PHYS/CHEM/ENVT 3800
Energy on Earth

Instructor: Dr. Weihong Wang
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Textbook: Ehrlich, R. 2013. Renewable Energy-a First Course, CRC Press

COURSE INFORMATION

Course Prerequisites:

PHYS 1010 or PHSC 1000 or CHEM 1010 or GEO 1010 or GEO 2040 or METO 1010, **AND** MATH 1050

Course Objectives:

This course introduces students to the physical, environmental and economic principles of renewable and nonrenewable energy sources. The objective is to give students enough information to allow them to understand the imperative for moving away from fossil fuels, to assess the relative merits of various renewable energy sources, to do calculations involving their applications in our daily lives, and to understand the factors in optimizing their design, application and locations. In addition, the course will also stress how to assess the feasibility and desirability of each source and draw conclusions from various information concerning energy resources.

Material needed: You have to bring the following material to every class:

- Scientific calculator
- Ruler (with both English and metric system)
- No. 2 Pencil
- Eraser

Expectations from me:

- Arrive on time!
- Be prepared when coming to class!
- Self-motivated!
- Excellent team work and individual effort!

Grading:

- Field trip 5%
- Project presentation 5%
- Paper Discussion and Critique 10%
- Term Paper 10%
- Midterm 10%
- Quizzes* 15%
- In-Class Activities* 15%
- Final Exam 15%
- Homework 15%

**Two lowest quizzes and two lowest in-class activities. But NO homework will be dropped.*

Course averages are normalized to a 100-point scale. Final grades will be based on the following scale:

• 93.5-100%	A	mastery of the learning objectives
• 90-93.5%	A-	
• 87-90%	B+	
• 83.5-87%	B	functional understanding of the learning objectives
• 80-83.5%	B-	
• 77-80%	C+	
• 73.5-77%	C	basic achievement of learning objectives
• 70-73.5%	C-	
• 67-70%	D+	
• 63.5-67%	D	met some learning objectives, but significant deficits
• 60-63.5%	D-	
• 0-60%	E	Did not demonstrate understanding of most learning objectives

***Missed/Late Tests and Assignments*:**

- Test make-ups will only be allowed if a doctor's note or other official documents are provided. Make-up tests may differ from regular, in-class tests. If you cannot take an exam, you need to let me know before the exam and you need to make it up within one week.
- Quizzes cannot be made up (but I drop the two lowest quiz grades…).
- In-class activities cannot be made up (but I drop the two lowest grades…).
- Homework assignments will be penalized 5 points for every day that they are late. (Please note: NO homework will be dropped).
- All assignment due dates are set on Canvas. It is your responsibility to know when assignments are due and when tests are given.

Canvas:

- All your grades, online quizzes, homework assignments, lecture slides, and announcements will be posted on Canvas (learn-uvu.uen.org). Assignments will be posted at least one week before they are due.

Academic Misconduct:

- Academic dishonesty will be not tolerated in this class. Dishonesty includes, but is not limited to plagiarism, unauthorized notes brought into an exam; copying answers from another student or letting another student copy your answers on tests or assignments. The penalty for the first offense will be a zero on the exam or assignment. Penalty for the second offense will be an E in the course.

Disability:

- Students who need accommodations because of a disability should contact the UVU Accessibility Services Department (ASD), located on the Orem Campus, in LC 312. To schedule an appointment, or speak with a counselor, call the ASD office at 801-863-8747, or for Deaf/Hard of Hearing individuals, use the video phone number, 886-760-1819.

Tentative Schedule*:

*The topics and corresponding schedule listed above tentative and may be subject to change during the semester.

Week	Class Plan	Reading Assignment	Important Due Dates
Week 1	Intro to Energy	Chapter 1,2	**Online Quiz 1 on Syllabus**
Week 2	Terms, Units, Conversions, Equations part 1	Chapter 1,2 Handouts	**In-class quiz 2**
Week 3	Terms, Units, Conversions, Equations part 2	Chapter 1,2 Handouts	**In-class quiz 3**
Week 4	Energy Conservation and Efficiency	Chapter 12	**In-class quiz 4** **Paper Critique 1** **HW1 DUE at midnight on Friday**
Week 5	Geothermal Energy	Chapter 6	**In-class quiz 5**
Week 6	Wind Energy	Chapter 7	**In-class quiz 6**
Week 7	Solar Energy	Chapter 9,10,11	**In-class quiz 7** **HW2 DUE at 11:59pm on Friday**
Week 8	Nuclear Energy 1	Chapter 3	**In-class quiz 8** **Field trip (Friday-Saturday)**
Week 9	Nuclear Energy 2	Chapter 3	**Paper Critique 2**
	Midterm		**Midterm on Friday**
Week 10	Hydropower	Chapter 8	**In-class quiz 9**
Week 11	**Fall or Spring Break, NO CLASS**		
Week 12	Tidal and Wave Energy	Chapter 8	**In-class quiz 10** **Paper Critique 3**
Week 13	Biofuels	Chapter 5	**In-class quiz 11**
Week 14	Fuel Cell/Batteries	Handouts	**In-class quiz 12** **Paper Critique 4**
Week 15	Energy Storage and Transmission	Chapter 13	**In-class quiz 13** **Paper Critique 5** **HW3 DUE at midnight on Friday**
Week 16	Climate and Energy (if time allows), Class Presentation	Chapter 14	
Final Week	**Cumulative Final Exam**		

Energy Term Paper:

An important part of this class is the group project, of your choosing, in which you will investigate a particular topic, energy source, or contemporary issue regarding energy in more detail. The project will be presented both as a term paper, and as a 15min presentation in class.
The project should be an in-depth, technical discussion of the issue you have chosen, presenting new information to me and to the class from what you have learned and investigated. The paper will be about 8 pages in length, including tables, charts, summary and bibliography.

Here are some ideas of project topics. THIS LIST IS NOT EXCLUSIVE! Look around you – what are YOU interested in digging into more deeply? Propose another topic to me if what you want to investigate is not on this list.

I. **Impact of Refrigeration, Central Air Conditioning and Heat Pumps**.
How does it work? How much power does it take? How much energy does it take? How expensive are they, and is it worth it? How does it impact Earth energy resources? How does it benefit? What can be done to such systems smarter?

II. **Solar Concentrators with Stirling Engines**
What is a solar concentrator? How does a Stirling engine work? What are the thermodynamics of such a system? What are the advantages of coupling the two together? Work the numbers – how much sun, what operating temperatures, etc?

III. **Solar concentrators with parabolic troughs**
What is a solar concentrator? What are the thermodynamic constraints on such a system? How can you derive useful work from low grade heat? What is the working fluid, and how is it cycled? How does the heat exchanger work? How much does it cost compared to other types of power plants? Why aren‟t we building more?

IV. **Solar - Photovoltaic Power**
What is the embodied energy in a PV Array? How does a photovoltaic device work? What new kinds of PV materials are being developed? What are the concerns with using large battery arrays? What are the real costs in implementing PV power?

V. **Wind Power**
How big must the blade be? What about its shape? What are the physics of power production - extraction efficiency, wind speed and power, etc? What is the embodied energy in a Wind tower and generator? How is the electricity from a wind generator distributed?

VI. **Enhanced efficiency/reduced emission production from coal**
Two-stage power cycle schemes, MHD generators, integrated gasification combined cycle designs.

VII. **Improving automobile transportation**
Intelligent (robotically-controlled) cars, enhanced, intelligent traffic control systems.

VIII. **Alternatives to cars**
Electric Bicycles? Mass Transit? Intelligent (robotically-controlled) cars, enhanced traffic control systems.

IX. **Lithium Ion Battery Technologies**

How much better are lithium batteries than other types of batteries? What makes them better? How do they compare to energy stored in fossil fuels? How safe are they? Where are the primary sources of lithium? What are the recycling issues?

X. Plug-in Hybrid Electric Cars

How much of an offset in oil to coal will such cars produce? What is the environmental impact of shifting the energy for transportation from petroleum to other sources? How efficient are electric drive trains? What is the added cost of an electric battery and drive train? What are the issues associated with the batteries?

XI. Fuel Cells

What is a fuel cell? What is the current state of the fuel cell market? What is the cost is $$/kw and how does it compare to conventional technologies? What poisons fuel cells? What degrades fuel cell performance? Are there strategic material limitations the hinder development? Compare methanol-direct fuel cells to hydrogen fuel cells? What limits reformer technologies?

XII. Hydrogen Cars/Hydrogen Economy/Hydrogen storage

How can hydrogen be produced without fossil fuel? How can hydrogen be stored and distributed? Is hydrogen really a practical fuel for an automobile?

XIII. Nuclear Fission – next generation safe reactors

What does a reactor need to work? What's a pebble-bed reactor? What safety features are thought to be `fool proof'? Investigate more on the proposed small reactors.

XIV. Nuclear power for space applications - Mini-reactors

XV. Novel Nuclear schemes - Fusion, Accelerator driven fission,

XVI. Environmental impact of growing energy use

What is the population - energy use connection? What is the effect of the growth in energy use in developing countries?