

MEC 516: Energy Technologies Laboratory

Fall 2020

Instructors:

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Office: 152 Heavy Engineering

Office Hours: Online, by appointment

<h2><u>Part 1: Course Information</u></h2>

Course Sections and Times:

MEC516-03(91366) - Tuesdays @ 7:00 - 10:00pm EST. Final Exam: 12/15 @ 8:30 - 11:00pm EST.

MEC516-04(91367) - Wednesdays @ 7:00 - 10:00pm EST. Final Exam: 12/16 @ 5:30 - 8:30pm EST.

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.”

Reference Books *(Not Required)*:

- Fundamentals of Engineering Thermodynamics, Morran and Shapiro
- Heat Transfer, Holman
- Heat Transfer: A Practical Approach, Yunus A. Cengel
- Principles Of Solar Engineering, Goswami, Kreith, and Kreider
- Additional background papers and reading materials specific to the experiments will be provided.

Course Delivery Mode and Structure:

This is an online course and will be delivered synchronously with assignments to be completed outside of class. This means that the class time will be used to deliver lecture-style instructional content and that students will need to read articles, watch videos, and write reports on their time. The content covered during class will be recorded so it may be reviewed by the students. Each week will cover one topic in energy technologies and there will be one lab report to write on this content. There will be a group project assigned and due later in the term on the date specified.

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 for lectures and voice-chat discussion about the course content on Zoom. The weekly Zoom meetings will *not* be used as replacement for watching or reading the course materials posted on Blackboard. Students should plan to look over the course content prior to the Zoom meetings. There will also be a message board on Blackboard where students can post general questions and discuss the course materials.

How We Will Communicate:

If you use Blackboard’s email tool from the course site, it will automatically include your full name, course name and section when you send an email. **Please allow between 24-48 hours for an email reply.** Your Stony Brook University email must be used for all University-related communications. You must have an active Stony Brook University email account and access to the Internet. All instructor correspondence will be sent to your SBU email account. Plan on checking your SBU email account regularly for course-related messages. To log in to Stony Brook Google Mail, go to <http://www.stonybrook.edu/mycloud> and sign in with your NetID and password. Regular announcements will be sent from Blackboard. These will be posted in the course site and may or may not be sent by email.

Regular communication for both instructors and students is essential in online classes. Logging in about once a day, checking the discussion board and participating with your peers helps to ensure success.

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.

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.

Part 2: Course Learning Objectives and Assessments

Grading Policy:

- **Lab Reports 70%.** 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 total of all lab reports account for 70% of the semester grade.
- **Group Project 20%.** 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.
- **Final Exam 10%.** 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.

Experiments:

1. **Solar Thermal Heating Lab** – 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.
2. **Infrared Thermography Camera Lab**– Examination of thermal radiation, measuring surface emissivity, temperature, and thermal imaging using IR cameras.
3. **Thermal Radiation & $1/r^2$ Lab** – Measuring thermal radiation emitted from a body, considering surface emissivity, temperature, and thermal measurement using IR sensors and thermocouples. Measuring attenuation of thermal radiation.
4. **Spectrophotometer Lab 1** – Understanding how a spectrometer works, what it measures and how to use it to measure the spectral transmission, absorbance, and reflectivity of materials.
5. **Spectrophotometer Lab 2** – 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.
6. **House** – Using thermal imaging to audit energy efficiency of structures.
7. **Thermal Conductivity & Insulation Lab** – Measuring and comparing the thermal insulating properties of some common building materials.
8. **Motor-Generator Lab** – working with electric motors and generators and measuring the efficiency of delivering power to a load.
9. **Battery Lab** – Measure the efficiency of the charge/discharge cycles of LiPO batteries, assessing the charge status and health of Lead/Acid batteries.
10. **Geothermal Heat Pump Lab** – Using a Geothermal system "trainer" to record system data and study the performance of a geothermal heat pump.
11. **Fujitsu "Split" Heat Pump Lab** - Using a Fujitsu "split" heat pump system to record system data and study the performance of a heat pump.
12. **Group Project** - Students will work on a research or technical project and presentation. Details to be shared separately on Blackboard.

Tentative Course Schedule:

<u>Week 1:</u> 8/23 - 8/29	<ul style="list-style-type: none">● Review of Syllabus● Introduction to Course & Course Structure● Overview of Course Content● Form Lab Groups
<u>Week 2:</u> 8/30 - 9/5	<ul style="list-style-type: none">● Thermography Lecture● Infrared Thermography Camera
<u>Week 3:</u> 9/6 - 9/12	<ul style="list-style-type: none">● House Lab
<u>Week 4:</u> 9/13 - 9/19	<ul style="list-style-type: none">● Thermal Conductivity Lecture● Thermal Conductivity Lab
<u>Week 5:</u> 9/20 - 9/26	<ul style="list-style-type: none">● Thermal Radiation Lecture● Thermal Radiation Lab
<u>Week 6:</u> 9/27 - 10/3	<ul style="list-style-type: none">● Solar Thermal Lecture● Solar Thermal Lab
<u>Week 7:</u> 10/4 - 10/10	<ul style="list-style-type: none">● Spectroscopy Lecture● Spectroscopy Lab 1
<u>Week 8:</u> 10/11 - 10/17	<ul style="list-style-type: none">● Spectroscopy Lab 2
<u>Week 9:</u> 10/18 - 10/24	<ul style="list-style-type: none">● Generator Lecture● Motor-Generator Lab
<u>Week 10:</u> 10/25 - 10/31	<ul style="list-style-type: none">● Charging Efficiency Lecture● Battery Charging Lab
<u>Week 11:</u> 11/1 - 11/7	<ul style="list-style-type: none">● Heat Pump Lecture● Fujitsu Heat Pump Lab
<u>Week 12:</u> 11/1 - 11/7	<ul style="list-style-type: none">● Geothermal Heat Pump Lab
<u>Week 13:</u> 11/8 - 11/14	<ul style="list-style-type: none">● Power Plants Lecture● Rankine Cycle Lab
<u>Week 14:</u> 11/15 - 11/21	<ul style="list-style-type: none">● Presentations
<u>Week 15:</u> 11/22 - 11/28	<i>Thanksgiving Break</i>
<u>Week 16:</u> 11/29 - 12/5	<ul style="list-style-type: none">● Final Exam Review

Part X: Course and University Policies

DISABILITY SUPPORT SERVICES (DSS) STATEMENT: 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, room 128, (631) 632-6748. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential. Students requiring emergency evacuation are encouraged to discuss their needs with their professors and Disability Support Services. For procedures and information, go to the following web site: www.stonybrook.edu/dss

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 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/>

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 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.
