MEC 517: Energy Technologies Laboratory II
(Spring 2021, Subject to Change)

Catalog Course 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.

Instructor
David J. Hwang (david.hwang@stonybrook.edu), 107 Light Engineering Building
Office Hours (online): Mon 1-4 PM + Lab hours (zoom link accessible from blackboard).
Contact instructor by email for further questions or setting up extra office hours (allow 24-48 hours for reply).

Schedule
- **Lectures/Labs:** 5:45 - 8:40 PM Tuesdays, online (synchronous, zoom meetings accessible from blackboard)
- **Final Exam:** 5/11, 5:30 - 8:00 PM Tuesday (location & method TBD)

Textbook: No required textbook. Lab manuals and supplementary materials to be uploaded on Blackboard

Reference books (NOT required):
- Fundamentals of Eng. Thermodynamics, Morran and Shapiro
- Heat Transfer: a practical approach, Yunus A. Cengel
- Fuel Cell Systems Explained, Larminie and Dicks
- Principles of Solar Engineering, Goswani, Kreith, and Kreider

Labs (11-12 labs, subject to change)
- **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.
- **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.
- **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.
- **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.
- **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.
- **Wind Turbine Experiment** – Students will learn how wind turbines convert wind energy into electrical energy and how the efficiency is affected by wind speed.
- **Photovoltaics Experiment** – Students will learn how to measure Voltage-Current characteristics and performance of a photovoltaic panel.
- **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.

Course Delivery Mode and Structure

- This is an online course and will be synchronously delivered via zoom. Students must be mindful of all course expectations, deliverables, and due dates, especially because the online portion of the course requires significant time management. All assignments and course interactions will utilize internet technologies. See "Technical Requirements" section for more information. In Blackboard, you will access online lessons, course materials, resources, and submit your coursework.
- The class time will be used to synchronously deliver introductory lecture contents, watch pre-recorded lab videos, have discussion on report writing and Q & A. Laboratory manuals and supplementary materials for each lab will be posted on Blackboard in advance, and all the students are required to read them before the class time. The synchronous online sessions will be recorded and uploaded on blackboard after the class time with lecture materials, pre-recorded lab videos and raw experimental data so that students can refer to as necessary.
- Each week will cover a single lab topic for all the students/groups, and each group should submit one lab report by the beginning of next online lab session. There will be a group project assigned and due later in the term on the date specified.

Grading

- **Lab Reports (70%):** Students form mostly groups of three. Each group collectively submits a single report for each lab. 70% of the semester grade will be based on the total grade of all lab reports.
- **Group Project (20%):** Each group collectively presents the project outcomes and collectively submits a single project report, accounting for 20% of the semester grade. The project will focus on the application of knowledge gained through the course lab sessions. Further details on the group project will be provided during the class time.
- **Final Exam (10%):** Each student will take a final exam during the final exam period, accounting for 10% of the semester grade. The exam will include questions from the labs performed during the semester, and any lecture and supplemental materials covered during the semester.

Technical Requirements

- This course uses Blackboard for the facilitation of communications between faculty and students, submission of assignments, and posting of grades and feedback. The Blackboard course site can be accessed at https://blackboard.stonybrook.edu. If you are unsure of your NetID, visit https://it.stonybrook.edu/help/kb/finding-your-netid-andpassword for more information.
- All the class will be held online in a synchronous fashion. Zoom meetings will be accessible from blackboard.

You are responsible for having a reliable computer and Internet connection throughout the term. Students should be able to use email, a word processor, spreadsheet program, and presentation software to complete this course successfully.

For some of the course work you may be asked to install free software to complete the course work. You will be given specific instructions on how to do this.

¡Caution!: You will be at a disadvantage if you attempt to complete all coursework on a smartphone or tablet. It may not be possible to generate or submit the files required for your homework assignments.

Course Learning Outcomes/Objectives

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

Detailed Schedule for Labs (tentative, subject to change)

All the sessions to be held via synchronous zoom meeting
(zoom link accessible from blackboard) except Final Exam (TBD)

Week 1: 2/2	Introduction to Course, Lab Group Formation
Week 2: 2/9	Thermoelectric Lab 1 - Heat Engine and Heat Pump (TE1 Lab)
Week 3: 2/16	Thermoelectric Lab 2 - Resistive Loads and Optimal Power (TE2 Lab)
Week 4: 2/23	Thermoelectric Lab 3 - Peltier Effect – Thermoelectric Cooling (TE3 Lab)
Week 5: 3/2	Thermoelectric Lab 4 - Seebeck Effect and Power Generation (TE4 Lab)
Week 6: 3/9	Power Inverter Lab (INV Lab)
Week 7: 3/16	Fuel Cell Lab 1- Hydrogen Fuel, Concepts of Operation (FC1 Lab)
Week 8: 3/23	Fuel Cell Lab 2 - Optimizing Fuel Cell Efficiency (FC2 Lab)
Week 9: 3/30	No class to alleviate stress involved with online class
Week 10: 4/6	Electrolysis Lab (ELEC Lab)
Week 11: 4/13	Wind Turbine Lab (WT Lab)
Week 12: 4/20	Photovoltaics Lab (PV Lab), (& *Charge Controller Lab - Lecture only, No actual Lab)*
Week 13: 4/27	Generator Lab (GEN Lab)
Week 14: 5/4	Project Presentations, Final Exam Review
Week 15: 5/11	Final Exam – Location & Method TBD

STUDENT ACCESSIBILITY SUPPORT CENTER STATEMENT

If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, Stony Brook Union Suite 107, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with you what accommodations 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 the 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 and search Fire Safety and Evacuation and 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

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Student Conduct and 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.

STATEMENT ADDRESSING ABSENCES

Students are expected to attend every class, report for examinations and submit major graded coursework as scheduled. If a student is unable to attend lecture(s), report for any exams or complete major graded coursework as scheduled due to extenuating circumstances, the student must contact the instructor as soon as possible. Students may be requested to provide documentation to support their absence and/or may be referred to the Student Support Team for assistance. Students will be provided reasonable accommodations for missed exams, assignments or projects due to significant illness, tragedy or other personal emergencies. In the instance of missed lectures or labs, the student is responsible for reviewing posted lecture materials, recorded lectures and recorded lab videos, and communicate/collaborate with group members to write lab report based on sample data. Please note, all students must follow Stony Brook, local, state and Centers for Disease Control and Prevention (CDC) guidelines to reduce the risk of transmission of COVID. For questions or more information click here.