Course Title: Modern Energy Technologies, ESE 509

Contribution of course to meeting the Professional Component: Engineering Science 50%, Laboratory Experience 0%, Mathematics 10%, Basic Science 20%, General Education 20%, Design Experience 0%

Fall 2018

Stony Brook University
Department of Electrical & Computer Engineering
College of Engineering and Applied Sciences
Course Title: Modern Energy Technologies
Course Instructor: Prof. Matthew D. Eisaman

Instructor and TA contact information:
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Office Hours: TBD

COURSE DESCRIPTION
This course cover a broad array of technologies that are essential to the modern energy industry, specifically focusing on the most contemporary topics and "hot" areas of research, development, and deployment. Students will gain a quantitative understanding of selected energy generation technologies, energy storage technologies, and pollution control technologies. For each of these topics, we will cover the physical principle of operation, as well as the economics and environmental impact.

Meeting time and location: Mondays 5:30pm – 8:20pm, Chemistry 126

Course Pre/co-requisites
Graduate student in any engineering or scientific discipline.

LEARNING OBJECTIVES (satisfies SBC's Understand Technology (TECH) learning objective)
At the end of this course, students will (LO = Learning Outcomes for "Understand Technology"):
1. Know how to use standard tools and methodologies to analyze the energy, economic, and environmental aspects of energy systems (LO1)
2. Understand a broad array of technologies that are essential to the modern energy industry (energy generation technologies, energy storage technologies, and pollution control technologies) and their role in the context of global energy demand and environmental degradation (LO2)

COURSE REQUIREMENTS
Attendance and Make Up Policy
Late work will not be accepted. Attendance at all exams is mandatory. In the case of 1) verifiable illness, 2) verifiable family emergency, 3) University-sanctioned religious holiday, or 4) participation in official University-sponsored events (for documented student athletes only), excuse must be documented on official letterhead (as appropriate) and will be verified by the instructor.

Description and schedule of Required Readings and/or Assignments.
REQUIRED TEXTBOOKS
- Francis Vanek, Louis Albright, and Largus Angenent, *Energy Systems Engineering: Evaluation and Implementation, Second Edition*, McGraw Hill. (2012). ISBN-13: 978-0071787789.

- Richard A. Muller, *Energy for Future Presidents*, W. W. Norton & Company, Inc. (2012). ISBN-13: 978-0393345100.
- ***Selected readings made available on blackboard, including:***
    - *US Department of Energy (DOE) Quadrennial Technology Review*
    - *Other selections from primary literature and selections from other textbooks*

OTHER RESOURCES (NOT REQUIRED)

- John Andrews and Nick Jelly, *Energy Science: Principles, Technologies, and Impacts*, Second Edition, Oxford University Press (2013). ISBN-13: 978-0199592371.

Syllabus:

Week	Dates	Topics	Readings
Week 1	TBD	Overview of the energy technology landscape in the context of global energy demand and environmental degradation	Vanek, Chs. 1, 4 Muller, Intro and Ch. 3
Week 2	TBD	Tools for the energy, economic, and environmental analysis of energy systems	Vanek, Ch. 2,3
Electricity generation			
Week 3	TBD	Fossil-based electricity generation: Unconventional oil and gas extraction, tar sands, offshore drilling, fracking, "Clean" coal technology	Vanek, Chs. 5, 6 Muller, Ch. 4, 5, 6, 19
Week 4	TBD	Nuclear: Status quo and advanced designs (including thorium, modular nuclear, and fusion), Environmental considerations post-Fukushima	Vanek, Ch. 8 Muller, Chs. 1,11
Week 5	TBD	Wind, including offshore and advanced concepts such as high-altitude wind	Vanek, Ch. 13 Muller Ch. 9
Week 6	TBD	Solar, including solar thermal and photovoltaics, and innovations in solar financing	Vanek, Chs. 10 and 11 Muller, Ch. 8
Week 7	TBD	Renewables other than solar and wind: Geothermal, biomass, ocean/tide, hydro	TBD
Electricity delivery			
Week 8	TBD	Grid integration: Integration of renewables onto the grid, and critical technologies for the future smart electricity grid	TBD
Electricity storage			
Week 9	TBD	Grid scale storage including batteries (historical and advanced concepts), compressed air energy storage, flywheels, supercapacitors, and chemical fuels	Muller Ch.10 Additional TBD
Transportation			
Week 10	TBD	Alternative liquid fuels: biofuels and synfuels	Muller Chs. 13, 14
Week 11	TBD	Advanced automobile technologies: Hybrids, electric, natural gas, and fuel cell cars	Vanek, Ch. 15, 16 Muller Ch. 16
Pollution control and environmental impact			
Week 12	TBD	Carbon capture and sequestration, geoengineering,	Vanek, Ch. 7

		reducing the impact of renewable energy technologies on wildlife	
Week 13	TBD	Technologies for disaster prevention and a review of past environmental and human disasters due to energy technologies, including Deepwater Horizon, Fukushima, TN coal ash spill, and others	Muller, Chs. 1,2 Other: TBB
Week 14	TBD	Presentation of final projects	N/A

Assignments

Problem sets

There will be weekly problem sets.

Final Project

Each student will complete a final project. For the project, each student will choose a promising energy technology that is not yet commercialized and perform an analysis of the technology, including: (1) Economic and market analysis indicating the competitiveness relative to entrenched technologies in the same space; (2) Environmental analysis of likely environmental impact of this technology; and (3) Technological analysis of the primary challenges to deployment and suggested pathways for overcoming these challenges.

GRADING

The course grade will be based on the following components:

Item	Percent
Problem Sets	50
Comprehension quizzes	10
Final project	40

Grades are based on the following scale:

A = 93-100, A- = 90-92
B+ = 88-89, B = 83-87, B- = 80-82
C+ = 78-79, C = 73-77, C- = 70-72
D+ = 68-69, D = 63-67, F <63

MEETING SCHEDULE

Mid-term exam: TBD
Final exam: TBD

CLASS PROTOCOL

All electronic devices are to be turned off during class unless advance permission is given by the instructor.

CLASS RESOURCES

Blackboard (http://blackboard.stonybrook.edu) will be used as the primary means of distribution for readings from the primary literature and submission of assignments.

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Disability Support Services, ECC (Educational Communications Center) Building,

room128, (631) 632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Disability Support Services. For procedures and information go to the following website: http://www.stonybrook.edu/ehs/fire/disabilities]

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty are required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at http://www.stonybrook.edu/uaa/academicjudiciary/

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures.