

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, Rajeev. <i>Principles of cyber-physical systems</i> . MIT Press, 2015.							
References							
<ul style="list-style-type: none"> • Lee, Edward Ashford, and Sanjit A. Seshia. <i>Introduction to embedded systems: A cyber-physical systems approach</i>. MIT Pres, 2016. (Free to download) • Tabuada, P. <i>Verification and control of hybrid systems: a symbolic approach</i>, Springer-Verlag 2009. 							
Course Learning Outcomes							
<ul style="list-style-type: none"> • 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	
Assessed →	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