MEC 516: Energy Technologies Laboratory I

(Fall 2021) - Tentative, Subject to Change

Catalog Course Description

Experiments in the areas of infrared imaging, heat pumps, batteries/power electronics, solar thermal, thermal conductivity, and insulation. The focus is on system efficiencies, system integration, and design for residential markets. The fundamentals of the relevant technologies will be presented and utilized in the laboratory sessions. Student groups are assigned laboratory projects focused on applying various energy technologies to solve engineering problems.

Instructor

David J. Hwang (david.hwang@stonybrook.edu), 107 Light Engineering Building

Office Hours: Tue 2-5 PM (107 Light Engineering Building) + Lab hours (132 Light Engineering Building). Contact instructor by email for further questions or setting up extra office hours (allow 24-48 hours for reply).

Schedule

- **Labs/Lectures:**
  - ➢ **MEC516-03** 5:45 - 8:40 PM Tuesdays, 132 Light Engineering Building
  - ➢ **MEC516-04** 6:05 - 9:00 PM Wednesdays, 132 Light Engineering Building
- **Final Exam:** Take-home exam, Final Week

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 labs) + Group Project, subject to change

- **Infrared Thermography Camera Lab (IR1)** – Examination of thermal radiation, measuring surface emissivity, temperature, and thermal imaging using IR cameras.
- **Thermal Radiation & $1/r^2$ Lab (IR2)**– Measuring thermal radiation emitted from a body, considering surface emissivity, temperature, and thermal measurement using IR sensors and thermocouples. Measuring attenuation of thermal radiation.
- **Spectrophotometer Lab 1 (SP1)** – Understanding how a spectrometer works, what it measures and how to use it to measure the spectral transmission, absorbance, and reflectivity of materials.
- **Spectrophotometer Lab 2 (SP2)** – Using the spectrophotometer to characterize the optical and thermal properties of commercial window samples. Using the spectrophotometer to measure the absolute power output of light sources.
- **House Energy Audit Lab (House)** – Using thermal imaging to audit energy efficiency of structures.
- **Thermal Conductivity & Insulation Lab (TC)** – Measuring and comparing the thermal insulating properties of some common building materials.
- **Motor-Generator Lab (Motor/Gen)** – working with electric motors and generators and measuring the efficiency of delivering power to a load.
- **Geothermal Heat Pump Lab (GHP)** – Using a Geothermal system "trainer" to record system data and study the performance of a geothermal heat pump.

- **Fujitsu "Split" Heat Pump Lab (FHP) -** Using a Fujitsu "split" heat pump system to record system data and study the performance of a heat pump.
- **Solar Thermal Heating Lab (Solar Thermal)** – Measure the operating data to understand a passive solar thermal heating system trainer to understand the components of a solar thermal heating system and how they work.
- **Battery Lab (Battery)** – Measure the efficiency of the charge/discharge cycles of LiPO batteries, assessing the charge status and health of Lead/Acid batteries.
- **Group Project -** Students will work on a research or technical project and presentation. Details to be shared separately on Blackboard.

Course Structure

- This is in-person lab course.
- Students typically form groups of three individuals to perform all the labs.
- Manuals for scheduled labs will be posted on Blackboard in advance. Students are required to read before lab hour.
- Each group submits a single report for each lab via Blackboard by the beginning of next scheduled lab session. • In Blackboard, you will access course materials including lab manuals, lecture/reference materials. • There will be a group project assigned.
- Each student must write at least three reports as a primary author. Peer-evaluations are being considered, and upon insufficient contribution by specific group member(s), separate grading scale will be applied.

Grading

- **Lab Reports (70%):** Students form groups of typically 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 energy application to broaden knowledge gained through the course lab sessions. Further details on the group project will be provided.
- **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 including lab reports, group project and final exam, 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.

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 in 132 Light Engineering Building

		MEC 516-03 Tuesday	MEC 516-04 Wednesday	Notes	Lab Set Schedule A	B	C	D
Week 1		8/24/2021 Intro	8/25/2021 Intro	First Class	Introduction and Group Formation			
Week 2	*	8/31/2021 Lab 1	9/1/2021 Lab 1	First Lab	IR1	IR1	IR2	IR2
Week 3	*	9/7/2021 Lab 2	9/8/2021 Lab 2	(Lab 1 Report Due)	IR2	IR2	IR1	IR1
Week 4	*	9/14/2021 Lab 3	9/15/2021 Lab 3	(Lab 2 Report Due)	SP1	SP1	House	House
Week 5	*	9/21/2021 Lab 4	9/22/2021 Lab 4	(Lab 3 Report Due)	House	House	SP1	SP1
Week 6	*	9/28/2021 Lab 5	9/29/2021 Lab 5	(Lab 4 Report Due) (Project Proposal)	SP2	SP2	TC	TC
Week 7	*	10/5/2021 Lab 6	10/6/2021 Lab 6	(Lab 5 Report Due)	TC	TC	SP2	SP2
Week 8		10/12/2021 Fall Break (no lab)	10/13/2021	Fall Break	no lab	no lab	no lab	no lab
Week 9	*	10/19/2021 Lab 7	10/20/2021 Lab 7	(Lab 6 Report Due)	Motor/ Gen	Solar Thermal	GHP	FHP
Week 10	*	10/26/2021 Lab 8	10/27/2021 Lab 8	(Lab 7 Report Due)	FHP	Motor/ Gen	Solar Thermal	GHP
Week 11	*	11/2/2021 Lab 9	11/3/2021 Lab 9	(Lab 8 Report Due)	GHP	FHP	Motor/ Gen	Solar Thermal
Week 12	*	11/9/2021 Lab 10	11/10/2021 Lab 10	(Lab 9 Report Due)	Solar Thermal	GHP	FHP	Motor/ Gen
Week 13		11/16/2021 Lab 11	11/17/2021 Lab 11	(Lab 10 Report Due) (Project Draft Due)	Battery (Detailed Lab schedule TBD)		Battery (Detailed Lab schedule TBD)	
Week 14		11/23/2021 Thanksgiving (no lab)	11/24/2021	Thanksgiving Holiday	no lab	no lab	no lab	no lab
Week 15		11/30/2021 Review and Project Pres.	12/1/2021	Last class (Lab 11 Report Due)	Fianl Exam Review and Project Presentations/Comments Take-Home Final Exam Assigned			
Final Week		12/8/2021-12/16/2021 Submission Due (no lab)		(Project Report & Final Exam Due)	Group Project Final Report Due (12/8, midnight) Take-Home Final Exam Due (given in 12/8, due by 12/16 midnight)			

***For Lab 1 - Lab 10. Groups 1A/1B/1C/1C** 5:45-7:05 Tue, **Groups 2A/2B/2C/2D** 7:20-8:40 Tue, **Groups 3A/3B/3C/3D** 6:05-7:25 Wed

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.