GESM-150: From Einstein to Nukes – Understanding Energy
(50474)

Units: 4
Term-Day-Time: Spring 2023 – Tuesday/Thursday – 2:00-3:20 PM
Location: THH 209
Instructor: Aaron Wirthwein
Office: SHS 369
Office Hours: Tuesday 4:00-5:00 PM or by appointment
Contact Info: wirthwei@usc.edu

Teaching Assistant: Not yet assigned
Office: TBA
Office Hours: TBA
Contact Info: TBA

Course Description

In this course we will discuss the basic physical principles behind various energy sources and the consequence of their usage on environmental, social, and economic systems. This course is designed for the non-science major with little-to-no background in science or mathematics at the university level. The central goal of this course is to develop a deeper understanding of energy from the perspective of a physical scientist, but we will also integrate complex questions regarding energy usage. Through guided exercises and real-world examples, we will evaluate our individual roles in using energy more effectively.

Learning Objectives
By the end of this course, students will be able to:

1. Think like a scientist. Students will learn and practice the scientific method. We will construct models of physical systems and test those models using empirical evidence.
2. Conduct a survey of peer-reviewed scientific literature. Students will learn how data is generated, presented, and interpreted.
3. Identify different forms of energy and how they relate to one another. Students will categorize energy forms and learn how they relate to simpler physical quantities (such as mass, speed, and temperature).
4. Utilize basic algebraic and quantitative reasoning to understand relationships between energy forms and simpler physical quantities.
5. Think critically about contemporary issues in energy usage and conservation.
6. Draw conclusions from empirical data and communicate results and observations to others.
7. Write a scientific article that illustrates the application of course knowledge to a contemporary issue or topic of scientific interest.

Communication
Announcements, illustrative material, grades, etc. will be posted on Blackboard.

Technological Proficiency and Hardware/Software Required
Students are expected to be proficient in using Blackboard. Students will require a hand calculator (e.g., on smartphone or personal computer) to do some of the laboratory and examination exercises.

USC technology rental program
We realize that attending classes online and completing coursework remotely requires access to technology that not all students possess. If you need resources to successfully participate in your classes, such as a laptop or internet hotspot, you may be eligible for the university’s equipment rental program. To apply, please submit an application.

USC Technology Support Links
Zoom information for students
Blackboard help for students
Software available to USC Campus

Required Materials

Grading Breakdown

Laboratory assignments: Students must register separately for laboratory sections. There will be 7 labs throughout the semester and each will take approximately 2 hours to complete. The labs will provide students with hands-on experience as they explore physical principles surrounding energy, its conservation, and its usage. Students will learn how to design an experimental apparatus and make quantitative measurements. Students will learn how to handle experimental uncertainties and present their numerical results in terms of confidence intervals. Laboratory sessions will begin during the week of January 16th. Lab exercises can be downloaded from Blackboard. The Teaching Assistant will grade all lab work; the instructor will intervene only in the case of conflicts.
Homework assignments: Approximately 7 assignments will be posted to Blackboard over the course of the semester. The due date for the assignment will be clearly posted and no late submissions will be allowed without instructor approval. The cumulative homework score, up to 15 grade points, will be computed for each student after dropping the student’s lowest score. The primary purpose of the homework assignments is to guide you through active participation with the course material on a personal level, and although discussing the homework with your peers is allowed (and encouraged), each student will submit their own assignment.

Examinations: The three examinations will evaluate student comprehension of the lecture and textbook material:
- Midterm Exam 1 will be given during class on Thursday, February 17th. It will cover only material up to the exam date.
- Midterm Exam 2 will be given during class on Thursday, March 23rd. It will cover only the material since midterm 1.
- Final Exam will be 2:00-4:00 PM on Thursday, May 4th. It will be a comprehensive examination, covering all lectures and reading assignments throughout the term. The location will be announced during class.

If you want to do well on the exams, I encourage you to attend class, take notes, read the assigned materials, and review the lectures.

Missed examinations: If you have to miss an examination because of illness or an academic conflict, you must inform the instructor by email in advance, and provide documentation. Make-ups of examinations will, in general, NOT be permitted except for extraordinary circumstances (e.g., documentable conflicts with other USC-related commitments). In the case of a missed midterm, where a reasonable excuse exists, the midterm may be waived with a score assigned that reflects the average of your work done on the other two exams.

Final report and presentation: Beginning the first week of classes, students will make progress on an individual project of their choosing that must have relevance to a contemporary issue in energy usage (personal, societal, or environmental) or a topic of scientific interest. Students will meet regularly with the instructor to discuss their progress. The students must submit a written report and give an oral presentation. Requirements and grading rubrics for the final report will be posted to Blackboard.

Maximum Scoring for Each Grade Element
Student grades are based on the cumulative score of 100 grade points summed over five graded elements: laboratory work, homework assignments, two mid-term exams, and a final exam. The maximum number of points that can be earned for each element is given in the following table:
<table>
<thead>
<tr>
<th>Graded Element</th>
<th>% of Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory Assignments</td>
<td>15</td>
</tr>
<tr>
<td>Homework</td>
<td>15</td>
</tr>
<tr>
<td>Midterm Exam 1</td>
<td>15</td>
</tr>
<tr>
<td>Midterm Exam 2</td>
<td>15</td>
</tr>
<tr>
<td>Final Exam</td>
<td>20</td>
</tr>
<tr>
<td>Final Report + Presentation</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

Although the lab component counts for only 15% of the final grade, students must pass the laboratory component to receive a passing grade in the class.

Disability Services
Students requesting academic accommodations based on a disability are required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP when adequate documentation is filed; please be sure the letter is delivered to the instructor as early in the semester as possible. DSP is open Monday-Friday, 8:30-5:00. The office is in Student Union 301 and the phone number is (213) 740-0776.

Grading Scale
Each student will receive a final grade based on their cumulative score.
A: 90-100%
B: 80-89%
C: 70-79%
D: 60-69%

Assignment Submission
All assignments will be posted on Blackboard, and all completed assignments will be submitted via Blackboard.

Communication Policy
To communicate with the instructor outside of class or office hours, email the instructor from your USC email account. In the subject line, indicate the course number and your full name. Simple questions will be answered by email, but for more complex discussions students may be instructed to visit office hours.

Sharing of course materials outside of the learning environment
USC policy prohibits sharing of any synchronous and asynchronous course content outside of the learning environment.

Residential and Hybrid Streaming Model Courses
The latest COVID-19 testing and health protocol requirements for on campus courses can be found on the USC COVID-19 resource center website.
## Course Schedule: A Weekly Breakdown (tentative as of June 7, 2022)

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture &amp; Discussion Topics</th>
<th>Readings</th>
<th>Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Philosophy of science, the scientific method, definition of energy</td>
<td>Posted materials Ch. 1 Hinrichs</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Forms of energy and energy conversions, energy of motion</td>
<td>Ch. 2 Hinrichs</td>
<td>Basic Aspects of Physics</td>
</tr>
<tr>
<td>3</td>
<td>Conservation of energy, energy efficiency</td>
<td>Ch. 3 Hinrichs</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Heat and work, laws of thermodynamics and heat engines</td>
<td>Ch. 4 - 5 Hinrichs</td>
<td>Conservation Laws of Motion</td>
</tr>
<tr>
<td>5</td>
<td>Energy from solar radiation and fossil fuels</td>
<td>Ch. 6 - 7 Hinrichs</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Home energy conservation and heat-transfer control</td>
<td>Ch. 5 Hinrichs</td>
<td>Heat Engines</td>
</tr>
<tr>
<td>7</td>
<td>Electricity; charges, currents, batteries</td>
<td>Ch. 10 Hinrichs</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Generation and transmission of electrical energy</td>
<td>Ch. 11 Hinrichs</td>
<td>Circuits &amp; Electromotors</td>
</tr>
<tr>
<td>9</td>
<td>Electricity from solar, wind, and hydro</td>
<td>Ch. 12 Hinrichs</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Energy use and air pollution</td>
<td>Ch. 8 Hinrichs</td>
<td>Solar Cells</td>
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<tr>
<td>11</td>
<td>Global warming and thermal pollution</td>
<td>Ch. 9 Hinrichs</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>The building blocks of matter, the atomic model</td>
<td>Ch. 13 Hinrichs</td>
<td>Spectroscopy</td>
</tr>
<tr>
<td>13</td>
<td>Mass-energy equivalence, nuclear power, fission &amp; fusion</td>
<td>Ch. 14 &amp; 16 Hinrichs</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Effects and impacts of nuclear power and radiation, case study in Chernobyl disaster</td>
<td>Ch. 15 Hinrichs</td>
<td></td>
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<tr>
<td>15</td>
<td>Energy and the economy, future energy alternatives</td>
<td>Ch. 16 Hinrichs</td>
<td>FINAL PRESENTATIONS</td>
</tr>
<tr>
<td></td>
<td>FINAL</td>
<td></td>
<td>FINAL EXAM WEEK</td>
</tr>
</tbody>
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## Statement on Academic Conduct and Support Systems

### Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” [policy.usc.edu/scampus-part-b](http://policy.usc.edu/scampus-part-b). Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, [policy.usc.edu/scientific-misconduct](http://policy.usc.edu/scientific-misconduct).
Support Systems:

*Counseling and Mental Health - (213) 740-9355 – 24/7 on call*
studenthealth.usc.edu/counseling
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

*National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call*
suicidepreventionlifeline.org
Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

*Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call*
studenthealth.usc.edu/sexual-assault
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

*Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298*
equity.usc.edu, titleix.usc.edu
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

*Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298*
usc-advocate.symplicity.com/care_report
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity [Title IX for appropriate investigation, supportive measures, and response.

*The Office of Disability Services and Programs - (213) 740-0776*
dsp.usc.edu
Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

*USC Campus Support and Intervention - (213) 821-4710*
campussupport.usc.edu
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

*Diversity at USC - (213) 740-2101*
diversity.usc.edu
Information on events, programs and training, the Provost’s Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
dps.usc.edu, emergency.usc.edu
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call
dps.usc.edu
Non-emergency assistance or information.

Supplemental resources and further reading

https://www.epa.gov/energy
https://www.energy.gov/
https://www.eia.gov/

*Energy and the Environment*, Ristinen, Kraushaar, & Brack (2022)
*Taking on Technocracy: Nuclear Power in Germany, 1945 to the Present*, Augustine (2021)
*The Skeptical Environmentalist*, Bjørn Lomborg (2001)