SYSTEMS ENGINEERING (SE)

SE 5000. Introduction to Systems Engineering. (3 Credits)
Introduction to the hard and soft skills that are required of good systems engineers. Lectures follow the competency models for systems engineers and include topics such as systems thinking, needs identification, requirements formulation, architecture definition, technical management, design integration, as well as verification and validation of designs. Some of the key systems engineering (SE) standards will be covered and the roles of organizations in enabling engineers to develop systems will be explored. Applications of SE concepts and tools in various settings will be discussed through examples and case studies. Students will learn to apply the SE methodologies in modern complex system development environments such as aerospace and defense, transportation, energy, communications, and modern software-intensive systems.
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SE 5001. Model-Based Systems Engineering. (3 Credits)
Provides students with the foundations of model-based systems engineering. Students will develop skills in the areas of fundamental logical, behavioral, and physical representations of engineered cyberphysical systems. Topics include software and systems requirements engineering, interface design and modeling, system architecting, system verification and testing, and system simulation. Emphasis is placed on modeling cyberphysical systems using modern MBSE principles, methods, and tools. Examples include a water distiller, a residential security system, an automobile, an elevator, and a geospatial library for the demonstration of the theoretical and practical aspects of systems modeling. Designed for all graduate students pursuing graduate certificates and degrees in an engineering discipline.
Enrollment Requirements: Undergraduate degree in engineering or science.
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SE 5095. Special Topics. (1-3 Credits)
General topics in systems engineering.
May be repeated for a total of 15 credits
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SE 5101. Foundations of Physical Systems Modeling. (3 Credits)
Provides students with the foundations of physical systems modeling and computational methods for performance analysis. Students will develop skills in the areas of fundamental physical and mathematical representations of fluid dynamics, thermodynamics, heat transfer, and electro-mechanics. Introduction to concepts on how systems can be architected and designed with the aid of models. Topics include system and component requirements specification, creation of system models for design and control analysis of physical systems. Emphasis is placed on the modeling of such systems in the equation oriented programming environment of the Modelica language, and the utilization of these system models within the Functional Mockup Interface for co-simulation and Model Exchange. Examples of Aircraft Environmental Control, Chiller Systems and Plants, Engine Fuel Systems, Variable Frequency Drives and Electric Machines are used for the demonstration of the theoretical and modeling aspects of physical system modeling.
Enrollment Requirements: Recommended preparation: Undergraduate degree in ME, CHEG and Modelica Software.
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SE 5102. Uncertainty Analysis, Robust Design, and Optimization. (3 Credits)
This course provides students with a thorough understanding of mathematical optimization and uncertainty analysis for the robust design of cyber-physical systems. Topics include optimization theory and practice, uncertainty modeling, sensitivity analysis, and formal and classical model-based robust design methodologies.
Enrollment Requirements: Recommended preparation: competency in numerical analysis and programming language (MATLAB).
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SE 5201. Embedded/Networked Systems Modeling Abstractions. (3 Credits)
Familiarizes students with design flows for designing, implementing and verifying embedded systems, and to provide skills necessary to specify requirements and perform platform-based design, analysis and modeling of embedded and networked systems. These models will be motivated by applications which demonstrate embedded systems design challenges of satisfying time-critical, event-driven, and data-centric requirements. Students will be cognizant of the role of embedded controllers and devices in the system design process, as they relate to event-driven and data-driven systems, and supervisory control of hybrid (continuous and discrete-time) systems. This will include exposure to platform-based design principles with an emphasis on requirements capture and refinement to platform architecture mapping, analysis and verification. Students will learn the technical aspects of modeling principles relevant to embedded systems, specifically modeling system architecture, system functions, computation, software, real-time systems, and distributed systems.
Enrollment Requirements: Recommended preparation: Background in hardware and/or software design. Not open to students who have passed SE 5301.
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SE 5202. Foundations of Control. (3 Credits)
Familiarizes students with system design flows used for designing, implementing and verifying control systems and to provide skills necessary to design and analyze practical regulatory controllers for Cyber-Physical systems. Successful students will be cognizant of the role of controls in the system design process and will be proficient in specifying control system requirements, especially as they relate to attenuation of load disturbances, robustness to dynamic system model uncertainty, actuator nonlinearities, and measurement noise; knowledgeable of the distinctions between modeling systems for control and understanding the fundamental limits of regulatory control systems; knowledgeable of the role of control architectures for regulatory controllers, including sensor selection and sizing of actuators; aware of practical control design methods focusing on PID controllers; controller implementation, validation, testing, diagnostics and tuning. Use of computer-aided engineering tools (Dymola, MATLAB/Simulink) in the design flows for control of cyber-physical systems is emphasized.
Enrollment Requirements: SE 5101. Recommended preparation: undergraduate course in systems analysis.
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SE 5402. Architecture of Internet of Things. (3 Credits)
(Also offered as CSE 5312.) This course is designed to provide students and professional engineers with a thorough understanding of the design, development, validation and evaluation of IoT systems, especially in industrial domains with stringent timing and performance requirements. The student will develop skills in specifying the requirements for the target IoT systems, selecting the appropriate hardware and software platforms, and validating and evaluating the system performance. Special emphasis will be placed on the semester-based industrial projects that will be designed from selected industrial domains to address real-life problems.
Enrollment Requirements: Open to graduate students in the SE (Advanced Systems Engineering), CSE (Computer Science and Engineering), and ECE (Electrical and Computer Engineering) programs, others with consent. Recommended preparation: An undergraduate degree in electrical engineering, computer engineering, or computer science or completed a graduate level course in embedded or network systems.
View Classes (https://catalog.uconn.edu/course-search/?details&code=SE%205402)

SE 5502. Capstone Projects for Systems Engineering. (3 Credits)
This project course is designed to provide students with a thorough understanding of cyber-physical systems modeling and design through a comprehensive capstone project. These projects will be practical and relevant to industry needs. Students submit a Project Proposal before registering for the course, and develop the proposal with feedback from a faculty member. The graduate student is expected to spend the same amount of time for the project course as any other graduate three-credit course in systems engineering.
Enrollment Requirements: SE 5001 or 5101 or 5102. Not open for credit to students who have passed SE 5195.
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SE 5602. Machine Learning for Physical Sciences and Systems. (3 Credits)
(Also offered as CSE 5602.) Foundational knowledge in applied aspects of machine learning, including methods for handling uncertain, small, and imbalanced data; feature selection and representation learning; and model selection and assessment. Students will also gain exposure to state-of-the-art research on interpretability of machine learning models, stability of machine learning algorithms, and meta-learning. Topics will be discussed in the context of recent advances in machine learning for materials, chemistry, and physics applications, with an emphasis on the unique opportunities and challenges at the intersection of machine learning and these fields.
Enrollment Requirements: Open to graduate students in Computer Science and Engineering, MEng in Advanced Systems Engineering, and MEng in Data Science, others with department consent. Recommended prep: Basic concepts in machine learning, linear algebra, optimization, statistics.
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SE 5702. Data Science for Materials and Manufacturing. (3 Credits)
(Also offered as ME 5702.) This course will provide students with data analytics skills for knowledge discovery and design optimization. The students will also learn how to apply data mining and machine learning techniques to tackle the challenges in manufacturing and computational materials engineering. Topics include basic concepts of supervised/unsupervised learning, design of experiments and data collection, material image processing, surrogate modeling, optimization and model calibration, multi-fidelity modeling, and applications of data analytics in manufacturing and computational materials engineering problems.
Enrollment Requirements: Undergraduate degree in engineering or computer science, departmental or unit consent required. Recommended preparation: Knowledge or coursework in probability and statistics. Ability to read, interpret and modify Python and MATLAB code. Ability to use Python and MATLAB for analyzing data for the course project.
View Classes (https://catalog.uconn.edu/course-search/?details&code=SE%205702)

SE 5832. Embedded/Networked Systems Modeling Abstractions. (3 Credits)
(Also offered as CSE 5832.) Students will become cognizant of the role of embedded controllers and devices in the system design process, as they relate to event-driven and data- driven systems, and supervisory control of hybrid (continuous and discrete-time) systems. This will include exposure to platform-based design principles with an emphasis on requirements capture and refinement to platform architecture mapping, analysis and verification. Students will learn the technical aspects of modeling principles relevant to embedded systems – specifically modeling system architecture, system functions, computation, software, real-time systems, and distributed systems. Use of software engineering tools (Rhapsody, Simulink, Stateflow and Simulink/MATLAB coder) in the embedded system design flows is emphasized.
Enrollment Requirements: Open to graduate students in the CSE program, others with consent.
View Classes (https://catalog.uconn.edu/course-search/?details&code=SE%205832)