

EE 438 Renewable Energy

Credits: 3

Instructor: Olga Boric-Lubecke

Text Book and Other Required Materials: G. M. Masters, “Renewable and Efficient Electric Power Systems”

Designation: Elective

Catalog Description: EE438 Renewable Energy (3) Fundamentals of power, electric power grid and conventional electricity generation. Wind and solar power systems. Photovoltaic materials and systems. Distributed generation and energy storage. Pre: 213, or consent.

Prerequisites: EE213 “Basic Circuit Analysis II”; Junior level standing in engineering

Class Schedule: 3 lecture hours per week

Topics Covered:

1. Energy and Power: basic concepts and units.
2. Fundamentals of Electric Power: power factor, three-phase systems, power supplies, power quality.
3. Electric Power Industry: electricity generation, transmission, and distribution; regulatory side of electric power.
4. Distributed Generation: biomass, micro-hydro, wave/tidal power, environmental impact.
5. Wind Power Systems: wind turbine generators, wind power, environmental impact.
6. Solar Resource: solar spectrum, Earth’s orbit, sun path diagrams, insolation.
7. PV Materials and Electrical Characteristics: PV cells, module and arrays, impact of temperature and insolation, shading, crystalline silicon, thin film technologies.
8. PV Systems: Load analysis, system sizing and positioning, inverters, energy storage, environmental impact.
9. Electrical Safety: physiological effects of electricity, safety standards, approaches to protection.

Course Objectives and Their Relationship to Program Objectives:

Student should understand (i) principles of electricity generation, (ii) principles of power system design, (iii) environmental and societal impact of fossil fuels and renewable energy sources, and (iv) develop skills for renewable energy power system design.

[Program objectives this course addresses: 1, 2, and 5]

Course Outcomes and Their Relationship to Program Outcomes:

The following are the course outcomes and the subset of Program Outcomes (numbered 1-7 in square braces "[]") they address:

1. Understand electric power generation, and power systems structure and operation. [1, 2, 7]
2. Understand the environmental and societal impact of using fossil fuels and renewable energy sources. [2, 4]
3. Characterize renewable energy sources in terms of efficiency, capacity factor, rated power, and societal and environmental impact. [1, 2, 4, 7]
4. Understand wind power, wind turbine generators, and their societal and environmental impact. [1, 2, 4, 7]
5. Understand solar resource, concentrating solar power technologies, and photovoltaic materials. [1, 2, 4, 7]
6. Analyze photovoltaic system load impact, sizing and positioning, and energy storage. [1, 2, 4, 7]
7. Understand electrical safety issues and approached to protection. [1, 7]
8. Design a renewable energy power system. [1, 2, 3, 4, 6, 7]

Contribution of Course to Meeting Professional Component

Engineering Topic: 100%

Computer Usage:

All class materials and announcements are posted on Lulima. Students use Microsoft Office or equivalent to prepare their project presentations and reports. Students use IEEE Xplore, Goggle Scholar and similar search engines to find references for their projects.

Grading: 60% Homework; 40% Project

Design is incorporated into the final project for the course. Each student may work individually or in a team of no more than 3 students to design a renewable energy power system of their choice. Students submit project proposals and give proposal presentations (one per team) in the middle of the semester, and submit individual final project reports and give final project presentations at the end of semester.

Person Preparing Syllabus and Date: Olga Boric-Lubecke, 4/12/2012. Revised 10/03/2014.
Revised by Matthias Fripp, 1/21/2021.