ECE 443 Syllabus

ECE 443 Renewable Energy Systems

3 credits; Tuesday 6:00pm-09:05pm KUPF108
Instructor: Dr. Serhiy Levkov. **E-mail:** levkov@njit.edu **WEB:** http://web.njit.edu/~levkov/ **Phone:** 973 642 7676.
MainText: Renewable and Efficient Electric Power Systems by Gilbert M. Masters, 2d edition, Wiley, 2004 ISBN 0-471-28060-7
Reference Texts:
Alternative Energy Systems & Applications by B.K.Hodge, Wiley, 2010 ISBN 978-0-470-14250-9
Renewable Energy Technologies, edited by J.C.Sabonnadiere, Wiley, 2009,ISBN 978-1-84821-135-3
Sustainable Energy Systems and Applications, Springer, 2011, 978-0-387-95860-6
Course description:
The course presents the various sources of renewable energy including wind, solar, and biomass as potential sources of energy and investigates the contribution they can make to the energy profile of the nation. The technology used to harness these resources will be presented. Discussions of economic, environment, politics and social policy are integral components of the course.
Prerequisite: ECE 231 and ECE 271

Specific course learning outcomes

Upon successfully completing the course a student should be able to perform the following:

#	Outcome
1	Understand and use for problem solving main concepts of electric power calculations for one and tree phase systems: complex power, power factor, power triangle, power quality and harmonic distortion.
2	Understand the main concepts of heat engine and Carnot efficiency. Calculate the efficiency of a fossil fuel steam cycle power plant and its pollution parameters.
3	Understand different types of steam cycle plants (base load and others) and calculate the optimal mix of combined cycle plants for a given load duration distribution.
4	Understand the concept of distributed generation and know its main types. Understand principle of work of micro-combustion turbines and Stirling engines.
5	Understand the concept of fuel cells. Calculate efficiency, fuel consumption and electric parameters of a simple fuel cell
6	Understand the concept of micro hydro-electric systems. Calculate efficiency, and parameters of a micro hydro system. Design a consumer micro hydro installation for a given site and performance parameters.
7	Evaluate economic efficiency and compare small scale renewable energy projects using major economic measures of pay-back period, simple rate of return, net present value, internal rate of return.
8	Understand major concepts of wind energy. Calculate air parameters at different conditions, impact of installation height, wind power and average wind power.
9	Calculate wind turbine performance parameters (efficiency, energy produced, capacity factor) for a turbine with given power curve and for a given location with given wind speed distribution function.
10	Calculate the major parameters of sun movement, solar radiation, and tracking systems.
11	Know the operation and comparative analysis of different concentrating solar power systems.
12	Design the parameters of a consumer scale stand alone and grid connected photovoltaic system for a given site location and performance specification.
13	Understand concepts of nuclear power systems.
14	Understand concepts of geothermal and marine power systems.

Student outcomes addressed by the course

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (1,2,3,4,5,6,7,8,11,13,14)
(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. (5,6,9,12)

Course Topics

Week	Topic	Topic details	Text section	HW
1	1. Introduction. Fundamentals of electric power	Electric energy in US and World Power factor, Complex power, power triangle. Three-phase systems. Synchronous generators. Power quality	LN, PP T1 3.1, 3.3 3.4, 3.5 3.6 3.8	See Moodle weekly
2,3	2. The basic conventional electric power industry	History & facts Regulatory side of electric power Heat engines. Carnot efficiency Types of conventional power plants (steam-cycle, combustion gas turbines, combined cycle power plants, nuclear power plants) Economically optimal mix of power plants Transmission and distribution. Grid stability. Losses in the transmission line	1.2, 1.4.4, PP T2.1 1.3 8.2.1, LN 1.5, PP T2.2, PP T2.3 1.6 1.4.1-1.4.3, 3.7 PP T2.4	
4	3. Energy economics	Energy economics	A.1 – A.8	
		Test 1		
5,6	4. Distributed generation. Various renewable energy systems	Intro to distributed generation Micro-combustion turbine, sterling engine Fuel cells Micro- hydro Wave power Tidal power Biomass & biogas Geothermal power	LN 9.7.2, 8.2.8, PP T4.1 9.8, PP T4.2 8.5, 8.6, PP T4.3 8.3 8.4 8.7, PP T4.4 8.8	
7.8	5. Wind power systems	Intro Power in the wind. Wind turbine performance Average power of the wind Wind turbine energy production Wind farms, wind economics, environmental impact	7.1-7.3 7.4 7.5 7.6 7.7 7.8-7.10	
		Test 2		
10,11,12	6. Solar energy systems	The solar resource Concentrating solar power technologies Photovoltaic cells Photovoltaic systems	4 (selected sections) 8.2, PP T6.1 5 6 (selected sections)	
13	7. Smart grid	Both sides of the meter	9.1-9.5	
14	Projects presentation			
15		FINAL EXAMINATION		

Project

A group project is planned in the second part of the course on the topics of student's choice. The topic has to be presented for approval by the end of 7th week.

Homework Policy

A minimum number of homework problems is assigned each class. Students are expected to solve all assigned problems. Solutions will be posted on the web after each assignment is discussed in class. The text contains numerous examples. Students are encouraged to study these examples and to work extra drill problems for practice.

Grading Policy

The course grade will be based on the tests and on the project:

2 Tests @100 points	200
Final examination (all inclusive)	150
Project	100
Total	450

Tests and final exam are closed books and notes. A list of formulas will be provided by instructor.

NJIT Honor Code

The NJIT Honor Code will be upheld, and any violation will be brought to the immediate attention of the Dean of Students