Emerging Energy Systems (ENGG*2050)
Winter 2013 Course Outline

Instructor:

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Lectures:

Tuesday and Thursday (1:00 pm – 2:20 pm), Room: Mack 234

Lab:

Monday (2.30 pm - 5.20 pm), Room: Thrn 3404, 1012

Course Text book:

1. Renewable Energy Resources , 2nd Edition (2006)
Authors: John Twidell & Tony Weir; Publisher: Taylor & Francis
2. Renewable Energy-Power for sustainable future, 3rd Edition (2012)
Edited by: Godfrey Boyle; Publisher: Oxford

Reference book:

3. Fundamentals of Renewable Energy Process, 2nd Edition (2009)
Author: Aldo Vieira da Rosa; Publisher: Elsvier
4.Sustainable Energy: Choosing Among Options
Author: Jefferson W. Tester et. al 2005, MIT Press

Notes:

Copies of lecture presentation materials, plus supplemental material, will be posted on Courselink. (Note: posting of all materials shown or discussed in class is not guaranteed.)

Undergraduate Calendar Description

The basic principles and design of emerging energy systems are covered. The systems which form the basis of the course are solar thermal systems, solar photovoltaic systems, fuel cells, biofuels and wind energy technology. Mechanisms for storing energy generated from each of these systems are studied.
Prerequisite(s): ENGG*2030, PHYS*1010

Rationale: Considering that energy is a critical need of the society, it is important that energy graduates should have an understanding of: i) the importance of renewable energy, ii) the working and design principles of different renewable energy technologies, and their storage iii) application of energy technologies in the economic sectors.

Learning Objectives: Canadian Engineering Accreditation Board – Graduate Attributes

Graduate Attribute	Taught	Assessed	Graduate Attribute	Taught	Assessed
1. Knowledge Base	Y	Y	7. Communication	N	Y
2. Problem Analysis	Y	Y	8. Professionalism	N	N
3. Investigation	Y	Y	9. Environment & Society	N	Y
4. Design	Y	Y	10. Ethics and Equity	N	N
5. Engineering Tools	Y	Y	11. Project Mgmt	N	N
6. Individual & Team Work	N	Y	12. Life-long learning	N	N

TOPICS TO BE COVERED

I. Introduction of Renewable Energy
   1. Definition
   2. Importance
   3. Different Kinds of Renewable Energies

II. Solar Energy
   1. Introduction
   2. Solar Radiation
   3. Solar Thermal Energy
   4. Solar Photovoltaic
   5. Design and Applications

III. Biomass Energy
   1. Introduction
   2. Biomass Conversion
   3. Design and Applications

IV. Wind Energy
   1. Fundamental of Wind Power
   2. Types of Turbines
   3. Design and Applications.

V. Geothermal Energy
   1. Introduction
   2. Geothermal Resource Types
   3. Applications for Heating and Electricity Generation.

VI. Tidal Energy
1. Introduction
2. Origin of Tides
3. Power Generation Schemes.

VII. Wave Energy
1. Introduction
2. Basic Theory
3. Wave Power Devices.

VIII. Ocean Thermal Energy Conversion (OTEC)
1. Introduction
2. Principles
3. Practical considerations

IX. Fuel Cell
Thermodynamics of extractable work vs. Carnot heat engine. Types of fuel cells. Costs; prospects for improvement.

X. Energy Storage. Batteries: important types, theoretical limitations on specific energy storage and current proximity to limits. Pumped hydroelectric. Compressed Air Energy Storage. Flow batteries. Flywheels. Electrochemical capacitors. Superconducting magnetic energy storage. Thermal energy storage. Applications: transportation; intermittent renewables; grid. Requirements for hybrid electric vehicle, plug-in hybrid electric vehicle, and electric vehicle. Hydrogen storage and transport.

XI. Outlook of future energy use
a. Towards a low carbon society
b. Energy access and energy conservation

Laboratory Session:
1. Solar PV and Energy Storage Systems
2. Characterization of Biomass
3. Combustion performance of a pellet stove
4. Wind Energy System
5. Geothermal System
6. Fuel cell System

A few suggested Journals and Magazines:
1. Energy
2. Renewable Energy
3. Energy Sources
4. Solar Energy
5. Wind Energy
6. Biomass conversion and biorefinary

GRADING SCHEME

Group/individual design project	20 %
Lab/assignments/investigation	20 %
Midterm	25 %
Final Exam	35 %

Project/Lab:
Each project/lab will be documented in a report that will be submitted. Project marks will be based on project reports. Topics of the project will be determined in consultation with the instructor. Reports submitted after the due date will be assessed a penalty of 10% of the report mark per day. Further details on the reports will be given in class.

Mid-Term Exam:
The material covered will include the last lecture prior to the exam. The exam will be closed book. Permitted aids will be announced prior to the midterm. Failure to attend the exam will lead to a zero for that exam unless valid documentation is provided for medical or compassionate grounds.

Final Exam:
The final exam will cover the material presented for the entire course and will be closed book. Permitted aids will be announced prior to exam. Failure to attend the exam will lead to a zero for that exam unless valid documentation is provided for medical or compassionate grounds.

RESPONSIBILITIES AND TASKS

During this class, the student is considered to be *an engineer in formation.* His/her work is not only to get good grade, but to also get prepared to skillfully assume his/her future job as engineer. With this in mind, the student does have the full responsibility to plan and manage his/her learning. Keep in mind that fundamental engineering knowledge/thinking is acquired by repetition and problem solving. Here are the three main tasks under the responsibility of the student.

The first task is to do the necessary work in order to understand and learn the concepts seen in class. This work consists in reading the suggested material prior to and after class. The lectures' purpose is to present, explain and complete the information in relation to the main concepts presented in class. The second task is to actively participate in the activities taking place in the classroom. Discussions and problem solving (alone or in a team) are the principal activities in which the participation of the student is demanded and advised. Finally, the student's third task is to use all the resources at his/her disposition in order to master the fundamental knowledge and the concepts needed to analyze and model the emerging energy technologies studied.

The instructor's responsibility is to organize and manage the environment in which the student is coming to learn. To this end, he will present the necessary learning resources and will animate the class activities. He is also available to help students with any kind of problem they could have regarding the content of the class. As usual, he plays a role in the grading process.

METHODOLOGY

Every lecture will be organized in a way that favors a good comprehension of the presented concepts and an active appropriation of knowledge. Generally, the instructor's formal lecture will alternate with problem solving presentations and period of questions and answers. In order for the student to actively participate during the lectures, they would need to have read the class materials before hand.

DISCLAIMER

The outline above is the course plan at the time this outline is distributed. The instructor reserves the right to change any or all of the above as the course progresses (including specifics of assignments, labs, projects and exams), subject to University of Guelph Academic Regulations. In the event that subsequent information about assignments, projects or exams differ from this outline, the more recent information will supersede this outline. Any course changes from those listed in this course outline will be announced in class and posted on the course Courselink page.

Notify the instructor immediately if you identify a conflict between course requirements and religious requirements, such as holy days of obligation.

Assignments, projects and exams in this course are individual assignments. While students are encouraged to assist each other with learning and understanding the course concepts, and to utilize a range of information sources, each student must submit their own unique work for assignments, projects and exams. Proper referencing of sources in reports is essential: if you are unsure what this means, consult with the instructor *before* submitting your work. Any cases of suspected academic misconduct will be reported to the Director of the School of Engineering.

Academic misconduct, such as plagiarism, is a serious offence at the University of Guelph. Please consult the current Undergraduate Calendar and School of Engineering program guide for offences, penalties and procedures relating to academic misconduct.
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml