EK 408 Introduction to Clean Energy Generation and Storage Technologies

Fall 2020

Course Syllabus

TEXT BOOK
Fundamentals of Renewable Energy Processes, by Aldo V. DaRosa

SUPPLEMENTARY REFERENCES
Sustainable Energy, R. A Dunlop
Sustainable Energy, J. W. Tester, E. M. Drake, M. J. Driscoll, M. W. Golay and W. A. Peters
Principles of Sustainable Energy, F. Kreith and J.F. Kreider
Renewable Energy and Climate Change, V. Quaschning

CLASS SCHEDULE
Lecture: Classroom EPC 208, Tuesdays and Thursdays, 1.30-3.15 PM
Office Hours/Discussion: Remotely by Zoom, Fridays, 1 – 2 PM

INSTRUCTOR Prof. S. N. Basu (Tel.: 617-353-6728, e-mail: basu@bu.edu)
Office: Room 204, 730 Commonwealth Ave.

INSTRUCTIONAL FORMAT
Lectures notes will be posted on Blackboard before each lecture. Please download them and bring to class. I will lecture from the notes by connecting to Zoom, and projecting my computer screen in the classroom. Whenever possible, students attending in-class lectures are encouraged to bring in a device to class that will give them the option to log into the Zoom meeting in class. Students attending class synchronously from a remote location can type in their questions. The chat will be monitored by student moderators who will be in class. The sessions will be recorded, and I will provide links to the recorded lectures for the remote students who are taking the class asynchronously. If needed, I will use a tablet to discuss lecture content further and/or solve problems in class.

I will be posting one or more problems at the end of each lecture note. If time permits, I will discuss the solution(s) in class. Otherwise, I will discuss the solutions in the office hour/discussion hour every Friday. These sessions will be recorded and will be available to everyone. I will have extended Friday hours the weeks before exams are scheduled. No homework sets will be assigned, but the problems at the end of lectures should be enough to prepare for the exams.

GRADING AND SCHEDULE

Exam 1 (10/6/20)	20 %
Exam 2 (11/5/20)	20 %
Exam 3 (12/3/20)	20 %
Project (12/8/20 and 12/10/20)	40 %

EXAMINATIONS

The course will have three exams. Exam 1 will cover Topics 1-4, Exam 2 will cover Topics 5-7, and Exam 3 will cover Topics 8-9. Exams will be taken remotely by all students. Students will have access to the exam on Blackboard for a limited time. The students will need to log into Zoom and take the exam on camera, and have to turn in the solutions as a pdf file by a deadline.

PROJECT

The project will be undertaken by groups of two or three students. The students are expected to self-select the groups, and I will step in only if some students remain unpaired. The deliverables will include an oral presentation via Zoom (20 points), and a written report delivered as a pdf file (20 points). The group should pick any current clean energy generation or storage technology and address the topics listed below. Groups with 2 students need only address the first two topics.

Topic 1: Overview of the technology chosen, and its advantages and challenges.
Topic 2: One major challenge limiting this technology and the current ongoing research to meet this challenge. The science and engineering principles should be clearly laid out.
Topic 3: What is its current state of implementation and current and projected market penetration of this technology? Who are the major players?

Project presentations are scheduled for the last two days of class. I will provide more details about the presentation and report formats later in the semester.

COVID-19 AND BU COMMUNITY HEALTH EXPECTATIONS

Currently, the COVID adjusted classroom capacity is more than the number of students who have indicated that they will attend in-person lectures. So, all students who have indicated that they want to attend in-person lectures can do so. That may change if new students add the class or students change their remote learning options. Masks are required and face coverings must be worn over the mouth and nose at all times when in public spaces on campus, including classrooms. Students who are attending in-person, must have clearances to attend class that day, and should be able to display them on their mobile devices. If students are unable to do so, they will be asked to leave the lecture. All students are expected to follow all university guidelines with respect to daily symptom checks, testing, social distancing, and mask wearing when they leave their dorm or home. For a detailed description of official BU policies regarding COVID, please visit: *http://www.bu.edu/dos/policies/lifebook/covid-19-policies-for-students/*

COURSE TOPICS

1. Introduction **1.5 week**
Planetary energy balance and energy utilization, market penetration function
Planetary energy resources, carbon cycle, photosynthesis
Greenhouse effect, carbon containment, fossil fuels, biofuels

2. Introduction to fundamental concepts **1 week**
Thermodynamics
Kinetic theory of gases

3. Nuclear energy **0.5 weeks**
Nuclear fuels, fission and fusion reactions

4. Mechanical Heat Engines **1 week**
Carnot, Otto, Diesel, and Stirling cycles
Gas turbines

5. Thermoelectricity **1 week**
Principles of thermoelectricity generation
Design of thermoelectric generators and Peltier coolers

6. Energy from hydrogen **1.5 weeks**
Fuel cells
Hydrogen generation technologies

7. Energy storage **1 week**
Hydrogen storage technologies
Batteries
Other storage technologies

8. Energy from the sun **2 weeks**
Solar radiation
Fundamentals of photodiodes
Photovoltaic converters
Solar collectors

9. Energy from wind and water **1.5 weeks**
Wind velocity distribution, available power density in wind, Betz limit
Lift and drag forces on wind turbine blades
Ocean energy

10. Project presentations **1 week**