CU 9.12: DIGITAL ENGINEERING FOR DECISION-MAKING

Director of studies: **Patrick CHARPENTIER**

General CU objectives:

In the context of the 4th Industrial Revolution:

- Mass data of various kinds.
- Information as a key element.
- The virtual world coexists with reality.
- Rational decisions.

Engineers must continuously make decisions using information that may be incomplete or uncertain.

Decision making is a complex process requiring not only knowing the principle, taking stock of the available data, but also the methods and models that can support this process.

The first objective of this CU is to know and know how to apply the methods and tools of data collection, exploration and analysis for classification, prediction or optimisation purposes.

The second is to know how to model the behaviour of an industrial system and its decision-making support and management information systems.

Consists of:

- Part 1: Data collection, structure, description, datamining, exploration.
- Part 2: Optimisation of production and logistics systems
- Part 3: Data organisation and management
- Part 4: Evaluation by simulation of industrial systems

Hourly volume

In-person		*Self-directed study*
28.00 H	**Lectures**	**48.00 H**
0.00 H	**Tutorials**	
64.00 H	**Practicals**	

Positioning of the CU in the School reference system:

after semester 8

Units of skills

In accordance with the RNCP sheet

Updated on 31 March 2025

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Part 1: Data collection, structure, description, datamining, exploration.	**Coefficient 1**
Session leaders: Patrick CHARPENTIER, Denise CHOFFEL, Charles ROLLAND	
Teaching assistants: Julien LALLEMAND	
Prerequisites: CU 5.2 Statistics	
Teaching materials: Course notes – Presentation slides – Reading list – Arche page – Project	
Assessment methods: individual Exploration report	

Learning outcomes	**Description**	**Number of student hours (in-person)**		
		Lectures	**Tutorials**	**Practicals**
Prepare data analysis and integration into a database. Keywords: acquisition, collection, sensors, mass data	Introduction to decision-making	1.75		
	Identification of data sources (production, surveys, public access buildings, etc.). Data properties (qualitative, quantitative, incomplete, uncertain, sampled, etc.). Structuring of data. Principal component analysis to sort data. K-means to highlight data clusters.	1.75		
	Datamining, exploration, representation and selection tools	3.50		16.00
		7.00	**0.00**	**16.00**

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Part 2: Optimisation of production and logistics systems	**Coefficient 1**
Session leaders: Patrick CHARPENTIER	
Teaching assistants:	
Prerequisites: none	
Teaching materials: Course notes – Reading list	
Assessment methods: individual Practical examination	

Learning outcomes	**Description**	**Number of student hours (in-person)**		
		Lectures	**Tutorials**	**Practicals**
Know and know how to deploy rational decision-making methods that simultaneously take into account several objectives. Keywords: optimisation, decision tree.	Introduction to multi-criteria optimisation	1.75		
	Quantitative approaches	1.75		
	Qualitative approaches	1.75		
	Applications			16.00
	Restitution	1.75		
		7.00	**0.00**	**16.00**

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Part 3: Data organisation and management	**Coefficient 1**
Session leaders: Hind BRIL EL HAOUZI, Emmanuel ZIMMERMANN (ACTA Mobilier)	
Teaching assistants:	
Prerequisites: none	
Teaching materials: Course notes – Reading list	
Assessment methods: individual Practical examination	

Learning outcomes	**Description**	**Number of student hours (in-person)**		
		Lectures	**Tutorials**	**Practicals**
Understand basic patterns and models of organisation and information processing. Design and use a DBMS: Database Management System Keywords: Information system, database, SQL.	Introduction to information systems, databases.	1.75		
	Model data and its processing, create a database, and create queries to leverage it.	5.25		16.00
		7.00	**0.00**	**16.00**

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Part 4: Evaluation by simulation of industrial systems	**Coefficient 1**
Session leaders: Patrick CHARPENTIER, Hind BRIL EL HAOUZI	
Teaching assistants:	
Prerequisites: none	
Teaching materials: Course notes – Presentation slides – Reading list – Arche page – Tutorials	
Assessment methods: individual Report - Practical examination	

Learning outcomes	**Description**	**Number of student hours (in-person)**		
		Lectures	**Tutorials**	**Practicals**
Know how to represent and study the dynamic behaviour of industrial systems. Keywords: numerical model, simulation, scenarios.	Introduction to simulation, dynamic production and logistics systems and their usual classifications.	1.75		
	Performance of systems and performance indicators.	1.75		
	Dynamic systems modelling.	1.75		
	Simulation of dynamic production and logistics systems (ARENA software).	1.75		16.00
		7.00	**0.00**	**16.00**

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