EEL4280 Renewable Energy Generation
Syllabus and Course Vitals

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Class time:

Prerequisite:
Undergraduate students: EEE4243 (power electronics)

Course Descriptions
This class provides an introduction to power electronics applications on renewable energy generation for undergraduate students. The course covers energy conversion, utilization and storage for renewable technologies such as solar, fuel cells and hybrid vehicle systems.

Course Objectives
At the end of the course, the student will be able to:
(1) define the smart grid system;
(2) develop the mathematical models for energy storage elements and photovoltaic cells;
(3) simulate the electric vehicle power train and PV system; and
(4) design energy storage system for electric vehicle applications.

Text and reference books
Since this course covers the most contemporary materials, there is no text book required. The lecture materials will include lecture notes, state-of-the art papers, latest technique reports, and some reference books. The following reference books are recommended:

- Energy Systems and Sustainability, Godfrey Boyle, Bob Everett, and Janet Ramage (eds.), Oxford University Press, 2004

Grading and required work

• Lecture/ reading assignments /presentations.
• Laboratory visit.

Class Performance and Work Ethic 10%, class project assignments (40%) , Final design project (50%) A is 90-100, B is 80-89, C is 70-79, D is 60-69, and below a 60 is an F.

Course Outline

Topic I. Renewable Energy Overview (4 lectures)
  o Energy Systems in Sustainable Future
  o Sources of renewable energy
  o Renewable energy trends
  o Key factors affecting renewable energy supply and prospects

Topic II. Smart Grid System (6 lectures)
Topic III. Photovoltaic Power (6 lectures)

- PV cell technologies
- PV introduction
- PV system modeling
  - Equivalent electrical circuit
  - Open circuit voltage and short circuit current
  - i-v and p-v curves
  - MPPT control
- Single-phase grid-connected PV system and control
- New generation of smart PV inverter (microinverter)
- Energy Storage with PV inverter

Topic IV. Electric Vehicle System

- Electric Vehicle Introduction
- Energy storage elements (battery and ultracapacitor)
- EV design example with battery sizing
- EV design example with motor control
- EV design example with hybrid energy storage elements

Design projects:

- **Project 1: Run simulation on a developed battery model.** A circuit model of a battery is given to the students with all the parameters. Students need to (1) simulate the battery voltage and current waveforms under different testing scenarios; and (2) describe and explain the simulation waveforms.

- **Project 2: Study the simulation model of the battery electric vehicle.** A battery electric vehicle simulation model is provided with motor speed control. Students need to (1) simulate this vehicle under ECE R40 driving cycle; (2) run the speed control simulation of motor in 2-quadrant; (3) plot the battery voltage and current waveforms under ECE R40 driving cycle and describe these waveforms.

- **Project 3: Run the simulation model of a PV panel.** A circuit model of a PV panel is provided and can be simulated using PSIM software. Students need to plot the V-I characteristics of this PV panel.

Final project:
Part of a system model of a PV-Battery Charger is given, students are required to: (1) Add a dc-dc converter model to interface with PV and battery; (2) simulate PV MPPT function; and (3) plot battery current and voltage under charge and discharge mode.

Policy Statements:

- Attendance is mandatory. Coming late or leaving early will be considered as the absence of class. An unexcused absence will result in a grade drop of 1%.
- Homework is due at the beginning of class.
- Makeup exams are allowed under excused absences. In the event of an excused absence, you must notify the instructor prior to the exam to discuss proper procedure.
- Cellular phones and beepers must be turned off in the classroom.
- Reference to the department’s Academic Learning Compact is at http://www.eng.fsu.edu/outcomes
**University Attendance Policy:**
Excused absences include documented illness, deaths in the family and other documented crises, call to active military duty or jury duty, religious holy days, and official University activities. These absences will be accommodated in a way that does not arbitrarily penalize students who have a valid excuse. Consideration will also be given to students whose dependent children experience serious illness.

**Academic Honor Policy:** The Florida State University Academic Honor Policy outlines the University’s expectations for the integrity of students’ academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to “. . . be honest and truthful and . . . [to] strive for personal and institutional integrity at Florida State University.” (Florida State University Academic Honor Policy, found at http://dof.fsu.edu/honorpolicy.htm.)

**Americans With Disabilities Act:** Students with disabilities needing academic accommodation should:
(1) register with and provide documentation to the Student Disability Resource Center; and
(2) bring a letter to the instructor indicating the need for accommodation and what type. This should be done during the first week of class.

This syllabus and other class materials are available in alternative format upon request.

For more information about services available to FSU students with disabilities, contact the:

Student Disability Resource Center
874 Traditions Way
108 Student Services Building
Florida State University
Tallahassee, FL 32306-4167
(850) 644-9566 (voice)
(850) 644-8504 (TDD)
sdrc@admin.fsu.edu
http://www.disabilitycenter.fsu.edu/