Course Number	CS 431	Course Title	Cyber-Physical Systems
Semester Hours	3	Course Coordinator	Henry Hexmoor
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 Cyber-Physical systems. Connectivity among devices in our daily lives such as WiFi-enabled thermostats, smarts grids, and driverless cars is ushering in an era of sociality that transcends human social networks to machine to machine networks.		

Textbooks

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

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.

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

Assessment of the Contribution to Student Outcomes

Outcome →	1	2	3	4	5	6	7
Assessed →	X	X	X	X	X	X	X

Prerequisites by Topic

CS 306 with a grade of C or better or graduate standing

Major Topics Covered in the Course

1. **Modeling (15 lectures)**:
   - Discrete State Models
   - Discrete State Models with Simulink/Stateflow
   - Hierarchical State Machines
   - Continuous System Modeling
   - Timed Automata
   - Hybrid Automata
2. **IoT (5 lectures)**:
   - Network Protocols
   - Wireless Sensor Networks
   - Mobile Networking
3. **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
4. **Synthesis and Control (10 lectures):**
   - Temporal Logic Parameter Mining and Synthesis
   - Temporal Logic Synthesis
   - Model Predictive Control

NOTE: When course is taken as 500-level credit (CS 591 "Special Topics"), there will be additional requirements such as a research project.

Latest Revision: Summer 2020