Embedded and Cyber-Physical Systems (ECPS)

Courses

ECPS 202. Cyber-Physical Systems Design. 4 Units.
Requirements and specification, MoCs, tools, design, merging cyber and physical, manufacturing, examples (robots, energy house, self-driving car, pacemaker...). Design process, specification, requirements, modeling, components, selection, interfaces, system structure, different levels, verification, testing.

Prerequisite: ECPS 205 and ECPS 206

ECPS 203. Embedded Systems Modeling and Design. 4 Units.
Embedded Systems definition, specification, and languages. Concepts, requirements, examples. Embedded system models at different abstraction levels. Test benches, design under test, Intellectual Property components. Discrete event simulation, semantics, algorithms. Design, analysis techniques for decentralized computer architectures, communication, and hardware-software systems.

ECPS 204. Embedded System Software. 4 Units.
Embedded system software concepts, requirements, examples, for engineering applications such as multi-media and automotive. Software methodology. Specification, design constraints. Embedded operating systems. Input/output, interrupt handling. Code generation, compilation, instruction set simulation. Distributed object model, distributed environment, platform-independent software agents, components.

Prerequisite: ECPS 203

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.

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.

ECPS 207. Security and Privacy in Cyber-Physical Systems. 4 Units.
ES and CPS security: attacks and countermeasures, authentication, identification, confidentiality, data integrity, authorization, access control, malware attacks and counter-measures, security protocols. Privacy issues e.g., vehicular devices and smart metering. Applications of public key and symmetric cryptography, e.g., digital certificates, credentials.

Prerequisite: ECPS 205

ECPS 208. Control Systems for Cyber-Physical Systems. 4 Units.
State space representation (continuous and discrete), principles of optimization, model predictive control, robustness to actuation or communications limitations, control of networked systems, multi-agent co-operation and control.

Prerequisite: ECPS 205

ECPS 209. Cyber-Physical Systems Case Studies. 4 Units.
Seminar course covering 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.

Prerequisite: ECPS 202

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 and ECPS 204 and ECPS 209

Repeatability: May be taken for credit 3 times.