CENTRALE NANTES

MASTER OF SCIENCE, TECHNOLOGY AND HEALTH

2025-2026

YEAR 2

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INDUSTRIAL ENGINEERING

PROGRAMME SUPERVISOR(S):
Catherine DA CUNHA

YEAR 2 - Autumn Semester

CORE COURSES

Course code	Title	ECTS Credits
AIIE	Artificial Intelligence for Decision Making in Industrial Engineering	4
CPPS	Integrated Design and Implementation of CPPS	4
MDMDS	Multicriteria Decision Making and Decision Support	4
PROJCONF	Project & Conferences	4
SCHE	Shop Floor Scheduling	4
SCM	SCM	4
SUSTM	Sustainable manufacturing	4

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	Master Thesis or Internship	30

Artificial Intelligence for Decision Making in Industrial Engineering [AIIE]

LEAD PROFESSOR(S): Catherine DA CUNHA

Requirements

Basic of statistics
Basic of programming

Objectives

At the end of the course, the students will be able to understand the meaning of the tryptic: 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.
This course contributes to the Sustainable Development Goal 12 "responsible consumption and production". Using the knowledge acquired in this class, the students will be able to use the data describing the behavior of a system (a machine, a factory,...) to improve it: reduce the energy consumption, reduce the waste, increase the lifetime of the tools....

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 databases for data structuring
o Creation of a simple database 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 Protegé 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

Mikut, R., & Reischl, M. (2011). Data mining tools. Wiley interdisciplinary reviews: data mining and knowledge discovery, 1(5), 431-443.
Knowledge-based multi-level aggregation for decision aid in the machining industry
Ritou, M., Belkadi, F., Yahouni, Z., Da Cunha, C., Laroche, F., & Furet, B. (2019). Knowledge-based multi-level aggregation for decision aid in the machining industry. CIRP Annals, 68(1), 475-478.
Ferhat, M., Ritou, M., Leray, P., & Le Du, N. (2021). Incremental discovery of new defects: application to screwing process monitoring. CIRP Annals, 70(1), 369-372.

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure

Sustainable Development and Social Responsibility Positioning

This course shows how advanced data analysis can contribute to process optimization, reduced resource consumption, and the mitigation of environmental impacts.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	14 hrs	8 hrs	8 hrs	2 hrs	0 hrs

Integrated Design and Implementation of CPPS [CPPS]

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

Requirements

Basic of informations systems
Basic of production management

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

This course contributes to the Sustainable Development Goal 12 "Responsible consumption and production" by increasing the knowledge of the students about cyber-physical production systems and their impacts on the environmental and social KPI.

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.

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Responsible consumption and production

Sustainable Development and Social Responsibility Positioning

This course positions advanced manufacturing systems as key enablers of sustainable development by promoting flexible, decentralized, and adaptive production architectures that improve resource efficiency and system resilience. By addressing cyber-physical systems, it highlights how responsible digitalization can reduce environmental impact while supporting socially responsible and robust industrial operations.

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

Multicriteria Decision Making and Decision Support [MDMDS]

LEAD PROFESSOR(S): Raphaël CHENOUARD

Requirements

Python programming language

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)
- 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.

Sustainable Development Goals (SDGs) covered by this course

Decent work and economic growth / Industry, innovation and infrastructure

Sustainable Development and Social Responsibility Positioning

Multi-criteria problems and multi-objective optimization make it possible to better define the trade-offs between sustainable development objectives.

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

Project & Conferences [PROJCONF]

LEAD PROFESSOR(S): Yasamin ESLAMI

Objectives

This course aims to introduce the research context in form of conducting a literature review.
by the end of this course, the students will be able to:
- Understand what research is and how different it is from search
- Utilize databases for research like Scopus, google scholar,...
- Form a research question
- Validate and justify a research gap in the literature
- Conduct a literature review

Course contents

The content of the course and the literature review will depend on the student's interest and the master's theme.
The course will be divided into two main steps:
- Formulate the search statement
- Building a literature review on what they have found

Course material

- Michaelson, H. B. (1990). How to write & publish Engineering Papers and Reports. Oryx Press, 4041 N. Central at Indian School, Phoenix, AZ 85012.
- Gastel, B., & Day, R. A. (2016). How to write and publish a scientific paper. ABC-CLIO.

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Responsible consumption and production

Sustainable Development and Social Responsibility Positioning

This course supports sustainable development and CSR by training students in research methods and literature review to critically analyse sustainability challenges and support evidence-based, responsible decision-making.

Assessment

Individual assessment: EVI 1 (coefficient 1)

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

Shop Floor Scheduling [SCHE]

LEAD PROFESSOR(S): Catherine DA CUNHA / Maroua NOUIRI

Requirements

Basics of Computer Science and Mathematics
Basics of operation research

Objectives

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

- Understand tangible scheduling problems that occur in industry
- Formalize scheduling problems in different types of shop floor (single machine, parallel machine, flow shop, job shop, flexible job shop, etc.)
- Use dispatching rules to solve simple scheduling problems (SPT, LPT, EDD, WSPT, etc)
- Use Moore algorithm, Johnson's algorithm, etc.
- Use scheduling software (LEKIN) to solve these problems
- Schedule in the face of uncertainty (machine breakdowns, new job arrivals, etc.)

This course contributes to the Sustainable Development Goal 12 "Responsible consumption and production". With the knowledge acquired in this class, the students will be able to schedule the activity of a machine considering criteria such as human well-being, resource use and environmental impact

Course contents

The lecture aim to present the main elements of shop floor scheduling Problem:

- The scheduling function in the manufacturing process and its relation to the planning function
- The scheduling problem: Definitions - Performance measures - Models
- Scheduling problem classification (Single Machine floor, Parallel machine, Flow shop, Job Shop, Flexible Job SHop)
- Tools and techniques to solve scheduling problem
- Flow shop - The Johnson method
- Heuristics: Dispatching rules (SPT, LPT, WSPT,)
- Computational complexity
- Scheduling in the face of uncertainty: Predictive scheduling, reactive scheduling, proactive-reactive scheduling

Practical exercises and homework will help students to apply the methods learned through various case studies.

Course material

- Scheduling, Theory, Algorithms, and Systems, Michael Pinedo, 2012, Springer
- Ordonnancement, Patrick Esquirol et Pierre Lopez, 1999, Economica.

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Responsible consumption and production

Sustainable Development and Social Responsibility Positioning

This course highlights how effective production scheduling supports sustainable development by optimizing resource utilization, reducing lead times, energy consumption, and operational waste in manufacturing systems

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	8 hrs	10 hrs	12 hrs	2 hrs	0 hrs

SCM [SCM]

LEAD PROFESSOR(S): Catherine DA CUNHA

Requirements

Basics of production management

Objectives

At the end of the course (30 hours + personal homework) the students will be able to:
- Understand the challenges of supply chain management
- Identify the issues with value networks
- Master the tools to address them.

Course contents

The lectures aim to present the main elements of Supply Chain Management:
- General introduction
- Value: its representation and its optimization
- Data mining: Links with operational decisions

Practical exercises and homework will help students to apply the concepts and tools covered (e.g. VSM, data forecasting).

Course material

- APICS publications
- Agrawal, D.K (2007). Distribution and Logistics Management – A Strategic Marketing Approach, MacMillan India Ltd, New Delhi.
- Rushton, A. et al. 2010. The handbook of logistics & distribution management. Kogan Page.
- Montreuil, B. 2011. Toward a Physical Internet: meeting the global logistics sustainability grand challenge. Logistics Research , Volume 3, Issue 2-3, pp 71-87

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Responsible consumption and production

Sustainable Development and Social Responsibility Positioning

This course positions Supply Chain Management as a key driver of sustainable development and CSR by focusing on value optimization, data-driven decision-making, and process transparency to reduce waste, improve resource efficiency, and support responsible operations across the supply chain.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	14 hrs	8 hrs	8 hrs	2 hrs	0 hrs

Sustainable manufacturing [SUSTM]

LEAD PROFESSOR(S): Yasamin ESLAMI

Objectives

1)To understand deeply the role of sustainability in Manufacturing
2) To cover the evolution of sustainable Manufacturing (Lean manufacturing, green manufacturing, 3R-based,etc)
3) To discover the principles of Sustainable Manufacturing
4)Practice the strategies of sustainable manufacturing like maintenance and circular supply chain management
5) Understanding the extension of LCA in social dimensions.

Course contents

First, sustainable development as a general concept will be reviewed. Then, the relationship between sustainability and manufacturing will be discussed. consequently, sustainable manufacturing evolution through lean and green manufacturing will be covered. Afterwards, sustainable manufacturing approaches and principles will be studied.

Sustainable Development Goals (SDGs) covered by this course

Affordable and clean energy / Climate action / Decent work and economic growth / Industry, innovation and infrastructure / Partnership s for the goals / Peace, justice and strong institutions / Responsible consumption and production

Sustainable Development and Social Responsibility Positioning

This course integrates sustainable development and CSR by teaching students to assess environmental, social, and economic impacts in manufacturing. It emphasizes resource efficiency, circular economy strategies, and responsible production for informed decision-making.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	12 hrs	16 hrs	0 hrs	4 hrs	0 hrs

Cultural and Communication English [CCE3]

LEAD PROFESSOR(S): David TROYA

Objectives

- Understand the fundamental principles of scientific writing and the importance of clarity and precision in communication.
- Structure scientific documents effectively, adhering to genre-specific conventions.
- Employ appropriate language and tone for diverse scientific audiences.
- Integrate and cite sources correctly to support research arguments and findings.
- Edit and revise their writing for coherence, style, and grammatical accuracy.
- Prepare and deliver scientific presentations, both written and oral.

Course contents

Introduction to Scientific Writing

Overview:

This course provides an essential foundation in scientific writing, equipping students with the skills necessary to effectively communicate research findings and scientific concepts. Through a combination of lectures, workshops, and practical assignments, students will learn the conventions of scientific writing, including structure, style, and clarity. The course will cover various types of scientific documents, such as research papers, literature reviews, grant proposals, and poster presentations.

Course Structure:

The course will be organized into weekly sessions that include lectures on theoretical concepts, hands-on writing exercises, peer review workshops, and discussions of exemplary scientific literature. Students will engage in collaborative projects and receive constructive feedback to enhance their writing skills.

Assessment:

Students will be assessed through a combination of assignments, including written documents, peer review participation, and presentations. Active participation in workshops and discussions is also required to foster a collaborative learning environment.

Course material

Hoogenboom BJ, Manske RC. How to write a scientific article. Int J Sports Phys Ther. 2012 Oct;7(5):512-7. PMID: 23091783; PMCID: PMC3474301.

Paré G, Kitsiou S. Chapter 9Methods for Literature Reviews. In: Lau F, Kuziemsky C, editors. Handbook of eHealth Evaluation: An Evidence-based Approach [Internet]. Victoria (BC): University of Victoria; 2017 Feb 27. Available from: https://www.ncbi.nlm.nih.gov/books/NBK481583/

How to Create a Research Poster. A guide fo creating a research poster. https://guides.nyu.edu/posters

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Quality education

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

Spanish Language [ESP3]

LEAD PROFESSOR(S): Marta HERRERA

Requirements

N/A

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

Sustainable Development Goals (SDGs) covered by this course

Affordable and clean energy / Climate action / Decent work and economic growth / Gender equality / Goo health and well-being / Industry, innovation and infrastructure / No poverty / Partnership s for the goals / Peace, justice and strong institutions / Quality education / Reduced inequalities / Responsible consumption and production / Sustainable cities and communities / Zero hunger

Sustainable Development and Social Responsibility Positioning

Key competencies for sustainability Collaboration: the abilities to learn, to understand and respect others; to deal with conflicts in a group; and to facilitate collaborative and participatory problem solving. Critical thinking: the ability to reflect on one's own values, perceptions and actions. Self-awareness: the ability to reflect on one's own role in a group; to continually evaluate and further motivate one's actions; and to deal with one's feelings and desires.

Assessment

Individual assessment: EVI 1 (coefficient 1)

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

French Language [FLE3]

LEAD PROFESSOR(S): Silvia ERTL

Requirements

N/A

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).

Sustainable Development Goals (SDGs) covered by this course

Quality education

Sustainable Development and Social Responsibility Positioning

Targeted competencies extracted from: Education for sustainable development goals, learning objectives (UNESCO) https: //unesdoc.unesco.org/ark:/48223/pf0000247507 https://www.coe.int/fr/web/common-european-framework-reference-languages/official-translations-of-the-cefr-global-scale

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

Master Thesis or Internship [THESIS]

LEAD PROFESSOR(S): Catherine DA CUNHA

Requirements

3 semesters of Industrial Engineering

Objectives

- 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.

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Quality education

Sustainable Development and Social Responsibility Positioning

The 6-month immersion in a research laboratory or company allows theoretical knowledge to be put into practice, which contributes to a qualitative engineering education.

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