SYSTEMS SCIENCE (SYS)

Courses in systems science (SYS) are offered by the Faculty of Engineering

SYS 5100 Systems Engineering (3 units)

Controllability and observability, Euler-Lagrange equations, Pontryagin maximum principle, dynamic programming, linear quadratic regulator problem, matrix Ricatti differential equations and properties of their solution, design of optimal regulator based on steady state solution of the Ricatti differential equation, time optimal control, LaSalle bang-bang principle, applications to motor speed control, satellite attitude control, etc.

Course Component: Laboratory, Lecture, Tutorial

SYS 5110 Foundation of Modelling and Simulation (3 units)

Fundamental aspects of systems modelling and the simulation process. Elements of continuous system simulation. Issues relating to the numerical solution of ordinary differential equations. Elements of discrete event simulation Generation of random numbers and variates. Simulation validation and quality assurance. Introduction to simulation languages.

Course Component: Lecture

SYS 5120 Applied Probability (3 units)

An introduction to stochastic processes, with emphasis on regenerative phenomena. Review of limit theorems and conditioning. The Poisson process. Renewal theory and limit theorems for regenerative processes; Discrete-time and continuous-time Markov processes with countable state space. Applications to queueing.

Course Component: Lecture

SYS 5130 Systems Optimization and Management (3 units)

Analysis of user requirements and model design. Data mining. Use of optimization software. Systems thinking and its application to economic systems and hierarchical systems. Applications to economic systems simulation, modeling, optimization and management.

Course Component: Lecture

SYS 5140 Economic System Design (3 units)

Introduction to the epistemology of systems thinking and its application to economic systems. Basic concepts of complex systems thinking including hierarchical systems and economic systems simulation and behaviour. Soft systems thinking. Examples from other fields of application will be reviewed from an interdisciplinary perspective.

Course Component: Lecture

SYS 5160 Systems Integration (3 units)

Planning, design of complex systems from continuous to discrete time. Synthesis of systems methodology. State estimation. Parameters identification. Discretization and stochastic effects. Dynamic, logic control. Modelling, discrete event, simulation examples.

Course Component: Lecture

SYS 5170 Essential Concepts in Data Science (3 units)

An introduction to the foundations of data science using a case study approach; overview of the data science process: types of tasks and models, data manipulation, exploratory data analysis, data summarization and data visualization; predictive modeling, descriptive modeling; reporting and deployment.

Course Component: Lecture

The courses CSI 4142, DTI 5125, DTI 5126, MAT 4373, IAI 5120 and SYS 5170 cannot be combined for units.

SYS 5180 Mathematics for Artificial Intelligence (3 units)

Mathematical foundations (algebra, statistics) of modern artificial intelligence applicable to machine learning, deep learning, vision, natural language and speech processing. Eigenvectors and Eigenvalues. Single Value Decomposition. Principal Component Analysis. Vector/Matrix Calculus. Gradient Algorithms. Common Distributions. Maximum Likelihood Estimation. Entropy and Cross Entropy. Kullback Leibler Divergence. Viterbi Algorithm.

Course Component: Lecture

SYS 5185 Foundations and Applications of Machine Learning (3 units)

The capabilities and limitations of machine learning; problem formulation; supervised and unsupervised learning techniques; deploying, monitoring, and evaluating machine learning models; storytelling and assessing the results of learning; current advances in application areas such as business, law, arts, social sciences and education.

Course Component: Lecture

The courses CSI 5155, ELG 5255, IAI 5100, IAI 5101, MIA 5100 and SYS 5185 cannot be combined for units.

SYS 5186 Topics in Systems Engineering (3 units)

Recent and advanced topics in the field of Systems Engineering and its related areas. Topics vary from year to year.

Course Component: Lecture

SYS 5187 Topics in Artificial Intelligence (3 units)

Recent and advanced topics in the field of Artificial Intelligence and its related areas. Topics vary from year to year.

Course Component: Lecture

SYS 5190 Directed Readings in Systems Science (3 units)

Directed Readings in Systems Science

Course Component: Research

Courses SYS 5190, SYS 5975 cannot be combined for units.

SYS 5295 Ethics for Design, AI, and Robotics (3 units)

The interplay between Artificial Intelligence, society, the law, and ethics; the course will explore how advances in Artificial Intelligence affect the law and other social institutions, and, conversely, how societal, legal, and ethical considerations affect the development and deployment of Artificial Intelligence technologies.

Course Component: Lecture

The courses CSI 5195, DTI 5310, DTO 5310, ELG 5295, IAI5 130 and SYS 5295 cannot be combined for units.

SYS 5975 Projet en génie des systèmes / Project in Systems Engineering (6 crédits / 6 units)

Volet / Course Component: Recherche / Research

Les cours SYS 5190, SYS 5975 ne peuvent être combinés pour l'obtention de crédits. / Courses SYS 5190, SYS 5975 cannot be combined for units.