Embedded and Cyber-Physical Systems (ECPS)

Courses

ECPS 202. Cyber-Physical Systems Design. 4 Units.
Requirements and specification, models of computation, tools, design, merging cyber and physical, data-driven modeling for edge artificial intelligence systems, cyber-physical examples. Design process, specification, requirements, modeling, components, selection, interfaces, system structure, different levels, verification, testing.

Restriction: Graduate students only.

ECPS 203. Embedded Systems Modeling and Design. 4 Units.
Embedded systems definition, system-level specification, models and languages. Concepts, requirements, examples. Embedded system models at different levels of abstraction. Test benches, design under test, IP components. Discrete event simulation, semantics, and algorithms.

Restriction: Graduate students only.

ECPS 204. Embedded System Software. 4 Units.
Embedded system software requirements, concepts, and examples for applications in the cyber-physical domain. Embedded operating systems, real-time system software (RTOS), I/O software. Multithreading. System software for power and energy management, and middleware.

Restriction: Graduate students only.

ECPS 205. Sensors, Actuators, and Sensor Networks. 4 Units.
Fundamental principles and applications of sensors, actuators. Smart sensors and microsensor/microactuator array devices. Introduction to signal processing and sensor/actuator networks, deployment and architecture, wireless communication, multiple access control layer, data gathering, routing and querying, collaborating signal processing.

Restriction: Graduate students only.

ECPS 206. Real-Time and Distributed Systems. 4 Units.
Time dependent systems, clock synchronization, real-time communication protocols, specification of requirements, task scheduling. Validation of timelines, real-time configuration management. Middleware architecture for distributed real-time and secure services.

Restriction: Graduate students only.

ECPS 207. Security and Privacy in Cyber-Physical Systems. 4 Units.
Embedded and cyber-physical systems security: attacks and countermeasures, authentication, identification, confidentiality, data integrity, authorization, access control, security protocols. Privacy awareness and mitigation. Side-channel attacks and defenses. Applications of public key and symmetric cryptography, digital certificates, credentials.

Restriction: Graduate students only.

ECPS 208. Control Systems for Cyber-Physical Systems. 4 Units.
Dynamic models, from first principles or via identification. Concepts in control (stability, controllability, observability). Control design (continuous times) and digital implementation. Introduction to optimization and direct discrete time control. Multi-agent systems, their control and implementation related concepts.

Restriction: Graduate students only.

ECPS 209. Cyber-Physical Systems Case Studies. 4 Units.
Covers CPS case studies in applications such as (but not limited to): automotive and transportation, manufacturing, power distribution grid, medical and healthcare, robotics, civil infrastructure, avionics.

Restriction: Graduate students only.

ECPS 210. Cyber-Physical Systems Project. 4 Units.
Students are required to complete a project that deals with a specific emphasis of Cyber-Physical Systems, such as (but not limited to): automotive, transportation, manufacturing, power grid, medical healthcare, robotics, civil infrastructure, avionics.

Prerequisite: ECPS 202 or ECPS 203 or ECPS 216

Repeatability: May be taken for credit 3 times.

Restriction: Graduate students only.
ECPS 211. Machine Learning and Data Mining. 4 Units.
Introduction to principles of machine learning and data-mining. Learning algorithms for classifications, regression, and clustering. Emphasis is on discriminative classification methods such as decision trees, rules, nearest neighbor, linear models, and naive Bayes.

Restriction: Graduate students only.

ECPS 212. Entrepreneurship for Scientists and Engineers. 4 Units.
Real-world introduction to the theory and practice of entrepreneurship. Explores organizational, strategic, and financial challenges; start-up strategies; business-idea evaluation; and business-plan writing. Presentations by prestigious entrepreneurs and industry leaders.

Restriction: Graduate students only.

ECPS 216. Internet of Things Systems and Software. 4 Units.
Internet of Things (IoT) concept, sensors and actuators, serial protocols, network and communication protocols and programming, IoT platforms, real-time performance, middleware architecture for IoT, edge and cloud support for IoT applications.

Restriction: Graduate students only.

ECPS 295. Special Topics in CPS. 1-4 Units.
Studies in selected areas of CPS. Topics addressed vary each quarter.

Repeatability: Unlimited as topics vary.

Restriction: Graduate students only.

ECPS 299. Individual Research. 1-12 Units.
Individual research or investigation under the direction of an individual faculty member.

Repeatability: May be repeated for credit unlimited times.

Restriction: Graduate students only.