# MEC 516: Energy Technologies Laboratory I

## (Fall 2023, 3 Credits) –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).

**Teaching Assistant : Yiting Zheng** (yiting.zheng@stonybrook.edu), will mainly assist lab tasks in 132 Light Engineering Building. Office Hours: TBA.

### Schedule

- **Labs/Lectures:**
  - **MEC516-03** 5:30 - 8:20 PM Tuesdays, 132 Light Engineering Building
  - **MEC516-04** 5:30 - 8:20 PM Wednesdays, 132 Light Engineering Building
- **Final Exam:** Take-home exam, Final Week

*. All the students are required to attend Labs/Lectures and take the exam as scheduled (check page 3) or should contact the instructor in advance for possible accommodations or makeups.

**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

### 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 with air leakage and temperature measurements 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.
- **Heat Pump Lab (HP)** - Using a 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.
- **Rankine Cycle Lab (Rankine)** – Using a Rankine cycle demonstration apparatus, record operating data and parameters to study the Rankine cycle and understand the components of a Rankine cycle power generation system. For Rankine Lab only, due to the safety concerns, pre-recorded video lab session will be offered.
- **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 should form groups to perform all the labs.
- Manuals for scheduled labs will be posted on Brightspace in advance. Students are required to read before lab hour.
- Each group submits a single report for each lab via Brightspace by the beginning of next scheduled lab session.
- In Brightspace, 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 and/or additional tasks will be applied.

## Grading

- **Lab Reports (70%):** Students form groups of typically four. 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 Brightspace 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 Brightspace course site can be accessed at https://brightspace.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 in-person lab 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 | | 8/29/2023 Intro | 8/30/2023 Intro | First Class | Introduction and Group Formation (173 Light Engineering Building at 5:30pm for each of Tue and Wed groups) | | | |
| Week 2 | * | 9/5/2023 Lab 1 | 9/6/2023 Lab 1 | First Lab | IR1 | IR1 | IR2 | IR2 |
| Week 3 | * | 9/12/2023 Lab 2 | 9/13/2023 Lab 2 | (Lab 1 Report Due) | IR2 | IR2 | IR1 | IR1 |
| Week 4 | * | 9/19/2023 Lab 3 | 9/20/2023 Lab 3 | (Lab 2 Report Due) | SP1 | SP1 | House | House |
| Week 5 | * | 9/26/2023 Lab 4 | 9/27/2023 Lab 4 | (Lab 3 Report Due) | House | House | SP1 | SP1 |
| Week 6 | * | 10/3/2023 Lab 5 | 10/4/2023 Lab 5 | (Lab 4 Report Due) (Project Proposal) | SP2 | SP2 | TC | TC |
| Week 7 | | 10/10/2023 Fall Break (no lab) | 10/11/2023 | Fall Break | no lab | no lab | no lab | no lab |
| Week 8 | * | 10/17/2023 Lab 6 | 10/18/2023 Lab 6 | (Lab 5 Report Due) | TC | TC | SP2 | SP2 |
| Week 9 | * | 10/24/2023 Lab 7 | 10/25/2023 Lab 7 | (Lab 6 Report Due) | Battery | Solar Thermal | Motor/ Gen | HP |
| Week 10 | * | 10/31/2023 Lab 8 | 11/1/2023 Lab 8 | (Lab 7 Report Due) | HP | Battery | Solar Thermal | Motor/ Gen |
| Week 11 | * | 11/7/2023 Lab 9 | 11/8/2023 Lab 9 | (Lab 8 Report Due) | Motor/ Gen | HP | Battery | Solar Thermal |
| Week 12 | * | 11/14/2023 Lab 10 | 11/15/2023 Lab 10 | (Lab 9 Report Due) | Solar Thermal | Motor/ Gen | HP | Battery |
| Week 14 | | 11/21/2023 Thanksgiving (no lab) | 11/22/2023 | Thanksgiving Holiday | no lab | no lab | no lab | no lab |
| Week 13 | | 11/28/2023 Lab 11 | 11/29/2023 Lab 11 | (Lab 10 Report Due) (Project Draft Due) | Rakine - prerecorded video | | | |
| Week 15 | | 12/5/2023 Review and Project Pres. | 12/6/2023 | Last class (Lab 11 Report Due) | Fianl Exam Review and Project Presentations/Comments Take-Home Final Exam Assigned (12/7/2023) | | | |
| Final Weeks | | 12/7/2023-12/21/2023 Submission Due (no lab) | | (Final Exam & Project Report Due) | Take-Home Final Exam Due (given in 12/7, due by 12/14 midnight) Group Project Final Report Due (12/21, midnight) | | | |

*__Groups 1A/1B/1C/1D__ 5:30-8:20 Tue

*__Groups 3A/3B/3C/3D__ 5:30-8:20 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. Until/unless the latest COVID guidance is explicitly amended by SBU, during Spring 2022 "disruptive behavior" will include refusal to wear a mask during classes.

For the latest COVID guidance, please refer to: https://www.stonybrook.edu/commcms/strongertogether/latest.php.

## 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.