Spring 2024

ECE 443-102: Renewable Energy Systems

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ECE 443: Renewable Energy Systems (3 credits, 3 contact hours, required course)

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Office: ECE Building, Room 337. **Office hours, recitations and group studies:** By appointment

Textbooks:
- Renewable and Efficient Electric Power Systems by Gilbert M. Masters, 2nd edition, Wiley-IEEE Press, 2013, ISBN: 978-1-118-14062-8 (main text)
- Alternative Energy Systems and Applications by B. K. Hodge, 2nd edition, Wiley, 2017, ISBN: 978-1-119-10921-1

Catalog Description:
This course introduces renewable energy systems, such as solar and wind power plants, and discusses their potential contribution to the nation's energy profile. Topics include the technology used to harness renewable resources, the challenges to integrating renewable energy systems into electric power grids, and the economic, environmental, and social impact of renewable energy systems.

Prerequisites: ECE 231 and 271

Corequisites: None

Specific course learning outcomes (CLO): The student will be able to
1. understand and use for problem-solving the fundamentals of electric power for single- and three-phase systems: complex power, power factor, power triangle, power quality, and power electronics.
2. understand fundamental concepts of solar energy. Understand seasonal variations and sun path diagrams for shading analysis.
3. calculate the solar position at any time of day and the total clear-sky insolation on a collecting surface. Understand and calculate the direct beam, diffuse, and reflected radiation.
4. understand photovoltaic materials and their electrical characteristics, including fundamental semiconductor physics and the equivalent circuits for photovoltaic cells, modules, and arrays.
5. understand the photovoltaic current-voltage (I-V) curve under standard test conditions. Calculate the impact of temperature variation, insolation, and shading on solar systems.
6. understand maximum power point trackers (MPPT), the buck-boost converter, and MPPT controllers.
7. understand behind-the-meter, utility-scale, and off-grid photovoltaic systems.
8. understand fundamental concepts of wind energy. Calculate air parameters at different conditions, the impact of installation height, wind power, and average wind power.
9. calculate wind turbine performance parameters, including efficiency, the energy produced, and capacity factor, for a turbine with a given power curve and a given location with a given wind speed distribution function.
10. estimate wind turbine yearly energy production under the assumption that wind speeds follow Rayleigh statistics.

11. understand wind turbine technology and the principal components of a wind energy conversion system, including the different types of rotors and generators.
12. understand the differences between onshore and offshore wind power plants.
13. understand concepts of wave energy conversion, tidal power, hydroelectric power, pumped-storage hydro, biomass, geothermal, and fuel cells.

Relevant student outcomes (ABET criterion 3):
1. an ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science, and mathematics. (CLOs 1–13)
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. (CLOs 5–7, 9–13)

Computer assisted design and course specific software: MATLAB

Tentative Course Schedule:

Week	Topic	Text section	Homework
1	The legacy electric power system	Chapter 1	
2	Selected fundamentals of electric power	Chapter 3	Assignment 1 (week 2)
3–6	Solar energy systems	Chapters 4–6	Assignment 2 (week 6)
4	Test 1	Chapters 1 and 3	
7–10	Wind energy systems	Chapter 7	Assignment 3 (week 10)
8	Test 2	Chapters 4–6	
11–13	Other renewable energy systems	Chapter 8	Assignment 4 (week 12)
14	Smart grids	Chapter 9	

Project:
An announcement with detailed information will be posted on Canvas within the first few weeks after the course has started.

Homework Policy:
Homework problems will be assigned regularly. Solutions will be posted online and discussed in class. The text contains numerous examples. Students are encouraged to study these examples and to work on additional problems for practice. Late homework will be penalized.

Grading Policy:

Homework	20
Test 1	15
Test 2	15
Project	25
Final Exam	25
Total	100

Updates and assignments: distributed via email and posted on Canvas.

Prepared by: M. Netto

Honor Code:
"Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf.
Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu."