MEC 517: Energy Technologies Laboratory II

Spring / 2020
Light Engineering LE-132
Tues 7-10 PM (Sec 01), Wed 7-10 PM (Sec 02)

Instructors/ Office Hours:

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Catalog Description:

Experiments in the areas of thermoelectric power, fuel cells, photovoltaics, wind turbines, hydrogen storage, hydrogen generation, and power electronics in addition to related project work. The focus is on system efficiencies, system integration, and design for residential markets. Student groups are assigned laboratory projects to build experience applying various energy technologies to solve problems.

This course and MEC 516 (offered in the Fall) are laboratory courses designed to give students hands-on experience with power generating and energy related technologies in a laboratory environment. Students will learn basic concepts of power generation and how they apply to specific technologies such as thermos electrics, fuel cells, electrolysis cells, wind turbines, photovoltaics, and generators. We will understand how these technologies deliver power and study the factors that affect the efficiency of the power generation and transmission. These courses will serve to illustrate and reinforce the theories and principles learned in other MEC lecture courses.

Textbook:

- There is no required text for the course
- Reading materials for the various experiments will be posted to Blackboard

Reference books:

- *Fuel Cell Systems Explained, Larminie and Dicks*
- *Fundamentals of Eng. Thermodynamics, Morran and Shapiro*
- *Heat Transfer, Holman*
- *Heat Transfer: a practical approach, Yunus A. Cengel*
- *Principles of Solar Engineering, Goswani, Kreith, and Kreider*

Activities:

1. Thermoelectric Experiments (1-4) – Students will learn about thermoelectric devices – how they work and what are the principle modes of operation. Understand the Seebeck and Peltier effects and how they relate to TE's. Factors that affect the efficiency such as heat loss, resistive heating, and thermal conductivity and how to arrange a TE assembly to optimize efficiency and heat transfer.

2. Fuel Cell Experiments 1 & 2 - Students will learn about the concepts of operation of fuel cells and how to optimize the output efficiency of a fuel cell system.

3. Electrolysis Experiment – Students will learn about the process by which electrolysis produces electrical power – how an electrolysis cell works and what are some of the cell design parameters that can be optimized to improve the efficiency.

4. Power Inverter Experiment – Students will learn about the differences between DC and AC power, how power inverters convert DC current to AC, and how to measure AC power output.

5. Generator Experiment – Students will work with small generators to understand the conversion of gravitational potential energy into electrical energy and the storage of energy in a flywheel.

6. Wind Turbine Experiment – Students will learn how wind turbines convert wind energy into electrical energy and how the efficiency is affected by wind speed.

7. Photovoltaics Experiment – Students will learn how to measure Voltage-Current characteristics and performance of a photovoltaic panel.

8. Charge Controller Experiment - Students will learn how charge controllers are used to manage the output of power generating systems such as photovoltaics, and how to measure their efficiency.

Assignments and Required Reading

- Assignments will be posted on Blackboard and through email announcements. Students are expected to check Blackboard regularly for updates.
- A schedule of the laboratory experiments will be posted on Blackboard. Laboratory manuals and supplementary materials for each experiment will also be posted on Blackboard. Students are required to read the materials and come to class prepared to conduct the experiments.

Grades

- Students will form groups to conduct the lab experiments and submit a report. Each of the lab reports will be graded out of 10 points. All students in a group receive the same report grade. The lab reports account for 70% of the semester grade.

- A group project or report will be assigned and due mid-November and will be worth 20% of the semester grade. The project will focus on the application of knowledge of heat and energy transfer gained through the course experiments. Further details will be given in class and on Blackboard.

- An exam will be given at the end of the semester, during Final Exam week, worth 10% of the semester grade. The exam will include questions from the experiments performed during the semester and any supplemental material covered during the semester. The time and place for the exam will be announced later in the semester. Check Blackboard for the date/time/place of the exam. No make-up exams will be given.

Learning Outcomes and Goals:

Students will:

- become familiar with power generating and energy storage technologies, how systems operate and what are the factors that affect their efficiency.
- Learn how to measure the practical efficiency of energy and power generating systems.
- Understand basis electrical power measurements and computations
- Design experiments and plan measurements to answer questions and obtain desired results
- Graphically analyze data and present results in concise, coherent reports.
- Collaborate and work with a group to plan, solve problems, and produce analyses.

The laboratory is an environment for learning.

- Students are strongly encouraged to collaborate in the laboratory within your lab group and with other groups. You should compare your observations and data with other groups to check for consistent results. Ask questions if you need help, and offer help if you see others struggling or doing something that you think is incorrect.
- While it is OK to compare results, and collaborate in the lab, your group's reports should be your own work.

Inclusivity Statement

We understand that our members represent a rich variety of backgrounds and perspectives. The Mechanical Engineering program/department is committed to providing an atmosphere for learning that respects diversity. While working together to build this community we ask all members to:

- share their unique experiences, values and beliefs
- be open to the views of others
- honor the uniqueness of their colleagues
- appreciate the opportunity that we have to learn from each other in this community
- value each other's opinions and communicate in a respectful manner
- keep confidential discussions that the community has of a personal (or professional) nature

Student Accessibility Support Center Statement

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Student Accessibility Support Center, ECC (Educational Communications Center) Building, Room 128, (631)632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential. https://www.stonybrook.edu/commcms/studentaffairs/sasc/facstaff/syllabus.php

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Student Accessibility Support Center. For procedures and information go to the following website: https://ehs.stonybrook.edu/programs/fire-safety/emergency-evacuation/evacuation-guide-people-physical-disabilities

Academic Integrity Statement

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 is 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/commcms/academic_integrity/index.html

Critical Incident Management Statement

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of University Community Standards 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. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.