and the redistribution of this energy through various radiative, latent and sensible heat transfer mechanisms. It considers the energy redistribution role of large-scale atmospheric systems, of warm and cold ocean currents, the role of the polar regions, and the functioning of various hydrological systems. The contribution

and influence of tectonic systems on the surface systems is briefly introduced, as well the important role of energy storage processes in physical and biological systems, including the accumulation of fossil fuel reserves.

Motivation

Energy issues are becoming increasingly prominent, notably the specific aspects of carbon intensity, price, source, storage, price stability, long-term sustainability, energy security, climate change amongst numerous other issues. While acutely aware of and partly motivated by these human issues - founded on the notion that energy is indispensable to humanity, this course is not about applications; rather it considers actual scientific processes resulting in these energy transformations that we see on planet Earth.

The desire is to provide detailed background on terrestrial systems as they function at both large and small scales, and to seek an overview of the “natural” functioning of the whole planet from an energy perspective. The goal is to understand both the Earth and energy well enough that key concepts can be explained, related and recognized in scientific and popular writing, and that these concepts can be used quantitatively in simple assessments. As the Anthropocene continues to modify Earth’s natural energy cycles, understanding the basic concepts is vital if we are to reduce the impacts of human-induced climate change.

A desired outcome of the course is for engineers and environmental specialists to understand that the world around them is part of an energy system and not a static body without external influence. By understanding our own environment, we stand a better chance of understanding those which we seek to alter and how we have altered our own.

Course Learning Outcomes

Upon successful completion of this course, you will be able to:

- Understand the role of energy on Earth: its sources and how it changes form.
- Apply basic laws in order to quantify and evaluate the amount of energy Earth receives from the sun and how it is distributed on Earth.
- Analyse fundamental properties of air and water including the application of psychrometric principles (the quantification of air’s energy content in relation to water vapour, and dry air masses) in order to understand how energy transfer and fluid movement occurs on our planet.
- Apply air/water concepts to understand weather patterns at a local and global scale including extreme examples including hurricanes, tornados and thunderstorms.
- Apply basic concepts to understand waves and ocean currents, including the study of tsunamis.
- Understand Earth’s sub-surface structure and its impacts on the surface.

Course Details

The course will be broken down into the following five Modules. While they are self-contained, material will recur and evolve throughout the course. Basic concepts will be studied and then applied as we seek to understand some of the ‘big stuff’: weather, major events including hurricanes, earthquakes and tsunamis.

Module	Topics	Learning Outcomes	Week

Module 1 Energy in our Own Backyard	Introduction and Key Concepts: Overview of the course, energy and environment, introduction to terrestrial energy, overview of Earth's energy balance, energy as global currency, Earth in space and time.	Apply basic laws in order to quantify the energy Earth receives from the sun and how it is distributed. Study the role of the moon and sun and apply that learning to understanding Earth's seasons.	1, 2, 3
Module 2 Air and Water Fundamentals, Consequences for Earth Energy Systems	Physics of the Earth: Overview of transformations of heat, work; quantitative statements of the 1st law of thermodynamics and energy forms; phase change, thermal stratification, and chemical reactions; key terrestrial energy carriers and transfers; dry and moist air, psychrometric relations.	Analyse the fundamental properties of air and water in relation to the redistribution of energy on Earth. Evaluate how energy exchange impacts water's phase changes and their key role in energy transportation. Understand how that redistribution is experienced as weather, climate and human comfort.	4, 5
Module 3 Applications in Weather	The Atmosphere and the Oceans: Basic models of the atmosphere and the Earth's energy balance: reflection, refraction and absorption; weather and climate systems, hydrologic coupling; atmospheric circulation, Coriolis force and geostrophic wind, effect of cloud cover and humidity, effect of land and sea, effect of elevation and aspect. Oceanography, oceanic circulation, shallow and deep circulations, hydrologic cycle, energy transport mechanisms in the oceans. Snow and ice formation, winter impact.	Analyse how basic laws characterise air movement and scale and the resulting weather outcomes Understand and analyse major storm types: thunderstorms, tornados, hurricanes	6, 7, 8, 9, 10
Module 4 Ocean Currents & Waves	Water Bodies & Waves: Waves, tides, currents, tsunamis.	Understand and evaluate concepts of water and energy transportation within the oceans Apply these concepts to large ocean waves and tsunamis	11, 12
Module 5 Earth's Structure	Subsurface Systems: Introduction to plate tectonics, earthquakes and volcanoes.	Understand basic concepts to evaluate Earth's sub-surface structure and its outcomes Apply those concepts to plate tectonics and earthquakes	13

Tutorials

Tutorials will be a mixture of instruction and group work. The tutorials are designed to complement the lecture material to further enhance the learning. There will be 6 practice problem sets (PPS) to give hands-on exposure to primarily numerical applications of the various topics and **these will make up the key material** on which the tests and exam will be based. Tutorials are based on the Modules. Tutorials are posted on the Wednesday for the following week's Tuesday tutorial.
Tutorials are not mandatory, and submissions are not required. An online option will be available. Complete solutions to the PPS will be posted prior to the quizzes and exams.

Prerequisites: None
Corequisites: None
Exclusions: ENV346H1
Recommended Preparation: None
Credit Value: 0.5
Graduate Attributes:

- 1B. Knowledge Base for Engineering: Demonstrate competence in natural sciences. [Applied]
- 12A. Life-Long Learning: Demonstrate the ability to independently summarize, analyze, synthesize and evaluate information from a wide variety of sources (learning independently). [Applied]

Informal Prerequisites. A general background/interest in science and a desire to understand your surroundings; reasonably proficient writing, reading and communication skills; basic skills in math and algebra; a desire to learn about the world you live in technically and quantitatively. This is **not** a calculation-heavy course, rather the study and application of key concepts that have remarkable outcomes that we know first-hand by living on an active planet. That's not to say that we cannot quantify and as such numerical analysis is a part of the course.

Course Materials

A custom and dedicated TES e-textbook **is required**.

This textbook can be purchased and is available in the U of T Bookstore as an electronic (or hard copy) to cover the key course requirements. The electronic version is available at a cost of $60.95. Please see the separate link under Modules in Quercus to purchase and access the textbook.

Marking Scheme

Assessment	Percent	Details	Due Date
Tutorial Quiz	30%	Based on the best 3 of 4 components.	To be advised
Group Project	20%	Written, creative assignment. Detailed instructions will be provided.	To be advised
Final Exam	50%	**Type 2:** All non-programmable electronic calculators **Type C:** A "closed book" examination. A student may prepare, bring to their exam and use a single examination aid sheet, downloaded from the Faculty's website, printed on an 8.5"x11" piece of paper. Download the Examination Aid Sheet (PDF). Students may enter on both sides of the aid sheet any information they desire, as specified by one of the three subtypes listed below. **Type C1:** Such entries will be handwritten and not mechanically reproduced. Digitally prepared sheets (e.g., handwritten on a tablet) will not be permitted.	Final Exam Period

The tutorial quiz will take place once the lectures and associated tutorials for the covered material have taken place. It will therefore lag the completion of the lecture work by a week or two. Note that there is no make up quiz. If you have programmed a conflict into your schedule, you are responsible for meeting your quiz times and dates for this course. This course is multi-department/multi-faculty, so accommodations are not possible due to timetabling.

The final exam will cover all the material from the course.

The tutorial quiz and final exam will be a mixture of multi-choice questions and short/long answer questions, both calculations and written answers. Written questions are a key part of this heavily concept-based course.

Policies & Statements

University Land Acknowledgement

I wish to acknowledge this land on which the University of Toronto operates. For thousands of years, it has been the traditional land of the Huron-Wendat, the Seneca, and the Mississaugas of the Credit. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.

Learn more about Canada's relationship with Indigenous Peoples here.

Indigenous Students' Supports

If you are an Indigenous engineering student, you are invited to join a private Discord channel to meet other Indigenous students, professors, and staff, chat about scholarships, awards, work opportunities, Indigenous-related events, and receive mentorship. Email Professor Bazylak if you are interested.

Indigenous students at U of T are also invited to visit Nations House's (FNH) Indigenous Student Services for culturally relevant programs and services. If you want more information on how to apply for Indigenous specific funding opportunities, cultural programs, traditional medicines, academic support, monthly social events or receive the weekly newsletter, go to the FNH website, email or follow FNH on social media: Facebook, Instagram, or TikTok. A full event calendar is on the CLNX platform. Check CLNX often to see what new events are added!

Wellness and Mental Health Support

Your personal wellness and mental health are important. The University of Toronto and the Faculty of Applied Science & Engineering offer a wide range of free and confidential services that can support your well-being.

As a U of T Engineering student, you have a Departmental Undergraduate Advisor or a Departmental Graduate Administrator who can support you by advising on personal matters that impact your academics. Other resources that you may find helpful are listed on the U of T Engineering Mental Health & Wellness webpage, and a small selection are also included here:

- U of T Engineering's Student & Community Wellness Coordinator
- Health & Wellness and the On-Location Engineering Wellness Counsellor
- Health & Wellness Peer Support Program
- Accessibility Services & the On-Location Advisor
- Graduate Engineering Council of Students' Mental Wellness Commission
- SKULE™ Mental Wellness
- U of T Engineering's Learning Strategist and Centre for Learning Strategy Support
- Registrar's Office and Scholarships & Financial Aid Office & Advisor

We encourage you to access these resources as soon as you feel you need support; no issue is too small. You may reach out to the counsellors at U of T Telus Health Student Support for 24/7 free and confidential counselling support.

If you find yourself feeling distressed and in need of more immediate support visit uoft.me/feelingdistressed or U of T Engineering's Urgent Support – Talk to Someone Right Now.

Accommodations

The University of Toronto supports accommodations for students with diverse learning needs, which may be associated with mental health conditions, learning disabilities, autism spectrum, ADHD, mobility impairments, functional/fine motor impairments, concussion or head injury, visual impairments, chronic health conditions, addictions, D/deaf, deafened or hard of hearing, communication disorders and/or temporary disabilities, such as fractures and severe sprains, or recovery from an operation.

If you have a learning need requiring an accommodation the University of Toronto recommends that students register with Accessibility Services as soon as possible.

We know that many students may be hesitant to reach out to Accessibility Services for accommodations. The process of accommodation is private; we will not share details of your needs or condition with any instructor.

If you feel hesitant to register with us, we encourage you to reach out for further information and resources on how we can support. It may feel difficult to ask for help, but it can make all the difference during your time here.

Phone: 416-978-8060
Email: accessibility.services@utoronto.ca

Equity, Diversity and Inclusion

Looking for community? Feeling isolated? Not being understood or heard?

You are not alone. You can talk to anyone in the Faculty that you feel comfortable approaching, anytime – professors, instructors, teaching assistants, first-year or upper years academic advisors, student leaders or the Assistant Dean of Diversity, Inclusion and Professionalism.

You belong here. In this class, the participation and perspectives of everyone is invited and encouraged. The broad range of identities and the intersections of those identities are valued and create an inclusive team environment that will help you achieve academic success. You can read the evidence for this approach here.

You have rights. The University Code of Student Conduct and the Ontario Human Rights Code protect you against all forms of harassment or discrimination, including but not limited to acts of racism, sexism, Islamophobia, antisemitism, homophobia, transphobia, ableism, classism and ageism. Engineering denounces unprofessionalism or intolerance in language, actions or interactions, in person or online, on- or off-campus. Engineering takes these concerns extremely seriously and you can confidentially disclose directly to the Assistant Dean for help here.

Resource List:

- Engineering Equity, Diversity & Inclusion Groups, Initiatives & Student Resources
- Engineering Positive Space Resources
- Request a religious-based accommodation here
- Email Marisa Sterling, P.Eng, the Assistant Dean, Diversity, Inclusion & Professionalism here
- Make a confidential disclosure of harassment, discrimination or unprofessionalism here or email engineering@utoronto.ca or call 416.946.3986
- Email the Engineering Society Equity & Inclusivity Director here
- U of T Equity Offices & First Nations House Resources

Plagiarism Detection Tool

Normally, students will be required to submit their course essays to the University's plagiarism detection tool for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the tool's reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of this tool are described on the Centre for Teaching Support & Innovation web site (https://uoft.me/pdt-faq).

Cell Phones and Laptop Usage

Technology can support student learning, but it can also become a distraction. Research indicates that multi-tasking (texting, surfing the Internet, using social networks) during class time can have a negative impact on learning (Clapp, Rubens, Sabharwal & Gazzaley, 2011; Ellis, Daniels, Jauregui, 2010; Hembrooke & Gay, 2003). Out of respect for your fellow learners in this class, please refrain from using laptops or mobile phones for entertainment during class and do not display any material on a laptop which may be distracting or offensive to your fellow students. Laptops may be used only for legitimate classroom purposes, such as taking notes, downloading course information from Portal, or working on an assigned in-class exercise. Checking social media, email, texting, games, and surfing the Web are not legitimate classroom purposes. Such inappropriate laptop and mobile phone use is distracting to those seated around you.

Lecture Capture by Instructor

If lecture recordings are provided, they are only for the exclusive use of enrolled students, for their personal learning. Lecture recordings are not to be shared in any way beyond enrolled students.

Privacy/FIPPA Statement

Personal information is collected pursuant to section 2(14) of the University of Toronto Act, 1971 and at all times it will be protected in accordance with the Freedom of Information and Protection of Privacy Act. Please note that this course requires presentations of one's work to the group. For more information, please refer to http://www.utoronto.ca/privacy.

Video Recording and Sharing (Download and Re-use Prohibited)

This course, including your participation, will be recorded on video and will be available to students in the course for viewing remotely and after each session.

Course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation and are protected by copyright. Do not download, copy, or share any course or student materials or videos without the explicit permission of the instructor.

For questions about the recording and use of videos in which you appear, please contact your instructor.

Academic Integrity

All students, faculty and staff are expected to follow the University's guidelines and policies on academic integrity. For students, this means following the standards of academic honesty when writing assignments, collaborating with fellow students, and writing tests and exams. Ensure that the work you submit for grading represents your own honest efforts. Plagiarismâ€”representing someone else's work as your own or submitting work that you have previously submitted for marks in another class or programâ€”is a serious offence that can result in sanctions. Speak to me or your TA for advice on anything that you find unclear. To learn more about how to cite and use source material appropriately and for other writing support, see the U of T writing support website. Consult the Code of Behaviour on Academic Matters for a complete outline of the University's policy and expectations. For more information, please see the U of T Academic Integrity website.

Quercus Information

This course uses the University's learning management system, Quercus, to post information about the course. This includes posting readings and other materials required to complete class activities and course assignments, as well as sharing important announcements and updates. The site is dynamic and new information and resources will be posted regularly as we move through the term, so please make it a habit to log in to the site on a regular, even daily, basis. To access the course website, go to the U of T Quercus log-in page at https://q.utoronto.ca. Once you have logged in to Quercus using your UTORid and password, you should see the link or "card" for this course. You may need to scroll through other cards to find this. Click on this link to open our course area, view the latest announcements and access your course resources.There are Quercus help guides for students that you can access by clicking on the "?" icon in the left side column.

SPECIAL NOTE ABOUT GRADES POSTED ONLINE: Please also note that any grades posted are for your information only, so you can view and track your progress through the course. No grades are considered official, including any posted in Quercus at any point in the term, until they have been formally approved and posted on ACORN at the end of the course. Please contact me as soon as possible if you think there is an error in any grade posted on Quercus.