Course: **TERRESTRIAL ENERGY SYSTEMS**

Course Number: CIV 300H1F, ENV 346H1F

Instructor: Ian Sinclair, P.Eng., MEng&Man ianc.sinclair@utoronto.ca

Time: *Lectures:* Monday 10-12 pm, ES1050. Thursday 11-12 pm, ES1050. First lecture Thursday September 8th.
Tutorials: Tuesday from 6 to 8 pm (though we will often finish earlier). Rooms BA2145-2195 for CIV300, HA401 for ENV346. Room number/tutorial styles to be confirmed. To begin Tuesday 20th September (**to be confirmed**).

Overview
This course overviews various systems of energy storage and transformation within our own environment, namely the Earth, and as relates to our sources of energy – specifically the sun. The energy systems considered include solar, atmospheric, subsurface and ocean systems. Convection, conduction and radiation are explored as key transfer mechanisms between these systems. Energy transformations, the Earth's energy balance, energy transport mechanisms in the atmosphere and the oceans due to circulation, currents, evaporation and precipitation - together with the key couplings and interactions that connect these into a planetary system – are reviewed. These together make up what we know of as weather, seasons and major dramatic events like hurricanes and earthquakes.

Motivation
Energy issues are becoming increasingly prominent, notably the specific aspects of price, source, storage, price stability, long-term sustainability, energy security, technical challenges, climate change amongst numerous other issues. While acutely aware of and partly motivated by these human issues that will increasingly affect *all* students during their careers, this course is not about applications; rather about actual scientific processes resulting in these energy transformations that we see on planet Earth.

The desire is rather to provide detailed background on terrestrial systems as they function on both large scales 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.

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. Alternately, what is special and what is quotidian about Earth that makes it out home?

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.

Evaluation
There will be 7 practice problem sets to give hands-on exposure to various topics and **these will make up the key material** on which the tests and exam will be based. More details about tests and exams will follow later.

The PPSs themselves will not be collected or graded, though complete solutions will be posted. Each of the two quizzes will have an equally weighted Part A (multiple choice) and part B (short answer portion). Students

separately over then next week or so. The mini assignment for CIV300 *only* will be set towards the end of the semester. It is a reflective learning exercise and will not be onerous.

Assessed Material	CIV300	ENV346
Mini assignment (CIV300 only), essay	**4%**	**20%**
2 Tutorial quizzes (mark based on best 3 of 4 parts)	**46%**	**-**
2 Tutorial quizzes (best 2 out of 3 parts)		**30%**
Final Exam (Type C; aid sheet with calculators)	**50%**	**50%**

Test Dates: Tuesday Oct 11th and Tuesday Nov 22nd – dates to be confirmed - from shortly after 6 pm until shortly after 7 pm in tutorial rooms to be announced; **lectures are typically cancelled on the Monday preceding the test as schedule permits**. As these dates may change do not make commitments during these tutorial times. Note that there are **no make up tests**.

References and Texts

A custom and dedicated TES textbook **is required to be purchased** and is available in the U of T Bookstore to cover the key course requirements. The textbook covers material in detail that is covered in lectures and also provides sample questions that are representative of examination material. Additional references and resources will be made available during the course. Some chapters may be set for independent learning and be included in the final examination. Note that the book has been revised for this year reflecting updated text books for the source material. It was also revised for fall 2013.

Special Learning Feature

Given the wide-ranging nature of the course and its many practical examples and outcomes visible in everyday life, as highlighted in the media, we will make use of the discussion board on Portal to exchange information and ideas and answer questions. The TA's may also set up specific threads to assist with tutorial work.

APPROXIMATE COURSE OUTLINE

Weeks 1-3 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.*

Weeks 4-5 Physics of the Earth: O*verview 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, psychometric relations.*

Weeks 6-10 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.*

Weeks 11-12 Water Bodies & Waves: *Waves, tides, tsunamis.*

Week 13 Subsurface Systems: *Introduction to plate tectonics, earthquakes and volcanoes.*

Accessibility Needs:

The University of Toronto is committed to accessibility. If you require accommodations for a disability, or have any accessibility concerns about the course, the classroom or course materials, please contact Accessibility Services as soon as possible: disability.services@utoronto.ca or http://studentlife.utoronto.ca/accessibility