ECE 3795 Cyber-physical Power Systems

Meetings: Tuesdays 14:00 to 16:40 ET at 312 Benedum Hall, with virtual access available.

Professor: Alexis Kwasinski (Benedum Hall 1229, akwasins@pitt.edu, Ph: 412-383-6744) – Guest professor: Andres Kwasinski (Rochester Institute of Technology (axkeec@rit.edu).

Course Home Page: http://www.pitt.edu/~akwasins/ECE3795CyphyPSFall15.html

Office Hours: Tuesdays from 12 pm to 2 pm, or by appointment.

Prerequisites: Fundamentals of circuit analysis (ECE0041 or an equivalent course in circuit analysis or ECE1769), probability (ENGR0020), signal processing (ECE1552), and linear systems (ECE1673) or consent from the instructor.

Reference Textbook(s): There is no required textbook. We will use various books and papers as reference material.

Course Description and objectives: This course discusses realization and application of integrated power and communication infrastructures in a cyber-physical system. In order to understand planning, design and operation of such systems, this course includes both topics related with the physical component of the system, such as technologies for storing and generating electric power (including renewable energy), and with the cybernetic component of the system, such as layering, networking, packets routing, coding, cellular networks, WLAN, and sensors. Approaches for an integrated operation, management and control of such a system, as well, as the application of signal processing techniques in electric power grids are also explored in this course. Implication of such integrated power and communications cyber-physical systems in terms of sustainability, security and resilience will also be reviewed through practical applications. This course also aims at helping graduate students to further develop their research skills.

Schedule:
Week 1 (Sept. 1)       Fundamentals of traditional power systems
Week 2 (Sept. 8)*     Communications and networking fundamentals
Week 3 (Sept. 15)*    Communications and networking fundamentals
Week 4 (Sept. 29)     Power infrastructure in communication systems
Week 5 (Oct. 6)*     Communications infrastructure in power systems.
Week 6 (Oct. 13)*    Wireless, WLAN and ad-hoc communication networks
Week 7 (Oct. 20)     No class. Equivalent to Monday.
Week 8 (Oct. 27)     Modern power systems; microgrids
Week 9 (Nov. 3)      Modern power systems; microgrids
Week 10 (Nov. 10)*   Renewables management and control; availability estimation.
Week 11 (Nov. 17)    Modern power systems: monitoring and control, sensing.
Week 12 (Nov. 24)    Signal processing in power grids. Thanksgiving.
Week 13 (Dec. 1)     Applications: Security, resilience, sustainability
Week 14 (Dec. 8)*    Applications: Security, resilience, sustainability
Week 15 (Dec. 15)    Student presentations

Note about the schedule: Stars indicate a class taught by the guest professor. Unless Dr. K from Pitt is away at a conference, he will still be at the course classroom to assist with the lecture.

Grading:
Homework: 35%
Project preliminary evaluation: 15%
Project report: 25%
Project discussion: 15%
Class participation: 10%

Letter grades assignment: 100% – 96% = “A+”, 95% – 91% = A, 90% – 86% = A-, 85% – 81% = B+, and so on.

**Homework:**
This course does not have conventional tests. Instead, this course has homework assignments and a project that last during the entire semester. Homework assignments tend to be a little more comprehensive than typical homework assignments you were used to having during your undergraduate studies. For this reason, homework will be assigned about every two weeks and you will have about that time to work on the problems. Sometimes, homework problems will also require students to find solutions with minimal guidance from the instructor. The goal of this approach for homework assignment planning is for students to learn how to find paths for solutions to problems. Many times there could be many paths that will lead to solving a problem and sometimes there will be many equally valid solutions for a given problem. Making mistakes is part of the learning process. For this reason the lowest score for an assignment will not be considered to calculate the homework total score. However, in order to have your lowest homework score discarded, you will need to attempt to solve all homework assignments which means that your lowest homework score will be discarded only if you submit all homework assignments showing a good-faith effort in solving the problems. Since some homework problems may have different valid solutions or different paths to a solution, the focus when I grade homework assignments is more on the process taken to address the problem and not so much on a numerical answer. Hence, it is very important that homework problem solutions explain clearly but concisely the path taken to find the solution to a given problem and that students include some brief discussion explaining their answer to each homework question. Additionally, please, expect about couple of weeks grading cycle for homework assignments as both the content and the grading approach require extra time in order to perform a fair assessment of the completed work.

**Project:**
This course also includes a project that will require successful students to survey current literature and to analyze a problem. The project consists of carrying out a short research project throughout the course. For this project, students need to identify some topic related with the cyber-physical nature of modern power systems and study it throughout the course.
The project is divided in three phases:

2) Second phase. Due date: Dec. 1. Submission of a short paper (the report), at most 10 pages long, single column.
3) Presentation phase: Each student will present their project to the class during the last week of classes. The format of the presentation will be discussed during the semester.

**Participation:**
Participation points are assigned at instructor’s discretion based on the perceived attitude of individual students towards learning during the semester.

**Submission of completed assignments and communications**
Since this is a course with a distant learning component and just to be a little more friendly with the environment, please, submit all of your assignments electronically in CourseWeb/Blackboard in a single **pdf** file. In case you have some trouble submitting the document with CourseWeb/Blackboard, you can
alternatively send me a message with the pdf file attached. Very important: when sending me a message related with this course via email start your Subject line with “ECE-3795 F15:”

Class presentations and homework assignments will be posted in both CourseWeb/Blackboard and the course website. Announcements will be posted in the course website and in most cases in CourseWeb/Blackboard, too. So, please, check both CourseWeb/Blackboard and the class website regularly for information, class notes and homework assignments.

**Disclaimers:**
Although unlikely, this syllabus and course topics may change according to my judgment as to what is best for the class. Any changes will be declared in class. For example, due to the particular nature of my research I may need to travel to disaster areas on short notice. Although I will communicate these trips in advance along with any potential changes that these trips may cause, it is not possible to know at this time when those trips may occur. General course schedule and administrative deadlines follow the University of Pittsburgh Academic Calendar 2015-2016 found at http://www.provost.pitt.edu/documents/Academic%20Calendar%202015-2016_Final.pdf

**University Policies:**

*Academic Integrity*
University official statement: Students in this course will be expected to comply with the University of Pittsburgh's Policy on Academic Integrity (http://www.provost.pitt.edu/info/ai1.html). Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process, initiated at the instructor level, as outlined in the University Guidelines on Academic Integrity. This may include, but is not limited to, the confiscation of the examination of any individual suspected of violating University Policy. Furthermore, no student may bring any unauthorized materials to an exam, including dictionaries and programmable calculators.

My additional statements: Each student in this course is expected to abide by this Academic Integrity Policy. Any work submitted by a student in this course for academic credit will be the student's own work. A good explanation of what constitutes plagiarism can be found in the following IEEE’s web page: http://www.ieee.org/publications_standards/publications/rights/ID_Plagiarism.html. Notice that paraphrasing could be considered a case of plagiarism. Finally, please be wise. Dishonesty is never worth it.

*Disability Services*
If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and Disability Resources and Services (DRS) (http://www.drs.pitt.edu/), 140 William Pitt Union, (412) 648-7890, drsrecep@pitt.edu, (412) 228-5347 for P3 ASL users, as early as possible in the term. DRS will verify your disability and determine reasonable accommodations for this course.

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Additional personal notice: I will post class presentations both in CourseWeb/Blackboard and the class website. The latter is open to the outside world but it is also a convenient way for students to access these class notes. Still, this material is copyrighted and protected according to the above notice. Other material, such as papers or class notes will only be shared in CourseWeb/Blackboard. In addition of being copyrighted, this material is only intended for students taking this course, so, please, do not distribute it or post it in the “outside world” as it is indicated in the above statement.

*Statement on Classroom Recording*
To ensure the free and open discussion of ideas, students may not record classroom lectures, discussion and/or activities without the advance written permission of the instructor, and any such recording properly approved in advance can be used solely for the student’s own private use.