

Astronomy 208 – Energy, Society, and the Environment

Spring 2016

TuTh 11:00-12:15

Steward Observatory 204

Instructor: Prof. Feryal Özel

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Office Hours: Tue 1:00 PM–2:00 PM or by appointment

Course Website:

All course materials, including the syllabus, lecture slides, homework, handouts, information about guest lectures and field trips, and any special announcements will be available on the course website on **D2L**. Any changes to the schedule will be announced here.

Course Objectives:

This course is designed to provide you with the methods, tools, and perspectives to understand, critique, and ultimately influence the management of energy generation and use, from the technical, economic, and policy choice points of view. We will focus equally on the scientific, technical, socioeconomic, political, and environmental impacts of energy. We will also focus on scientific literacy: researching, analyzing, and writing scientific texts.

We will address a number of issues such as:

- The energy needs of the U.S. and the world
- The role of fossil fuels in the 20th and 21st century
- The role for renewable energy and energy efficiency today and in the future
- If nuclear power is necessary in our present and future energy mix
- The role of fuel cells or hybrid technology in the future of the automotive industry
- How the U.S. and the world will address global warming.

Textbook:

The required textbook for the class is Energy and the Environment by **Ristinen** and **Kraushaar**. There will be additional required reading that will be available through the course website. In addition, you will be required to carry out literature search on topics of your choice related to the course throughout the semester.

Grading Policy:

The final grade will be determined by:

Participation, including in class writing: 20%

Homework: 20%

Exam I: 20 %

Exam II: 20 %

Exam III: 20 %

Grading Scale:

Letter grades will be assigned based on the following scale:

A: 88-100

B: 75-88

C: 62-75

D: 50-62

E: < 50

Please do not ask me during the semester what your "running grade" is. You are welcome to use the above formulae (the grading policy and grading scale) to calculate where you stand, but I do not keep track of a running grade. In addition, I do not assign letter grades until I have the final cumulative grades. There is no way I will be able to tell you what letter grade you stand at (but you have all the information to figure this out yourselves).

Incompletes will only be given if a student has satisfactorily completed the majority of the work in the class and has a valid reason, such as medical, for not completing the remainder of the course. Students must make arrangements with the instructor in order to receive an incomplete.

Discussion, In-Class Writing, Guest Lectures, Movie Days:

We will use some of our class time to have discussions and in-class writing assignments on pre-assigned reading and to solve example problems together. In addition, some days will be set aside for guest lectures and movies on topics of energy and climate. These activity days will be announced in class ahead of time. Attendance is required on these days, as with all other class times.

Written assignments:

We will have writing assignments throughout the term that will consist of a short report on the topic we are covering in class. The objective is to research, analyze, and quantitatively argue about scientific, economic, social, and environmental aspects of the topic, as being able to look at energy issues comprehensively is one of the main goals of this class. For example, if our topic is "Can nuclear energy be an effective solution to the energy needs of the U.S.?", you would the efficiency of nuclear energy generation in comparison to other sources, the availability of nuclear fuel, the effects of nuclear reactor design, safety, the requirements for nuclear waste disposal, half-lives of nuclear waste, etc. In your writing, one of our objectives will be to demonstrate an understanding of all the facts and scientific issues at the core of the arguments you present (rather than anecdotal evidence or emotional arguments).

Some writing assignments will be given as independent work to be completed outside of the classroom. Others will be shorter and completed in-class.

Assignments:

You will have a homework assignment consisting of problems and questions every 1-2 weeks. They will be posted on the website/D2L. They will be due the beginning of class on the dates indicated on the assignment (and listed on the schedule). There is no credit for late assignments, but one of the assignments (the one with the lowest score) will be dropped when calculating the final grade. The homework problems and writing assignments will be discussed in the discussion sections.

The assignments are an important part of the class because you can only learn quantitative thinking by solving examples yourselves. It is also crucial to learn to present results through clear scientific writing. Literature search, understanding scientific data, working out quantitative examples, and written presentations will all be emphasized equally.

Do not start working on them the last minute. You can discuss problems with your classmates or come to me for help when you are stuck, but you may not work on the whole set together with your friends. You may not turn in the same solutions to the problem sets. If your solutions look identical to another set of solutions, neither set will receive any credit. The problem sets will not require any advanced mathematics.

Similarly, do not leave your writing assignments to the last minute. You will need to do background reading, literature search, quantitative assessments, and you will need to present your results in your own words. You are welcome to come for help before the assignments are due, and discuss your findings with your friends. However, copying from the internet, textbooks, or articles is strictly forbidden and will be treated as plagiarism.

Late Homework Policy:

Late assignments will not be accepted. However, one homework missed or low-score homework assignment will be dropped from the final grade.

Exams:

We will have three in class exams during the semester. The dates are:

Exam I: Thursday February 25

Exam II: Thursday March 31

Exam III: Tuesday May 3

If you need to miss an exam or the due date of a paper because of a university function (scientific meeting, a team event, ...), please let me know well in advance to make alternate arrangements. Last minute absences from an exam need to have a documented valid excuse (such as a medical emergency, death in the family, etc).

Attendance Policy:

Attendance at the lectures, discussion sections, and field trips is required. We will cover some material that is not in the textbook and your class notes will be very important. In class writing assignments will be a part of your attendance grade.

Low-tech "Clickers":

We will use color-coded answer cards in class instead of clickers. I will distribute one to each student in the first class. Please have it with you for each class. If you lose it, you can print another one from the file on D2L.

Honors Options:

Honors credit for this course can be received through a contract with the instructor. Because of where we live, and the emphasis Arizona, in general, and Tucson, in particular, has placed on solar energy, the additional work required of an honors student will involve chances to explore solar energy in ways we will not get to do in class. Honors students will get the opportunity to visit a solar power plant, meet with Prof. Roger Angel, or visit the Solar Institute. You will be asked to create a video blog of your site visits and/or your interviews and share them with the rest of the class. We will schedule your presentations according to the number of honors students.

Honor Code:

You need to turn in original work on all of the homeworks, term papers, and exams. For homework assignments, it is acceptable to work with a classmate or a group, but you must turn in your own original solutions and discussions. Homework submissions that are identical or very similar for two or more students will all receive zero credit. For the term paper, we will use turnitin.com. Plagiarism will be met with zero tolerance and students involved in plagiarizing will immediately fail the class. You are not allowed to use calculators, electronic devices, or any study aids during in-class exams.

Course Content:

1. Overview of Energy Issues
 - Energy: Definition, Units
 - Energy Consumption in the World, Forecasts
 - Energy and National Development
2. Transportation
 - Energy Demands for Transportation
 - Biofuels
 - Electric/hybrid-electric cars
 - Hydrogen Fuel Cells
3. Climate Change
 - The changes in the climate
 - Causes of Global Warming
 - The Future
 - Carbon Tax, Cap-and-Trade Initiatives
4. Fossil Fuels I: Petroleum
 - Oil reservoirs and exploration
 - Oil use in the US and the world
 - Sociopolitical issues
 - Emissions
 - Reducing the Oil Dependence
5. Fossil Fuels II: Coal and Natural Gas
 - Reservoirs and exploration
 - Power Plants
 - Economic and Environmental Analysis
6. Generating Energy
 - Energy Thermodynamics
 - Combustion, Power plants
 - Consumer Needs: Environment, Portability, Safety, Cost, Waste, Sustainability
 - Life-cycle and Cost Analysis
 - Distribution and Storage of Energy
 - National Grid Issues
7. Nuclear Energy
 - Basic Principles

- Nuclear Reactors
- Nuclear Safety
- Cost
- Nuclear Waste
- Nuclear Proliferation

8. Renewable Energy Sources: Solar Energy

- Our Sun and Energy Generation
- Concentrated Solar/ Solar-Thermal
- Photovoltaic Cells
- Prospects for Arizona

9. Renewable Energy Sources: Hydroelectric Power, Wind and Geothermal Energy

- Basics of Hydroelectric Power
- Dams
- Cost
- Efficiency-Lifetime Issues
- Environmental Issues
- Turbines
- Geothermal Power Generation
- Cost and Feasibility
- Prospects

10. Efficiency

- Managing Energy Demands
- Buildings
- Automobiles
- Industry

11. Legislation and Global Initiatives

Additional Information:

Students with disabilities who require reasonable accommodations to fully participate in course activities or meet course requirements are encouraged to register with the Disability Resource Center and contact me to discuss access issues.

Students are expected to follow all of the university-wide student policies, which are available at <http://catalog.arizona.edu/2007-2008/policies/aaindex.html>

Students are also expected to understand and follow the Student Code of Academic Integrity: <http://dos.web.arizona.edu/uapolicies>

Other than grade and absence policies, the information contained in this syllabus may be subject to change with reasonable advance notice.

