University of Central Florida
College of Engineering and Computer Science
Department of Electrical and Computer Engineering

EEE 6712:
"Modeling and Analysis of Networked Cyber-Physical Systems"

Spring 2018 – 3 Credit Hours

Instructor

Dr. Yaser Fallah
HEC 355,
407-823-4182
Yaser.Fallah@ucf.edu

Office Hours

Tu,Th 12:30pm -1:25pm

Class Time

Tu,Th 1:30PM - 2:45PM

Class Location

BA1 O216A or online

Class sections

EEE 6712 - Modeling and Analysis of Networked Cyber-Physical Systems

Class	Section	Days & Times	Room	Instructor	Meeting Dates
20582	0R01-LEC Regular	TuTh 1:30PM - 2:45PM	BA1 O216A	Yaser Pourmohammadi Fallah	01/08/2018 - 05/01/2018

Class	Section	Days & Times	Room	Instructor	Meeting Dates
20583	0V71-LEC Regular	Online	Online	Yaser Pourmohammadi Fallah	01/08/2018 - 05/01/2018

Class	Section	Days & Times	Room	Instructor	Meeting Dates
20584	0V83-LEC Regular	Online	Online	Yaser Pourmohammadi Fallah	01/08/2018 - 05/01/2018

Prerequisites

Graduate standing in CECS. Preferred (not required): Signals and Systems, Communication networks (an undergraduate course), a basic knowledge of control/systems theory is also desired. Familiarity with MATLAB (for course project).

Textbook

- Introduction to Embedded Systems: A Cyber-Physical Systems Approach - (required, available online - free), http://leeseshia.org/
- Data Networks (Bertsekas and Gallager) – required, available online – free: http://web.mit.edu/dimitrib/www/datanets.html
- Hybrid Systems: Modeling, Analysis and Contrl – required, available online at http://inst.cs.berkeley.edu/~ee291e/sp09/handouts/book.pdf
- Lecture Notes

Course Description

Study of networked Cyber-Physical Systems (CPS), defined as cyber (computing/communication) systems that are embedded in the physical world and interact with it; examining design and modeling concepts, communication networks, and sensing and control

architectures for cyber-physical systems such as intelligent transportation networks, smart grid, and industrial control systems; an overview of system modeling techniques from hybrid systems to stochastic modeling, application of wireless networks, control theory, and embedded system design concepts in emerging "connected vehicles" or "smart grid".

Learning Outcomes

- Understand the complexities of design and analysis of CPS.
- Learn modeling techniques for complex CPS networks
- Apply networking, control, and systems theories to the design of networked systems such as connected vehicle, industrial networks, or smart grid.

Grading

Homework (2)	30%
Seminars (1 or 2)	15%
Midterm Exam (take-Home)	25%
Term Project Report	30%

Semester Grade

$92 \le A \le 100$
$80 \le B < 90$ A- >90, B+ >85
$70 \le C < 80$ B- >77
$60 \le D < 70$
$F < 60$

Class Policy

- ✓ General: Attendance at lecture is expected. If you miss a class, you are responsible for all assignments and material covered. You are required to participate in all class discussions. You will be required to answer questions or discuss your solutions in class. You must maintain good class notes and should review all past materials covered before attending a class.

- ✓ Homework Assignments: There will be 2-3 Homework assignments during the semester. Typically problems will be assigned in class. These exercises are to help you determine your level of mastery of knowledge presented in class.

- ✓ Term Paper: The term paper will be a report on a project that each student is expected to complete during the semester. The grading will be based on the thoroughness of the work in several areas: search of research topics, understanding the technical papers, and exploring new solutions.

- ✓ Seminars: Students are expected to present three 20-30 minute seminars in class. The aim is to evaluate their level of mastery of the research methods thought in class. Evaluation will not be based on presentation skills. The first seminar is expected to be on a general topic and include literature survey. The second and third seminars will focus on the term project, covering design methodologies, and evaluation and testing.

- ✓ Help in Learning: If you attended the lectures and did not understand any material, see the instructor promptly – before the next lecture. If you did not attend the class, first obtain the notes from your classmates, review the material, and then promptly see your instructor.

- ✓ Plagiarism: Plagiarism will be severely penalized according to UCF rules and may result in an F grade for the course or receive no credit for the specific test or project. Students are expected to

exhibit the same level of professionalism and integrity that will distinguish them in their future careers. Both the person who reproduced in whole or in any part from the work of others and the person who allowed the work to be copied will be penalized. Consequences and procedures for dealing with cases of academic dishonesty are outlined in the UCF Student Code of Rights and Responsibilities.

- ✓ Inclusivity: The University of Central Florida community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion. If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with the Office of Disability Services.

Tentative Lecture Schedule and Topics

Modeling and Analysis of Networked Cyber-Physical Systems
The course focuses on the emerging cyber systems that interact with the physical world. These systems are called Cyber-Physical Systems (CPS). Examples of such systems include emerging intelligent transportation systems (ITS) that use new communication and sensing technologies to improve safety and efficiency of transportation, distributed networked systems that will control the smart grid. The objective of the course is to educate students on how to approach the design and analysis of complex cyber-physical systems. The course studies CPS at two levels: overall system design, and component level design. The aim is to educate students on the system design methodology and modeling on one hand and sensing/ computing/ communication technologies on the other hand. Students will learn about emerging interdisciplinary fields related to CPS (such as ITS or Smart Grid) and how they can prepare to tackle the challenges that CPS poses. They will learn about applications of wireless networks, embedded systems and control theory in the emerging complex system such as connected vehicles and smart grid.

Course format:
Lectures every week, plus 3 seminar presentations by students.

Order of Topics covered:

Examples of cyber-physical systems
- Intelligent Transportation Systems (Autonomous driving, collision avoidance, efficiency)
- Smart Grid
- Industrial Control

CPS as a System
- An overview of modeling techniques

CPS components
- Sensing Technologies
  - Positioning
  - Sensors and Sensor Networks
- Networking Technologies
  - Internet
  - Industrial Networking (CAN, BacNet)
  - Wireless Networks
- Control Architectures
  - SCADA
  - Distributed Control

Modeling CPS: Components and System
- Modeling Physical aspects of a CPS
- Modeling Cyber aspects of a CPS
  - Computing
  - Communication/Networking
- Modeling a CPS
  - Hybrid Systems
  - Stochastic Hybrid Systems
  - Interaction of Components
  - System validation, certification

Note: