# ENERGY AND PROCESS EFFICIENCY (CHE 510) Fall 2020

Tuesday, 5:00 – 7:40 pm, ONLINE

**Professor**: Virgil Adumitroaie
Office: Blackboard
e-mail: adumitro@usc.edu

**Teaching Assistant**: TBD
Office: TBD
email: TBD@usc.edu

**Course Text**: Alternative Energy Sources (Green Energy and Technology) by Efstathios E. Michaelides; Springer: 2012. ISBN-13: 978-3642209505 - free ebook at Springer via USC library.

**Course References:** In addition to the above texts, some course material and in-class problems may come from the sources listed below.

**Pre-requisites**: Graduate status. This course is multi-disciplinary, and as such a maturity level in science and engineering is necessary, e.g. by having taken an undergraduate course in thermodynamics.

**Course Objectives**: This course covers engineering strategies that can be employed to improve energy efficiency and reduce economic costs. A discussion of various sources for power production includes conventional fossil fuels, synthetic fuels as well as hydroelectric, solar, wind, geothermal, biomass, and nuclear power. The environmental consequences of utilizing various energy sources for power production are discussed. The course objective is to provide students with an understanding of the fundamentals of energy conversion, focusing on the physico-chemical principles underlying the specific technologies and on application of these principles to practical analysis of energy systems, followed by a survey of operational principles of conventional and renewable energy systems. As appropriate, the economic and societal issues surrounding the adoption of new alternative energy technologies or expansion of the current conventional approaches will be discussed. Students will develop the ability to identify, formulate and solve simple to complex problems of energy conversion and storage.

**Course Schedule**: See below.

**Course Assignments**: See below.

**Grading**: As noted in the attached, there are 12 separate homework assignments, each of which is valued at 20 points (45% of grade). The midterm exam is 120 points (23%) and the final examination is 170 points (32%). The exams will be closed book and 4 pages of notes. You may bring a calculator, but not a laptop.

Under close guidance from the professor, the grader will grade all homework and exams. If dissatisfied with the grader's grading in a specific instance, the student may appeal to the professor to re-evaluate the grade. An appealed grade may be raised, lowered, or remain as originally scored. (Caution: The final grade in this course depends to significant extent on the graded assignments, and thus we take very seriously the academic integrity issue inherent in this activity. Do your own work.)

**Class Participation**: Attendance will be taken; it is expected that students will want to attend every class meeting. Active participation in the class will be noted, although there will be no explicit credit given for participation.

**Office Hours**: Prof. Adumitroaie is available for office hours on Blackboard.

**Homework:** All written homework assignments are due at 11:59 pm on the dates indicated below and will be uploaded through the Blackboard Assignment link. Offsite students should upload their paper or fax hardcopy on the day of the class. All relevant reading assignments should be completed before coming to class. Include your name, date, course number and assignment number in your submitted homework.

Late homework will be accepted up to two days past due date with 2 points penalty per day. Homework turned in later than past due date + 3 days will not receive any credit. No homework will be accepted after the last class meeting.

**Course schedule and assignments** are summarized below. This syllabus is subject to change as announced in class.

| DATE | WEEK | TOPIC(S) | HOMEWORK |
|---|---|---|---|
| Aug 25 | 1 | Energy Demand and Supply. Reserves, Resources and Future Demand for Energy. | Assigned: #1 |
| Sep 1 | 2 | Environmental and Ecological Effects of Energy Production and Consumption. Sustainable Development. | Due: #1 (Wed)<br>Assigned: #2 |
| Sep 8 | 3 | Economics of Energy Projects. Investment Appraisal Methods. | Due: #2 (Wed)<br>Assigned: #3 |
| Sep 15 | 4 | Fundamentals of Energy Conversion Processes. Exergy: Availability. | Due: #3 (Wed)<br>Assigned: #4 |
| Sep 22 | 5 | Elements of Atomic and Nuclear Physics. Nuclear Fission. | Due: #4 (Wed)<br>Assigned: #5 |
| Sep 29 | 6 | Nuclear Reactor Types and Power Plants. Breeder Reactors. | Due: #5 (Wed)<br>Assigned: #6 |
| Oct 6 | 7 | Fusion Energy. ''Cold Fusion,'' Other Myths and Scientific Ethics. | Due: #6 (Wed)<br>Assigned: #7 |
| Oct 13 | 8 | **MIDTERM EXAM (take-home)**<br>Based on lectures 1 - 6 | |
| Oct 20 | 9 | Solar-Thermal Systems. Photovoltaics. | Due: #7 (Wed)<br>Assigned: #8 |
| Oct 27 | 10 | Principles of Wind Power. Power Generation Systems. | Due: #8 (Wed)<br>Assigned: #9 |
| Nov 3 | 11 | Geothermal Energy. Cooling Systems. Geothermal District Heating. | Due: #9 (Wed)<br>Assigned: #10 |
| Nov 10 | 12 | Biomass. Biofuels. The Future of Biomass for Energy Production. | Due: #10 (Wed)<br>Assigned: #11 |
| Nov 17 | 13 | Hydroelectric Power. Tidal Power. Ocean Thermal Energy Conversion. Energy Storage: Batteries. | Due: #11 (Wed)<br>Assigned: #12 |
| Nov 24 | 14 | Fuel Cells. Energy Conservation and Efficiency. The Use of the Exergy Concept. | Due: #12 (Tue) |
| Dec 8 | 15 | **FINAL EXAM**<br>Comprehensive | |
| | | | |

**Course References:**


Advances in Renewable Energies and Power Technologies: Volume 1: Solar and Wind Energies; Imene Yahyaoui, Elsevier: 2018.
Alternative Energy Systems and Applications (2nd ed.); B. K. Hodge; Wiley, New York: 2017.
Energy Systems and Sustainability: Power for a Sustainable Future (2nd ed.); Bob Everett, Godfrey Boyle, Stephen Peake, Janet Ramage Eds.; Oxford University Press, Oxford, UK: 2012.
Energy, the environment, and sustainability; Efstathios E. Michaelides; CRC Press: 2018.
Energy Science: Principles, Technologies, and Impacts (3rd ed.); John Andrews and Nick Jelley; Oxford University Press, Oxford, UK: 2017.
Fundamentals of Renewable Energy Processes (3rd ed.); Aldo da Rosa; Academic Press: 2013.
Sustainable Energy: Choosing Among Options (2nd ed.) by Jefferson W. Tester, Elisabeth M. Drake, Michael J. Driscoll, Michael W. Golay, William A. Peters; MIT Press, Cambridge, MA: 2012.
Sustainable Energy - Without the Hot Air; David JC MacKay; UIT Cambridge Ltd., Cambridge, UK: 2009.


**Academic Integrity**. The Viterbi School of Engineering adheres to the University's policies and procedures governing academic integrity as described in SCampus (http://www.usc.edu/dept/publications/SCAMPUS/). Students are expected to be aware of and to observe the academic integrity standards described in SCampus, and to expect those standards to be enforced in this course.

**Students with Disabilities**. Any Student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m. - 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.