

<b>Course Number</b>	<b>CS 431</b>	<b>Course Title</b>	<b>Cyber-Physical Systems</b>			
<b>Semester Hours</b>	<b>3</b>	<b>Course Coordinator</b>	<b>Henry Hexmoor</b>			
<b>Catalog Description</b>	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, smart grids, and driverless cars is ushering in an era of sociality that transcends human social networks to machine to machine networks.					
<b>Textbooks</b>						
Alur, R. (2015). <i>Principles of Cyber-Physical Systems</i> . MIT Press.						
<b>References</b>						
<ul style="list-style-type: none"> <li>• Lee, E. &amp; Sanjit A. (2016). <i>Introduction to Embedded Systems: A Cyber-Physical Systems Approach</i>. MIT Press.</li> <li>• Tabuada, P. (2009). <i>Verification and Control of Hybrid Systems: A Symbolic Approach</i>, Springer-Verlag.</li> </ul>						
<b>Course Learning Outcomes</b>						
<ul style="list-style-type: none"> <li>• Learn the fundamentals of mathematical modeling of CPS</li> <li>• Familiarize with the spectrum of analysis, testing and verification methods for CPS</li> <li>• Gain basic understanding of algorithms for automatic synthesis and control of CPS</li> <li>• Familiarize with modeling and simulation tools utilized in both research and industry</li> </ul>						
<b>Assessment of the Contribution to Student Outcomes</b>						
<b>Outcome →</b>	1	2	3	4	5	6
<b>Assessed →</b>	X	X	X	X	X	X
<b>Prerequisites by Topic</b>						
CS 330 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