1 INSTRUCTOR

1.1 Instructor
Instructor: William David Lubitz, Ph.D., P.Eng.
Office: THRN 1340, ext. 54387
Email: wlubitz@uoguelph.ca
Office hours: By appointment

1.2 Lab Technician
Technician: Mike Speagle
Office: RICH 3502, ext. 56803
Email: mspeagle@uoguelph.ca

2 LEARNING RESOURCES

2.1 Course Website
Course material, news, announcements, and grades will be regularly posted to the ENGG*6660 Courselink site. You are responsible for checking the site regularly.

2.2 Required Resources
Course notes and supporting materials will be posted on Courselink.
The course will also draw on material in several electronic text books that are available at no additional cost to students through the University of Guelph library. The following three texts will be the most
extensively utilized. It is recommended that students download the following three textbooks through the University of Guelph library:


2.3 Additional Resources

**Lecture Information:** Lecture notes will be posted on Courselink. These notes are not guaranteed to be a comprehensive reflection of the lectures and discussions that occur in class.

**Assignments:** Assignments and some supporting materials will be posted on Courselink.

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### 3 ASSESSMENT

#### 3.1 Course Mark Distribution

<table>
<thead>
<tr>
<th>Component</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework Assignments</td>
<td>25%</td>
</tr>
<tr>
<td>Test</td>
<td>25%</td>
</tr>
<tr>
<td>Project</td>
<td></td>
</tr>
<tr>
<td>Literature Review</td>
<td>15%</td>
</tr>
<tr>
<td>Analysis/Design Plan and Preliminary Results</td>
<td>10%</td>
</tr>
<tr>
<td>Analysis/Design Report</td>
<td>20%</td>
</tr>
<tr>
<td>Poster Presentation</td>
<td>5%</td>
</tr>
</tbody>
</table>

#### 3.2 Deliverable Due Dates and Test Date

The test date, and due dates for deliverables, are given in Section 5.2

#### 3.3 Assignments

Six assignments will be given on different aspects of the course material. Each student is expected to complete each assignment individually and submit their own work, on or before the due dates in Section 5.2. The overall mark for the assignments will be based on the highest five assignment marks for each student. (One way of looking at this is to say that a student can miss a single assignment without any penalty.) All students must complete Assignment 0.

#### 3.4 Test

The test will be a comprehensive written test on course material. It will be closed book (acknowledging that we are using electronic textbooks) but students will be allowed to bring up to five sheets (8.5 by 11 inch) of handwritten notes, which will be submitted with the completed test. (The test and notes will be returned to students after the test is marked).
3.5 Project

Each student will conduct an independent research project related to the investigation of a research question, or design or site-specific utilization of a specific renewable energy technology or application. All projects must include a time-domain simulation of a renewable energy system, which students will implement in MATLAB.

Each student will answer a practical question related to a topic relevant to renewable energy by conducting original analysis, or design a solution related to the project. A list of potential project topics will be provided, or an alternative topic may be determined in consultation with the instructor. There are several deliverables for the research project, each of which is due at the time indicated in Section 5.2:

1. A project topic memo identifying the project topic of interest to the student, and giving a brief rationale for the topic choice.
2. A concise literature review on the project topic, written to publishable standards, including proper referencing of reputable sources.
3. A project plan for the main analysis or design work, and preliminary results consisting of high level “back of the envelope” analysis, or a high level design scoping and feasibility.
4. A report documenting the analysis or design solution, written to publishable standards, including proper referencing of reputable sources.

All project deliverables should utilize the paper template supplied on Courselink. The submission for each deliverable should incorporate all of the prior deliverables. (For example, the project plan should be submitted with the topic overview and the literature review.)

Project Topic Memo

Students must identify their project topic of interest, and submit a brief (one page) memo describing their project topic, and their reasons for choosing this topic. If the topic is from the list of topic ideas provided by the instructor, the student should submit a first, second and third choice of topic. Each student must complete a project on a unique topic. If the student is defining their own topic, they should discuss their topic idea with the instructor before submitting the memo.

The memo should clearly state one or more specific, relevant questions that the student will be seeking to answer through their project.

Any topic deemed insufficient or outside the scope of the course will be modified by the instructor. These modifications will be considered final. If you have any uncertainty about a potential topic, it is your responsibility to discuss and clarify it with the instructor before submitting your memo.

Literature Review

The overall goal of the literature review is to provide needed background knowledge and context for the project.
The project literature review should be based primarily on high-quality published materials (such as peer-reviewed journal articles) and include:

1. An overview of the topic.
2. Fundamental engineering and scientific principles of the topic.
3. Review of research conducted in the field. The review should synthesize the findings from the literature. Do not just report the major findings of each paper one after another.
4. A statement of research or design goals that will form the basis of the project, informed by what you learned from your literature survey.

A minimum of 10 peer reviewed papers should be cited (however, more sources may be necessary for some topics). Literature reviews should be 1500 concise, information-dense words (excluding abstract and reference list). Include the word count at the end of the review.

**Analysis/Design Plan and Preliminary Results**

This deliverable should include either an initial preliminary design or an initial analysis. If it is a design, it should summarize the design problem and criteria, and provide an initial “high level” design, including the architecture or layout of the design, and estimates of scale, costs and performance. If the project is an analysis, it should include the research question, relevant information, and a “high level” investigation (e.g. order of magnitude estimates, analysis of a more simplified problem, and/or investigation of a subset of the overall problem) including results. The second part of this deliverable should be a realistic plan (including schedule) for completing the detailed design or analysis.

The plan and results should be written to follow the literature review you previously completed. Submit one document that includes an introduction, the literature review and then a following section that is clearly the plan and preliminary results.

**Analysis or Design Project Report**

The project analysis or design solution should be original work completed by the student. Do not report details of a project or analysis from the literature. This work should be guided by the findings from the literature review. The analysis or design report should be written to follow the literature review, and should include

1. A definition and explanation of the question to be answered, or the design problem to be addressed. You should refer directly to the results of your literature review.
2. Any additional background information that is needed to understand the work but is not included in the literature review.
3. Documentation of the design study and engineering analysis of the research project.
4. Results of testing and analysis, and a conclusion suggesting the direction that would be most fruitful for future work on the project.

Submit a complete document, including an introduction, the literature review, relevant material from the plan and preliminary results, and a final section on your analysis or design results. The analysis/design section should be approximately 1500 words plus tables and figures. Add a short conclusion section at the end that summarizes the main findings and gives some suggestions for future research or development.
Poster Presentation
A poster session will be held during the last week of the semester. Each student will prepare a poster summarizing their project, and present it to the class during the poster session.

3.6 Course Grading Policies

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 in writing, with your name, id#, and e-mail contact. See the graduate calendar for information on regulations and procedures for Academic Consideration:
http://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/sec_d0e1400.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

Late Assignments and Project Deliverables: Assignments and project deliverables will be due at specified dates and times. Late submissions will be assessed a 20% mark penalty if submitted within 48 hours of the due date and time. Assignments and project deliverables will not be accepted more than 48 hours after the date and time they are due.

Minimum Quality of Written Deliverables (Assignments and Projects): All written deliverables (assignments and project deliverables) must be written clearly in grammatically correct English. Deliverables that do not meet a minimum writing quality will be returned unmarked, and the student will be required to rewrite and resubmit the deliverable by a specified date. If the student does not resubmit the deliverable, or the resubmission is also poorly written, the student will receive a mark of zero for the deliverable. The final mark for a rewritten deliverable will be reduced by 30% as a late penalty.

Submission of Original Work: Student submissions may be analyzed using TurnItIn software, or other tools to identify non-original work. All students must submit their own, original writing.

4 AIMS & OBJECTIVES

4.1 Calendar Description

The engineering principles of renewable energy technologies including wind, solar, geothermal and biomass will be examined, including technology-specific design, economic and environmental constraints. Students will compare the relative merits of different energy technologies and gain a knowledge base for further study in the field.

4.2 Course Aims

Engineering principles of renewable energy technologies will be covered using a learner-centered approach, with a specific focus on solar, wind and hydro energy. The design, economic and environmental constraints of each
technology will be investigated. Students will learn to compare the relative merits of different energy technologies, and gain a knowledge base for further study in the field.

4.3 Learning Objectives

At the successful completion of this course, the student will have demonstrated the ability to:

1. Understand the governing principles of solar, wind and hydro energy systems.
2. Integrate prior knowledge of fluid mechanics, heat transfer, thermodynamics and engineering systems in order to compare renewable energy systems.
3. Apply knowledge of specific renewable energy technologies to assess the feasibility of proposed energy systems in engineering, financial and social contexts.
4. Build and use parametric models to critically evaluate proposed energy technologies and systems for practicality and potential performance.
5. Design energy systems based on solar, wind and hydro technologies for specific goals and locations.
6. Concisely and articulately communicate the results of an energy system analysis or design process to an engineering audience.

4.4 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/D2L but these are not intended to be stand-alone course notes. 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 project.

4.5 Students’ Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and tutorials. 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.

E-mail Communication: As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

Recording of Materials: Presentations which are made in relation to course work—including lectures—cannot be recorded in any electronic media without the permission of the presenter, whether the instructor, a classmate or guest lecturer.

4.6 Relationships with other Courses

Previous Courses: This course builds on fundamental engineering concepts in energy, fluid mechanics, heat transfer and electricity.
Follow-on Courses: Students interested in the renewable energy field should consider the following courses:

ENGG*6090*01 ST: Fuel Cells (Clemmer)
ENGG*6090*03 ST: Biofuels and Bioenergy (Dutta)

Note that the courses listed above have been offered as special topics courses recently, and course numbers may change in future offerings.

5 Teaching and Learning Activities

5.1 Timetable

Lectures:

Tuesdays and Thursdays, 1:00 pm to 3:50 pm. Thornbrough 3527

5.2 Course Topics and Schedule

<table>
<thead>
<tr>
<th>Day</th>
<th>Topics</th>
<th>References*</th>
<th>Submissions (Due at start of class – 1:00 pm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Sep 8</td>
<td>Course Overview Introduction Simulation Using MATLAB</td>
<td>Notes provided on Courselink</td>
<td></td>
</tr>
<tr>
<td>2 Sep 13</td>
<td>Systems Modeling Heat Transfer Global Warming</td>
<td>Notes provided on Courselink</td>
<td></td>
</tr>
<tr>
<td>6 Sep 27</td>
<td>Wind Energy Intro. Wind Resources</td>
<td>Notes provided on Courselink</td>
<td></td>
</tr>
<tr>
<td>Day</td>
<td>Topics</td>
<td>References*</td>
<td>Submissions (Due at start of class – 1:00 pm)</td>
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</tr>
<tr>
<td>9 Oct 6</td>
<td>Wind Farms, Intermittency</td>
<td>Notes provided on Courselink</td>
<td>Assignment 3: Wind Energy</td>
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<tr>
<td>Oct 11</td>
<td>No class - holiday</td>
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<tr>
<td>Oct. 25</td>
<td>Assignment 5 returned Review</td>
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<td>Literature Review</td>
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<tr>
<td>Oct. 27</td>
<td>Test</td>
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<tr>
<td>Nov. 1</td>
<td>Test Returned and Reviewed</td>
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<td>Nov. 17</td>
<td>Analysis Design/Plan and Preliminary Results</td>
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<td>Nov. 29</td>
<td>Poster Session</td>
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<td>Poster Presentation</td>
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<tr>
<td>Dec. 1</td>
<td>Analysis/Design Report</td>
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* Notes will be provided on Courselink. Papers and e-text books can be downloaded at no additional cost via the University of Guelph library website (www.lib.uoguelph.ca).
5.3 Other Important Dates

Drop Date: The last date to drop one-semester courses, without academic penalty, is Friday, Nov. 4, 2016. Refer to the Graduate Calendar for the schedule of dates:

http://www.uoguelph.ca/registrar/calendars/index.cfm?index

6 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.

7 RECORDING OF MATERIALS

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

8 ACADEMIC MISCONDUCT

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 discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection. The Academic Misconduct Policy is detailed in the Graduate Calendar:

http://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/sec_d0e1687.shtml

8.1 Resources

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:

http://www.academicintegrity.uoguelph.ca/
The School of Engineering has adopted a Code of Ethics that can be found at: 
http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

The Graduate Calendar is the source of information about the University of Guelph’s procedures, policies and regulations which apply to graduate programs:
http://www.uoguelph.ca/registrar/calendars/graduate/current/