The following courses are offered by Telfer School of Management.

**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
The following courses are recommended as prerequisites: CSI 1100, MAT 2341, (MAT 2324 or MAT 2331), MAT 2371, MAT 2375.

**SYS 5110 Foundation of Modelling and Simulation (3 units)**

**Course Component:** Lecture
The following courses are recommended as prerequisites: CSI 1100, MAT 2341, (MAT 2324 or MAT 2331), MAT 2371, MAT 2375.

**SYS 5111 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 4145, CSI 5155, ELG 5255, IAI 5100, SYS 5111 cannot be combined for units.

**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
The following courses are recommended as prerequisites: CSI 1100, MAT 2341, (MAT 2324 or MAT 2331), MAT 2371, MAT 2375.

**SYS 5122 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, SYS 5122 cannot be combined for units.

**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
The following courses are recommended as prerequisites: CSI 1100, MAT 2341, (MAT 2324 or MAT 2331), MAT 2371, MAT 2375.

**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
The following courses are recommended as prerequisites: CSI 1100, MAT 2341, (MAT 2324 or MAT 2331), MAT 2371, MAT 2375.

**SYS 5160 Systems Integration (3 units)**

**Course Component:** Lecture
Prerequisites: 6 course units from SYS 5100, SYS 5110, SYS 5120, SYS 5130, SYS 5140.

**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)**
Artificial Intelligence technologies are becoming ever more present in applications like: automated vehicles and mobility-as-a-service (e.g. driving and system-level control algorithms); consumer electronics (e.g. social robots and smart speakers); healthcare (e.g. image classification in medical imaging); and weapons systems (e.g. targeting and kill decision-making). Many of these applications are raising significant ethical concerns. A range of topics in applied technology ethics are examined through the lens of contemporary philosophy and applied ethics texts and popular media articles. Practical frameworks, methodologies and tools for anticipating, and addressing, ethical issues are introduced through hands-on, group-based design thinking workshops and projects.

**Course Component:** Lecture
The courses CSI 5195, DTI 5310, ELG 5295, SYS 5295 cannot be combined for units.

**SYS 5975 Projet en science des systèmes / Project in Systems Science (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.

**SYS 7990 Proposition de thèse de maîtrise / Master Thesis Proposal Volet / Course Component:** Recherche / Research

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