
MASTER OF SCIENCE, TECHNOLOGY AND HEALTH

2022-2023

YEAR 2

INDUSTRIAL ENGINEERING

SMART AND CONNECTED ENTERPRISE

PROGRAMME SUPERVISOR(S):

Farouk BELKADI



YEAR 2 - Autumn Semester

CORE COURSES

Course code	Title	ECTS Credits
AI4IE	Artificial Intelligence for Decision Making in Industrial Engineering	5
CISE	Collaborative Information Systems in the Enterprise	4
CPPS	Integrated Design and Implementation of CPPS	4
DKIE	Data and Knowledge Integration in the Enterprise	4
IDEPSS	Integrated Design Engineering of PSS	4
MDMDS	Multicriteria Decision Making and Decision Support	5
PROJT	Project	2

LANGUAGE COURSES

Course code	Title	ECTS Credits
CCE3	Cultural and Communication English	2
ESP3	Spanish Language	2
FLE3	French Language	2

YEAR 2 - Spring Semester

CORE COURSES

Course code	Title	ECTS Credits
THESIS	Internship / Thesis project	30

Artificial Intelligence for Decision Making in Industrial Engineering [AI4IE]

LEAD PROFESSOR(S): Catherine DA CUNHA

Objectives

At the end of the course, the students will be able to understand the main applications of artificial intelligence to support decision making in industrial engineering. The course will address the problematics of decision making based on both formal and qualitative approaches.

Course contents

The key elements to be introduced in this course are the following:

- Introduction to Smart Decision Aid systems
- Big data and Data mining
- Machine learning and neural networks
- Decision tree
- Case-based reasoning

In the lab sessions, students will learn to use the relevant Python librairies

Course material

Datamining : Concepts and techniques. Han & Kamber, Morgan Kaufmann 2000

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	14 hrs	8 hrs	8 hrs	2 hrs	0 hrs

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Collaborative Information Systems in the Enterprise [CISE]

LEAD PROFESSOR(S): Farouk BELKADI

Objectives

At the end of the course (32 hours + personal work) the students will be able to:

- Understand the role of information systems (EIS) in the enterprise and their main functions
- Understand the main types and architecture of Enterprise Information Systems
- Manipulate the main functions of key types of Enterprise Information Systems
- Understand the need for customization and administration of collaborative EIS

Course contents

These introductory lectures aim to present the main functions of collaborative enterprise information systems (EIS), classified according to the main business processes of the enterprise.

An overview of main commercial ERP/PLM tools is given to clarify the scope of these tools. After this introduction, the following items will be presented in detail:

- Introduction to enterprise information systems
 - o Concepts related to enterprise information systems
 - o Types of enterprise information system
- Design of information systems for data and knowledge management
 - o Design of Service Oriented software architecture (SOA)
 - o New challenges of interoperability
- Main Functions of ERP (Enterprise Resource Planning)
 - o Marketing and sales
 - o Supply chain management
 - o Production Management
 - o Introduction to OpenERP and Sage ERP tools
- Main Functions of PLM
 - o Concept of workspace and collaborative design (notification, viewer, etc.)
 - o Data searching, where use function, connection to CAD
 - o Product configuration (eBOM - mBOM) and variant management
 - o Data-file management (volt, check-in, check-out, version, iteration)
 - o Concept of lifecycles and workflows
 - o Introduction to administration of PLM tools (team management, roles, access rights)
- Introduction to MES
 - o Principles of Manufacturing Execution Systems
 - o Creation of a customized product order

A simple use case will be conducted during the tutorials (TP) to show how different processes and data are managed and implemented in different tools.

Course material

- Product Lifecycle Management, Mariusz Cholewa, Wrocław University of Technology http://www.studia.pwr.wroc.pl/p/skrypty/14_Production%20Management%20%20W-10/03_Product%20Lifecycle%20Management.pdf
- Enterprise Resource Planning: Foundations http://www3.unipv.it/ingegneria/copisteria_virtuale/motta/doss/13-PV-DoES-03-ERP-v1.pdf
- Open ERP user guide
- Windchill user guide
- Audros user guide

- 3DExperience tutorial

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	6 hrs	0 hrs	24 hrs	2 hrs	0 hrs

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Integrated Design and Implementation of CPPS [CPPS]

LEAD PROFESSOR(S): Catherine DA CUNHA / Olivier CARDIN

Objectives

At the end of the course (30 hours + personal work) the students will be able to:

- Express the main characteristics and benefits of cyber-physical production systems
- Model a heterarchical manufacturing control architecture
- Integrate the basics of holonic paradigms
- Implement a cyber-physical production system using multi-agent technologies

Course contents

The lectures aim to introduce the following concepts:

- Systems of cyber-physical production systems;
- Heterarchical manufacturing control;
- Holonic manufacturing systems;
- Emerging behavior and bio-inspired systems;
- Cloud Manufacturing.

After an introduction lecture, practical classes will lead to a development project in full autonomy using an automated, robotized and emulated manufacturing system.

Course material

- Trentesaux, D., 2009. Distributed control of production systems. *Engineering Applications of Artificial Intelligence, Distributed Control of Production Systems* 22, 971–978.
- Cardin, O., Ounnar, F., Thomas, A., Trentesaux, D., 2017. Future Industrial Systems: Best Practices of the Intelligent Manufacturing and Services Systems (IMS2) French Research Group. *IEEE Transactions on Industrial Informatics* 13, 704–713.
- *Multiagent Systems*, 2013. G. Weiss, 2nd ed. MIT Press, Cambridge, MA, USA.
- Monostori, L., 2014. Cyber-physical Production Systems: Roots, Expectations and R&D Challenges. *Procedia CIRP, Variety Management in Manufacturing Proceedings of the 47th CIRP Conference on Manufacturing Systems* 17, 9–13.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	8 hrs	12 hrs	8 hrs	4 hrs	0 hrs

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Data and Knowledge Integration in the Enterprise [DKIE]

LEAD PROFESSOR(S): Farouk BELKADI

Objectives

At the end of the course, the students will be able to understand the meaning of the triptic: data, information and knowledge, and how these concepts are integrated and managed to support various business and technical paradigms behind the enterprise of the future.

Course contents

This course presents the fundamentals of data and knowledge management and engineering. The key elements to be introduced in this course are as follows:

- Principles of data and knowledge management
 - o Distinction between data, information and knowledge
 - o Key processes of knowledge management
- Design of data bases for data structuring
 - o Creation of a simple data base with Access
 - o Data search and queries
- Knowledge management
 - o Principle of knowledge management
 - o Traceability and reuse of experience
- Knowledge Engineering
 - o Concept of ontology (definition, meaning, and objectives)
 - o Creation of ontology with Protégé tool
 - o Reasoning on ontology with SPARQL and rules engines
- Knowledge based reasoning for decision making
 - o Principles of Fuzzy logic for decision support
 - o Introduction to case based reasoning

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	12 hrs	4 hrs	12 hrs	4 hrs	0 hrs

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Integrated Design Engineering of PSS [IDEPSS]

LEAD PROFESSOR(S): *Yasamin ESLAMI*

Objectives

The aim of this course is to show how new information and communication technologies and other industry 4.0 related technologies can improve sustainability methods and tools. Lessons learned from recent projects are summarized in order to explain how the current challenges of socio-economic sustainability are addressed in both industry and scientific fields, in the new era of enterprise of the future.

First of all, an overview will be provided on the main concepts of sustainability. The concept of sustainability in manufacturing will be explored.

The focus will be on life cycle assessment and the circular economy as key processes in manufacturing sustainability. The course will also cover how access to data and automatic processing of large datasets will contribute to improving the current practices.

At the end of the course, the students will be able to understand the main concepts and methods of integrated design and development of product service systems (PSS), from business, organizational, engineering and technological perspectives. A focus will be made, through practical case studies, on the advantage of new data driven and communication technologies to support innovative PSS business.

Course contents

The structure of this course will be divided into five main sections:

- Definition of socio-economic sustainability and related paradigms (circular economy, frugality, Product-Service systems)
- Industry 4.0 and sustainable manufacturing practices
- Innovation methods for product-service systems design (blueprinting, scenario based, etc.)
- Technological and organizational aspects related to PSS
- Product-service systems lifecycle design and management based on systems engineering

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	12 hrs	4 hrs	12 hrs	4 hrs	0 hrs

Multicriteria Decision Making and Decision Support [MDMDS]

LEAD PROFESSOR(S): Raphaël CHENOARD

Objectives

At the end of the course (30 hours + personal homework) the students will be able to:

- Understand decision problems
- Use some decision-making methods to choose a solution among others
- Solve multi-objective decision problems

Course contents

These lectures aim to present the main elements of multi-criteria decision making and decision support methods and tools:

- Introduction to decision theory
- Multicriteria decision methods (AHP, ELECTRE)
- Design of experiments
- Multi-objective optimization

Practical exercises and homework will help students to apply the learned concepts and methods.

Course material

- Saat. Fundamentals of Decision Making and Priority Theory with the Analytic Hierarchy Process (1994).
- Deb. Multi-Objective Optimization using Evolutionary Algorithms. Wiley, 2001.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	8 hrs	12 hrs	8 hrs	4 hrs	0 hrs

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YEAR 2 - Autumn Semester

Project [PROJT]

LEAD PROFESSOR(S): Farouk BELKADI

Objectives

The objectif of this transdisciplinary course is to give the students the opportunity to discover current advances in the era of the enterprise of the future and industry 4.0, within the objective of sustainability.

Course contents

Students will realize in full autonomy a literature survey on a topic of their interest from both scientific and industrial perspectives. They can based their review on webinars and journal papers.

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	2	0 hrs	0 hrs	0 hrs	24 hrs	0 hrs

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Cultural and Communication English [CCE3]

LEAD PROFESSOR(S): David TROYA

Objectives

Team-building and Communicational English:

- Understand the general concepts of team-building
- Build a team-building project
- Understand and nurture the creative process
- Enhance self-belief and self-empowerment

Behavioral skills in an inter-cultural environment:

- Strengthen self-confidence and capacity for interaction
- Develop active listening and reformulation skills
- Develop networking skills

Course contents

Cultural and Communicational English: exercises to explore in practice the areas of culture and communication
Field-related or inter-cultural project.

Course material

Written and televised press, information and digital tools, general documents business environment and company strategies.
Internet conferences (Ted Talks, etc.), our own educational materials on Hippocampus (Moodle).

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	2	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

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Spanish Language [ESP3]

LEAD PROFESSOR(S): Marta HERRERA

Objectives

For beginners:

Practice and reinforcement of the five skills (oral and written expression and comprehension as well as interaction)

Acquisition of vocabulary and linguistic structures

Be able to talk about yourself and those around you

Be able to express oneself during daily activities

Know how to give your opinion

For advanced students:

Practice and reinforcement of the five skills (oral and written expression and comprehension as well as interaction)

Acquisition of specialised vocabulary

Be able to understand the essential content of concrete or abstract subjects including a technical discussion

Be able to communicate spontaneously and fluently

Be able to express oneself in a clear and detailed manner, to express an opinion on a topical subject

Course contents

For beginners:

Personal environment (introduce yourself, express yourself, your tastes, your character, your hobbies, etc.), your surroundings (friends, family, location, climate), your interests (sports, leisure)

Present tense (regular and irregular)

Language patterns to express habit, obligation, "gustar" and its equivalents,

Possessive adjectives

Differences between "es", "está", "hay"

Use of "por" and "para"

Adverbs and frequency patterns

Numeral adjectives

For advanced students:

Knowledge of the Hispanic world (economic, technical, cultural and social environment)

Present tense (regular and irregular)

Imperative

Past tenses

Direct / indirect style

Future tense

Conditional tense

Present and past subjunctive moods

Course material

Preparation manuals, our own tailor-made documents, written and internet press, general civilization documents, digital tools

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	2	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

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YEAR 2 - Autumn Semester

French Language [FLE3]

LEAD PROFESSOR(S): *Silvia ERTL*

Objectives

The objective is to familiarize the learner with the French language and French culture through an entertaining task-based communicative language teaching, focused on speaking combined with:

- Phonetics
- Self-correcting exercises on our learning platform
- Learning Lab activities
- Project work
- Tutoring

Course objectives include the acquisition and reinforcement of vocabulary, syntax, and pronunciation by both traditional means and through the use of digital resources. Students will learn general French, develop language skills of oral and written comprehension and expression.

After completing this course (32 hours + personal work), the students will be able to communicate in spoken and written French, in a simple, but clear manner, on familiar topics in the context of study, hobbies etc. Another important goal of this course is to introduce the student to French culture.

At the end of the course, complete beginners can achieve an A1 level and some aspects of the A2 of The Common European Framework of Reference for Languages. More advanced students may aim for B1/B2 levels. Those who already completed the first year of the French course will be prepared for working in a French business environment.

Course contents

Two different tracks are proposed: track 1 for students newly arrived at Centrale Nantes and track 2 for students who have completed the first year of the French course. Track 1:

Full range of practical communication language exercises: reading comprehension, listening comprehension, written expression, oral expression.

Learners will be able to use the foreign language in a simple way for the following purposes:

1. Giving and obtaining factual information:

- personal information (e.g. name, address, place of origin, date of birth, education, occupation)
- non-personal information (e.g. about places and how to get there, time of day, various facilities and services, rules and regulations, opening hours, where and what to eat, etc.)

2. Establishing and maintaining social and professional contacts, particularly:

- meeting people and making acquaintances
- extending invitations and reacting to being invited
- proposing/arranging a course of action
- exchanging information, views, feelings, wishes, concerning matters of common interest, particularly those relating to personal life and circumstances, living conditions and environment, educational/occupational activities and interests, leisure activities and social life

3. Carrying out certain transactions:

- making arrangements (planning, tickets, reservations, etc.) for travel, accommodation, appointments, leisure activities
- making purchases
- ordering food and drink

Track 2:

This track follows on directly from the first-year French course, developing and completing the concepts studied thus far. The main themes are: housing, health and work. These topics will help prepare students for their future work environment. For example, housing is explored in the form of a search for accommodation upon arrival in a new city. Special workshops for CVs and cover letters, elevator pitches and job interviews.

Course material

Preparation manuals, our own tailor-made documents, written and televised press, internet, general civilization documents, digital tools, our own educational materials on Hippocampus (Moodle).

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	2	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

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YEAR 2 - Spring Semester

Internship / Thesis project [THESIS]

LEAD PROFESSOR(S): Farouk BELKADI

Objectives

The main goal of the Master thesis is to be initiated to a real project. So, it would necessary to:

- Be exposed to and adapt to an industrial or research environment;
- Put in practice the scientific and technical skills acquired in the previous semesters;
- Strengthen interpersonal and communication skills;
- Be part of or manage a project;
- Organize tasks, analyze results and build deliverables.

Course contents

Students should be pro-active and career-oriented in the search for their thesis/internship.

The topics are validated by the program supervisor to ensure an adequate Master level.

The thesis/internship is evaluated through the submission of a written report and an oral defense.

Course material

- Turabian Kate Larimore, Booth Wayne Clayton, Colomb Gregory G., Williams Joseph M., & University of Chicago press. (2013). A manual for writers of research papers, theses, and dissertations: Chicago style for students and researchers (8th edition.). Chicago (Ill.) London: University of Chicago Press.
- Bui Yvonne N. How to Write a Master's Thesis. 2nd ed. Thousand Oaks, Calif: Sage, 2014.
- Evans David G., Gruba Paul, et Zobel Justin. How to Write a Better Thesis. 3rd edition. Carlton South, Vic: Melbourne University Press, 2011.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	30	0 hrs	0 hrs	0 hrs	0 hrs	0 hrs