EK 408 Introduction to Clean Energy Generation and Storage Technologies

Fall 2022

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
Lectures: Classroom: EPC 208, Tuesdays and Thursdays, 1.30-3.15 PM

INSTRUCTOR Prof. Soumendra Basu (Tel: 617-353-6728, e-mail: basu@bu.edu)

Office: Room 204, 730 Commonwealth Ave.
Office Hours: Friday, 1 – 2 PM
Other appointments must be scheduled in advance.

INSTRUCTIONAL FORMAT
I will be using the chalkboard for the lectures in the class. I will also post lecture notes on Blackboard before each class. Please download them and bring to class, since they have figures I will be projecting in class, and you won't have to redraw them. Please note that I may not fully cover all the material in the notes, so taking your own notes in class is strongly suggested. There will be one or two relevant questions at the end of each lecture note. The solutions to the questions will be posted within a week of posting the lecture.

GRADING AND SCHEDULE

Exam 1	35 %
Exam 2	35 %
Project	30 %

EXAMINATIONS
The course will have two exams. Each exam will cover roughly half the course material. The date of the first exam will be announced in class, while the second exam will be on December 1, 2022. The second is NOT cumulative and will cover the second half of the course.

HOMEWORKS

There will no formal homework handed out for the course. However, the questions at the end of each lecture are in lieu of formal homework sets. It is highly recommended that you try to solve the questions independently within a week of receiving them before the solutions are posted. I will have extended office hours to discuss the solutions before each exam.

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 in-class oral presentation (15 points), and a written report (15 points). The group should pick any current clean energy generation or storage technology and address the topics listed below. Groups with 2 students need to address only 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?

The project title and the names of group members are due in the middle of the semester (I will let you know the deadline later in the semester. Project presentations are scheduled for the two lectures of the semester (12/6/22 and 12/8/22). I will provide more details about the presentation and report formats, and the grading rubrics later in the semester.

ACADEMIC CONDUCT CODE

As students in this class, you need to abide by the BU Academic Conduct Code found at: https://www.bu.edu/academics/policies/academic-conduct-code/. In-class exams must be taken completely independently, and any copying or unauthorized help will lead to disciplinary action. Finally, for the project, copying from other sources without attribution will be considered plagiarism and is also grounds for disciplinary action.

COURSE TOPICS

1. Introduction **1.5 weeks**
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**