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:
Prof. Matthew D. Eisaman
Email: matthew.eisaman@stonybrook.edu
Work Phone: 631-632-8421
Office Location: Light Engineering 145
Office Hours: TBD

COURSE DESCRIPTION
This course covers 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

• **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)**

**Syllabus:**

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<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Topics</th>
<th>Readings</th>
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<tbody>
<tr>
<td>Week 1</td>
<td>TBD</td>
<td>Overview of the energy technology landscape in the context of global energy demand and environmental degradation</td>
<td>Vanek, Chs. 1, 4 Muller, Intro and Ch. 3</td>
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<tr>
<td>Week 2</td>
<td>TBD</td>
<td>Tools for the energy, economic, and environmental analysis of energy systems</td>
<td>Vanek, Ch. 2,3</td>
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**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                           |
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:

<table>
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<tr>
<th>Item</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Problem Sets</td>
<td>50</td>
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<tr>
<td>Comprehension quizzes</td>
<td>10</td>
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<tr>
<td>Final project</td>
<td>40</td>
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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,
Modern Energy Technologies (ESE 509)  
Prof. Eisaman

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.