ECE 7995 Syllabus
Smart Grid: Operation and Control of Power Systems and Integration of Renewable Sources

Credit Hours:
4 Credit Hours (LCT 4).

Course Description:
Prereq: ECE 4330. Power system optimal dispatch, power system stability analysis and control. Smart grid technologies and applications, covering modeling and control of renewable energy systems, distributed generation, Microgrid architecture and control, demand response, energy storage for power grids, grid interface and integration of renewable sources, and electricity market fundamentals.

Instructor: Dr. Caisheng Wang,
Course Meeting Time: Tuesday and Thursday, 5:30 PM - 7:10 PM
Course Meeting Location: 0159 MAIN
Office Hours: Tuesday and Thursday, 2:00 PM - 3:30 PM
Office Location: 3146 Engineering Building
Phone: (313) 577-7084
Email: cwang@wayne.edu

Prerequisite(s): ECE 4330: Linear Network and System Analysis.
Co-requisite(s): None.

Textbook(s) Required:

Computer Programs:
MATLAB/Simulink and PowerWorld Simulator

Goals:
Introduction to the multi-disciplinary field of smart grid and renewable energy systems. Understand the theory and methods for analysis and control of smart grid and integration of renewable systems.

Course Objectives:
Upon completion of this course the student will be able to:
1. Understand the concepts of power systems and smart grids.
2. Understand the contemporary challenges in implementing smart grids and increasing adoption of renewable sources.
3. Describe optimal dispatch of power generation  
4. Carry out stability analysis of a power system  
5. Analyze and design controllers for power systems  
6. Model the main components in typical renewable energy systems.  
7. Understand the concepts of distributed generation and Microgrids  
8. Understand the typical methods of renewable energy integration  
9. Describe the need and function of energy storage and demand response  
10. Understand the modern electricity market.

Topics:

1. Introduction: Concepts and motivations (1 week)  
2. Fundamental of power systems (1 week)  
   Components, power flow  
3. Optimal dispatch of generation (1 week)  
4. Power system stability (1 1/2 weeks)  
5. Power system control (1 1/2 week)  
6. Alternative/Renewable Energy Systems and System Integration (2 1/2 weeks)  
7. Distributed generation and microgrids (1 1/2 weeks)  
8. Energy storage systems (2 week)  
9. Demand response (1 week)  
10. Fundamentals of modern electricity market (1 week)

Contributions to the ECE Program Outcomes:

(a) Demonstrate mastery of advanced principles pertaining to the electrical engineering research path of the Ph.D. candidate. The homework assignments, project, and exams require direct applications of mathematical, scientific, and engineering knowledge to successfully complete the course. Students are required to perform analysis, design, control, and optimization of power systems and smart grids to complete the tasks.

(b) Plan and conduct independent research which leads to the development of new knowledge, approaches and solutions for electrical engineering problems. The course project requires students (either in individual or team) to independently study the analysis, modeling and control methods of power system and smart grid given in the textbook, to carry out literature survey on the related advanced topics in the field, and to present solutions to an identified problem related smart grid challenges.

(c) Effectively communicate, both verbally and in writing, scientific and engineering concepts to audiences with a broad range of technical knowledge. Students are required to write a comprehensive project report according to IEEE format and give presentations to show their results before the class and answer questions from the audience.
Grading Policy:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homework</td>
<td>25%</td>
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<tr>
<td>Project</td>
<td>25%</td>
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<tr>
<td>Mid-term Exam</td>
<td>25%</td>
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<tr>
<td>Final</td>
<td>25%</td>
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</tbody>
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Grading Scale:

- A: 93-100
- A-: 90-92
- B+: 87-89
- B: 83-86
- B-: 80-82
- C+: 77-79
- C: 73-76
- C-: 70-72
- D+: 67-69
- D: 63-66
- D-: 60-62
- F: Below 60

Schedules:

- Homework due: one week after completing the corresponding chapters/topics
- Project due: Dec 14
- Final Exam: Dec 14

Attendance:

Students are expected to attend all lectures. The most common reasons for failing this course are (1) not attending all lectures and (2) not having sufficient time spent on the course.

WITHDRAWAL POLICY:

- Last day to drop with a tuition refund: End of 2\textsuperscript{nd} Week of Semester
- Last day to drop without a notation of W on the transcript: End of 4\textsuperscript{th} Week

Depending on the situation of withdrawal, one of the following grades will be assigned:
- WP: Withdrawal with Passing
- WF: Withdrawal with Failing
- WN: Withdrawal Never Attended
All drop/add activity during the first four weeks should be done by the student through Pipeline. Withdrawal after the fourth week requires the instructor’s permission and must be submitted on a Drop/Add form to the Registrar’s Office. Withdrawal after the ‘final drop’ date will only be permitted under exceptional circumstances and requires the permission of the Chair of the ECE department. A failing grade is not an acceptable reason for withdrawal after the ‘final drop’ date.

**POLICY ON CHEATING:**

Cheating is defined by the University as “intentionally using or attempting to use, or intentionally providing or attempting to provide, unauthorized materials, information, or assistance in any academic exercise.” This includes any group efforts on assignments or exams unless specifically approved by the professor for that assignment/exam. Evidence of fabrication or plagiarism, as defined by the University in its brochure *Academic Integrity*, will also result in downgrading for the course. Students who cheat on any assignment or during any examination will be assigned a failing grade for the course and may be subject to additional penalties. See [http://www.otl.wayne.edu/wsu_integrity.php](http://www.otl.wayne.edu/wsu_integrity.php) for more details.

**Code of Ethics for Engineers:**

WSU library has a tutorial that talks about transmitting ideas, plagiarism, copyright, and citing sources. At the end, there is a quiz. You are encouraged to visit this site then take the quiz at the end. [http://www.lib.wayne.edu/services/instruction_tutorials/searchpath/mod6/contents.html](http://www.lib.wayne.edu/services/instruction_tutorials/searchpath/mod6/contents.html)

The following list gives additional sites:

- [http://onlineethics.org/codes/](http://onlineethics.org/codes/)
- [http://www.iit.edu/departments/csep/codes/coe/abet-a.html](http://www.iit.edu/departments/csep/codes/coe/abet-a.html)

**AVAILABILITY TO STUDENTS WITH DISABILITIES**

If you have a documented disability that requires accommodations, you will need to register with Student Disability Services (SDS) for coordination of your academic accommodations. The Student Disability Services (SDS) office is located at 1600 David Adamany Undergraduate Library in the Student Academic Success Services department. SDS telephone number is 313-577-1851 or 313-577-3365 (TDD only). Once you have your accommodations in place, the instructor will meet with you privately to discuss your special needs. Student Disability Services’ mission is to assist the university in creating an accessible community where students with disabilities have an equal opportunity to fully participate in their educational experience at Wayne State University. Please be aware that a delay in getting SDS accommodation letters for the current semester may hinder the availability or facilitation of those accommodations in a timely manner. Therefore, it is in your best interest to get your accommodation letters as early in the semester as possible.

**Last Updated:**

August, 2017

**Prepared by:** Dr. Caisheng Wang