ENGR3355: Renewable Energy
Fall 2006 Syllabus
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Course Description

Modern society relies on stable, readily available energy supplies. Renewable energy is an increasingly important component of the new energy mix. The course covers energy conversion, utilization and storage for renewable technologies such as wind, solar, biomass, fuel cells and hybrid systems. Thermodynamics concepts (including the first and second law) will form the basis for modeling the renewable energy systems. The course also touches upon the environmental consequences of energy conversion and how renewable energy can reduce air pollution and global climate change. Transport Phenomena is recommended as a co-requisite, but not required.

How this course will be run:

I will be using the *Active Learning Model for Renewable Energy.*

Students are expected to take responsibility for their own learning. I will lead you through the steps necessary to do this, and will provide you with opportunities in every class to test your learning and receive feedback.

There will be reading and practice problems assigned for most classes. You are expected to complete the reading and make a substantial attempt at the practice problems PRIOR to coming to class. There will be a written response exercise at the beginning of each class in which you will be asked to think critically about the reading and practice problem. During class we will spend time checking your understanding of the material with concept questions, discussing difficult or confusing topics, answering questions, working on group exercises and performing demonstrations. Class will be very interactive, and all are expected to participate. Many classes will include a short lecture component, depending on the complexity of the material. Feedback (in the form of MUD cards) will be collected at the end of every class which will be used to customize the class as needed. Completed practice problems will be due every other week.

Typically you will spend 1.5 hours of preparation for each hour of class. Including the class time, this accounts for approximately 10 hours a week. The remaining 2 hours will typically be spent finishing and writing up the practice problems. The workload will be adjusted to account for time needed to complete the class project.

Assignments

Homework (25% of final grade)

Homework will consist of all practice problems assigned during a given two-week period and will be due as stated in the master schedule. Each student receives 6 late days to be used throughout the semester. Any homework received after the due date and time will be considered late. A new late day starts at the time that homework was due (not midnight, not end of day). Students may use their late days all at once, or distributed throughout the semester. Once your late days are used up, late homework will be marked down by 15% for each day late.

Homework guidelines will be provided to you and should be followed when completing homework assignments. Your homework grade will be partially based on how well you followed these guidelines. A separate handout on homework guidelines will be provided.

Written Response Exercises (15 – 20 over the semester, 5% total)

At the beginning of each class, you will be given a written response exercise based on the reading and the practice problems. You must complete 80% of these exercises to earn this 5% of your grade.

Journal Critique (25%)

Each week a student will present their review and critique of a journal article in the field of renewable energy. A separate handout with details on this assignment will be provided.

Project (35%)

Students will form teams and complete a feasibility study to bring a renewable energy system to the Olin Campus. A separate handout with details on this assignment will be provided.

Portfolio (10%)

Students will put together a class portfolio containing all the work they did during the semester (homework, written response exercises, journal critique and project), plus written responses to each assignment. A separate handout on what should be contained in the portfolio and how it will be assessed will be provided.

Honor Code

Your conduct and work in this course must adhere to the standards of the Olin College Honor Code. All members of the Olin faculty regard the Honor Code as essential to the academic integrity of Olin College. It is expected that all assignments, exams, and other course activities will be completed under the guidelines set by the Honor Code.

If you discuss or work out homework problems with classmates, please indicate their names on your homework. In general, discussion of material covered and homework problems with classmates is strongly encouraged in this class.

Class Meeting Times

Tuesday 11:00 – 11:50 am, AC218
Wednesday 1:00 – 2:50 pm, AC218
Friday 11:00 – 11:50 am, AC218

Required Books

Fundamentals of Renewable Energy Processes
Aldo Da Rosa
Elsevier Academic Press
ISBN 0120885107

Fundamentals of Thermodynamics
Sonntag, Borgnakke, Van Wylen
John Wiley and Sons, Publisher
6th Edition (ISBN 0471152323)

Other useful references (on reserve in the library)

Renewable Energy, Bent Sorensen
Principles of Solar Engineering, Goswami, Kreith and Kreider
Renewable Energy, Godfrey Boyle
Energy Systems and Sustainability, Boyle, Everett, Ramage
The Renewable Energy Handbook: A Guide to Rural Energy Independence, Off-Grid and Sustainable Living, Kemp
Renewable Energy Policy, Paul Komor

Course Learning Objectives:
Course Objectives are general statements of the goals of the course.

I. Understand and analyze energy conversion, utilization and storage for renewable technologies such as wind, solar, biomass, fuel cells and hybrid systems and for more conventional fossil fuel-based technologies.

II. Use the First and Second Laws of Thermodynamics and introductory transport phenomena to form the basis of modeling renewable energy systems.

III. Understand the environmental consequences of energy conversion and how renewable energy can reduce air pollution and global climate change.

Measurable Outcomes:
Measurable Outcomes are specific statements indicating what students should be able to do upon completion of the course. To be successful in this course (ie to pass the course with a grade of C or better) you should be able to do the following by the time of the final exam:

1. Students have a basic physical intuition for the thermodynamic performance of cycles used to extract power from renewable sources as indicated by recognition of what good, average and poor performance is (metrics and numbers). (Qualitative Analysis)
Assessments: Homework, Journal Club, Project, Class participation

2. Students have a qualitative knowledge of the main sources of renewable energy, the origins of those sources, and the means by which the sources can be exploited for energy generation. (Qualitative Analysis)
Assessments: Homework, Class participation, Self-Assessments

3. Students have a quantitative understanding of the energy generating potential of renewable energy sources and can perform analyses of energy conversion from these sources, and determine analytically the power requirements, power output, and efficiency of renewable energy driven power cycles. (Quantitative Analysis)
Assessments: Homework, Project

4. Students are aware of the framework within which renewable energy is studied, including the economic, socio-economic, political, historical, and environmental contexts that are relevant. (Context)
Assessments: Journal Club, Project

5. Student can identify and locate relevant information sources on renewable energy and assess the quality of the information and the information source. (Lifelong Learning)
Assessments: Journal Club, Project

6. Students can produce written and oral analyses of problems relating to renewable energy that are clear, concise and elegant. (Communication)
Assessments: Homework, Journal Club, Project

7. Students can design a renewable energy power generation or power savings system, by narrowing the focus of the design problem, making the appropriate assumptions, utilizing the right tools and analyses, and making design choices that work for the community, the environment and the client. (Qualitative Analysis, Quantitative Analysis, Context, Teamwork, Design)
Assessments: Project

Competencies Addressed in ENGR3355:

Qualitative Analysis: Olin graduates will be able to analyze and to solve engineering problems qualitatively. The subcompetencies of Estimation, Analysis with Uncertainty, and Qualitative Prediction and Visual Thinking are addressed.
Assessment Methods: homework, exams, concept questions

Quantitative Analysis: Olin graduates will be able to analyze and to solve engineering problems quantitatively. The subcompetencies of Quantitative Modeling and Numerical Problem Solving are addressed.
Assessment Methods: homework, exams, in-class problem solving exercises

Context**:** Olin graduates will demonstrate knowledge of the ethical, professional, business, social, and cultural contexts of engineering, and the ability to articulate their own professional and ethical responsibilities. The subcompetencies of Perspective, and Influence and Impact are addressed.

Teamwork**:** Olin graduates will be able to contribute effectively in a variety of roles on teams, including multi-disciplinary teams. The subcompentencies of Personal Attributes, Team Membership, and Team Leadership are addressed.

Communication: Olin graduates will be able to convey information and ideas effectively, to a variety of audiences, using written, oral, and visual and graphical communication. The subcompetencies of Oral Communication, Visual Communication and Graphical Communication are addressed.
Assessment Methods: class participation, homework, exams

Life Long Learning: Student is able to identify and to address his/her own educational needs in a changing world. The subcompetencies of Personal Attributes, and Information Fluency are addressed.
Assessment Methods: Self-assessment exercises, homework

ENGR3355: Renewable Energy – Class Schedule

Date	Topic	Reading	Assignments
F 9/1	Introduction to Renewable Energy		
T 9/5	Introduction to Energy	Da Rosa Ch. 1	
W 9/6	Field Trip An Inconvenient Truth		
F 9/8	Discussion of An Inconvenient Truth		
T 9/12	Review of Thermodynamics	Da Rosa Ch. 2	
W 9/13	Review of Thermodynamics	Da Rosa Ch. 3	
F 9/15	Second Law Analysis		
T 9/19	Availability, Exergy, Free Energy		
W 9/20	Problem Solving Session		
F 9/22	Class Canceled		
T 9/26	OTEC	Da Rosa Ch. 4	
W 9/27	Journal Club - Jessica OTEC		
F 9/29	Solar Radiation	Da Rosa Ch. 4	
T 10/3	Solar Radiation		
W 10/4	Journal Club Solar Thermal	Goswami Ch. 5 - 8	
F 10/6	Solar Thermal		
T 10/10	No Class – Olin Monday		
W 10/11	Journal Club PV	Da Rosa Ch. 14	
F 10/13	PV		
T 10/17	Biomass	Da Rosa Ch. 13	
W 10/18	Journal Club Biomass		
F 10/20	Biomass		
T 10/24	Wind Energy	Da Rosa Ch. 15	
W 10/25	Journal Club Wind Energy		
F 10/27	Wind Energy		
T 10/31	Fuel Cells	Da Rosa Ch. 9	
W 11/1	No Class – Major Speaker		
F 11/3	Olin Wednesday, Class 1 – 3 pm Fuel Cells		
T 11/7	Fuel Cells		
W 11/8	Journal Club Hydrogen Production	Da Rosa Ch. 10	
F 11/10	Hydrogen Production		
T 11/14	Hydrogen Storage	Da Rosa Ch. 11	
W 11/15	Journal Club Hydrogen Storage		
F 11/17	Thermionics	Da Rosa Ch. 6	
M 11/20 – F 11/24	Thanksgiving Break		
T 11/28	Thermionics		
W 11/29	Journal Club	Da Rosa Ch. 16	

	Wave		
F 12/1	Wave		
T 12/5	Presentations		
W 12/6	Journal Club Presentations		
F 12/8	Presentations		
T 12/12	Last Day of Classes Reports Due		