

Course Outline

1. Document Information

Degree Program	Computer Science
Course Number	CS 431
Course Title	Cyber-Physical Systems
Semester Hours	3
Course Coordinator	Henry Hexmoor
Revision Term	Summer 2020
Latest Revision	Summer 2020

2. Catalog Description

The goal of this course is to introduce and develop an understanding of the computing and communication for Internet of Things as a subset of CyberPhysical systems. Connectivity among devices in our daily lives such as WiFi-enabled thermostats, smart grids, and driverless cars is ushering in an era of sociality that transcends human social networks to machine-to-machine networks.

3. Textbooks

- Alur, R. (2015). Principles of Cyber-Physical Systems. MIT Press.

4. References

- Lee, E. & Sanjit A. (2016). Introduction to Embedded Systems: A Cyber-Physical Systems Approach. MIT Press.
- Tabuada, P. (2009). Verification and Control of Hybrid Systems: A Symbolic Approach, Springer-Verlag.

5. Course Learning Outcomes

- Learn the fundamentals of mathematical modeling of CPS.
- Familiarize with the spectrum of analysis, testing and verification methods for CPS.
- Gain basic understanding of algorithms for automatic synthesis and control of CPS.

- Familiarize with modeling and simulation tools utilized in both research and industry.

6. Assessment of the Contribution to Student Outcomes

Outcome	1	2	3	4	5	6
Assessed	X	X	X	X	X	X

7. Prerequisites by Topic

CS 330 with a grade of C or better or graduate standing.

8. Major Topics Covered in the Course

- Modeling (15 lectures):
 - Discrete State Models
 - Discrete State Models with Simulink/Stateflow
 - Hierarchical State Machines
 - Continuous System Modeling
 - Timed Automata
 - Hybrid Automata
- IoT (5 lectures):
 - Network Protocols
 - Wireless Sensor Networks
 - Mobile Networking
- Analysis (10 lectures):
 - Safety Properties for CPS
 - State-Space Exploration
 - Symbolic Verification Methods
 - Analysis of Properties of Continuous Systems
 - Reachability Analysis for Hybrid Automata
 - Temporal Logics for Verification of CPS
- Synthesis and Control (10 lectures):
 - Temporal Logic Parameter Mining and Synthesis
 - Temporal Logic Synthesis
 - Model Predictive Control