CENTRALE NANTES

ENGINEERING PROGRAMME

2025-2026

Year 2 / Year 3

Specialisation option

Industrial Engineering

OD GI

PROGRAMME SUPERVISOR

Raphaël CHENOUARD

Autumn Semester

Course unit	ECTS Credits	Track	Course code	Title
UE 73	12	Core course	ACTOR MADEC MAPIN PROD	Roles and Organization Decision-making tools and methods Processes, quality and standards Sustainable production
UE 74	13	Core course	CHANE P1GI PILOT RISK SIGEC	Product Modelling Project 1 Performance, Indicator, dashboard and data processing Risk management Information Systems and Knowledge Management

Spring Semester

Course unit	ECTS Credits	Track	Course code	Title
UE 83	14	Core course	CHANGE HACOPG_GI P2GI RVAL SIROP	Change Management Costing, purchasing and pricing Project 2 Value Networks Simulation and Operations Research

Roles and Organization [ACTOR]

LEAD PROFESSOR(S): Raphaël CHENOUARD

Objectives

Provide students with an overview of key players and different organizations within enterprises and value networks.

Course contents

- Enterprise and organization theory
- Circular economy
- Product lifecycle and design
- Industrial testimony

Skills developed through this course

- C1 : Design and prototype innovative systems that create value
  - C1C1 : Develop
    - Proficient
  - C1C3 : Deliver and create value
    - Proficient

Skills assessed through this course

No skill observed

Sustainable Development Goals (SDGs) covered by this course

Decent work and economic growth / Industry, innovation and infrastructure / Responsible consumption and production

Sustainable Development and Social Responsibility Positioning

Rethinking the role of business in society and its economic resilience. Moving from a linear “extract-dispose” model to a virtuous cycle model. Innovating technically to reduce the carbon footprint from the moment a product is created.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	10 hrs	10 hrs	10 hrs	0 hrs	2 hrs

Decision-making tools and methods [MADEC]

LEAD PROFESSOR(S): Raphaël CHENOUARD

Objectives

Provide students the tools and methods to support decision making with regard to product design as well as for driving a value chain.

Course contents

Formulation and resolution of multi-objective optimisation problems
Evaluation of risks and the implications of decisions
Implementation of methods for multi-criteria decision making
Design of experiments

Skills developed through this course

- C2 : Analyse a complex system from all angles (scientific, economic, human, social) and propose a solution
  - C2C1 : Represent and model
    - Proficient
  - C2C2 : Solve and arbitrate
    - Proficient
  - C2C3 : Think and act in an unpredictable and uncertain environments
    - Proficient

Skills assessed through this course

No skill observed

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

Collective assessment: EVC 1 (coefficient 0.2)

Individual assessment: EVI 1 (coefficient 0.8)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	12 hrs	8 hrs	10 hrs	0 hrs	2 hrs

Processes, quality and standards [MAPIN]

LEAD PROFESSOR(S): Hervé THOMAS / Raphaël CHENOUARD

Objectives

OPTIMIZE THE PRODUCTION OF A PART :
- Know how to define a manufacturing study project.
- Generate machining trajectories in CAM.
- Define operating strategies and parameters to optimize machining time and the quality of machined surfaces.

Course contents

Design a moldable object in epoxy resin: goodies, jewelry, key rings, etc.
Model the counter-mold of the product.
Define the counter-mold manufacturing process.
Generate machining paths in CAM to machine the counter-mold.
Machine the counter-mold.
Make the mold of the product in silicone.
Make the product in epoxy resin.
Optimize costs for producing 200 parts.

Skills developed through this course

- C2 : Analyse a complex system from all angles (scientific, economic, human, social) and propose a solution
  - C2C1 : Represent and model
    - Proficient

Skills assessed through this course

No skill observed

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure

Sustainable Development and Social Responsibility Positioning

This course provides a detailed analysis of the manufacturing process for a part in order to understand how to optimize a process.

Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	4 hrs	12 hrs	16 hrs	0 hrs	0 hrs

Sustainable production [PROD]

LEAD PROFESSOR(S): Yasamin ESLAMI

Objectives

Combine the constraints of productivity with those of sustainability

Course contents

Review of production management
- Sustainable production:
  - Sustainable KPI
  -Sustainable Manufacturing
  -Lean and Green Manufacturing
  -Life Cycle Assessment (LCA) methodology and example
  - Recyclability and waste management
  - Remanufacturing
  -Maintenance

Part of the sessions of this course are given in English.

Skills developed through this course

- C1 : Design and prototype innovative systems that create value
  - C1C1 : Develop
    - Proficient

Skills assessed through this course

No skill observed

Sustainable Development Goals (SDGs) covered by this course

Climate action / Decent work and economic growth / Industry, innovation and infrastructure / Responsible consumption and production

Sustainable Development and Social Responsibility Positioning

This course addresses sustainable production through the analysis of environmental and industrial performance of manufacturing systems. It integrates sustainable manufacturing, Lean and Green Manufacturing, maintenance, recyclability, remanufacturing, life cycle assessment (LCA), and Industry 4.0 to support responsible and continuous improvement of production systems.

Assessment

Collective assessment: EVC 1 (coefficient 0.75)

Individual assessment: EVI 1 (coefficient 0.25)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	10 hrs	14 hrs	6 hrs	0 hrs	2 hrs

Product Modelling [CHANE]

LEAD PROFESSOR(S): Matthieu RAUCH

Objectives

Within the framework of concurrent engineering, this course gives students the opportunity to acquire a broad body of knowledge from product design to production via virtual prototyping.

Course contents

1. Product modeling: Digital mock-ups - Object representation - Graphic techniques - Topological modeling - Reverse engineering in the CAD/CAM approach - Elements of industrial design and VR.
2. Rapid product development: Rapid Prototyping - Direct Manufacturing
3. Know-How Engineering: Capitalizing on know-how - Advanced CAD/CAM systems Integration of Production constraints in Design (DFM, DFA) - "Trade" CAD/CAM applications: Data Integration
4. Data Management: Technical Data Management - Product Configuration Management - PDM, PLM elements - Databases, DBMS - Technical Data Exchange - BIM - Cloud Computing
5. Applications

Course material

Machine à commande numérique, B. MERY, Hermès - CADAM Theory and Practice, I. Zeid, Mc Graw-Hill - Surface Modeling for CadCam, BK. Choi, Elsevier - Fundamentals of Computer Integrated Manufacturing, A.L. Foston, CL Smith, T. Au, Prentice Hall - La CFAO Concevoir et produire autrement, F. Piquet, JP Poitou, JC Tass, Nathan - NC Machine Programming and Software Design, CH Chang, MA Melkanoff, Prentice Hall.
Lecture notes and laboratory sessions.

Skills developed through this course

- C1 : Design and prototype innovative systems that create value
  - C1C3 : Deliver and create value
    - Proficient
- C2 : Analyse a complex system from all angles (scientific, economic, human, social) and propose a solution
  - C2C1 : Represent and model
    - Proficient

Skills assessed through this course

No skill observed

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure

Sustainable Development and Social Responsibility Positioning

Industry, innovation and infrastructure

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	10 hrs	0 hrs	20 hrs	0 hrs	2 hrs

Project 1 [P1GI]

LEAD PROFESSOR(S): Raphaël CHENOUARD

Objectives

Apply theoretical knowledge to real industrial issues.

Course contents

Project conducted in collaboration with an industrial partner.

Skills developed through this course

No skill teached

Skills assessed through this course

- C2 : Analyse a complex system from all angles (scientific, economic, human, social) and propose a solution
  - Intermediate
  - Proficient

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Partnership s for the goals

Sustainable Development and Social Responsibility Positioning

Innovate technically to reduce the carbon footprint from the moment a product is created. Share best practices and create synergies between players in the sector.

Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	1	0 hrs	0 hrs	0 hrs	32 hrs	0 hrs

Performance, Indicator, dashboard and data processing [PILOT]

LEAD PROFESSOR(S): Catherine DA CUNHA

Objectives

By the end of this course, students will be able to:

- Understand the role of scoreboards in industrial systems.
- Design effective KPIs aligned with strategy and processes.
- Build and interpret visual scoreboards (manual and digital).
- Use data mining techniques to improve KPI

Skills developed through this course

Sustainable Development Goals (SDGs) covered by this course

Responsible consumption and production

Sustainable Development and Social Responsibility Positioning

Through the design of relevant KPIs, data analysis, and the use of dashboards, this course contributes to SDG 12 – Responsible Consumption and Production by enabling the optimization of industrial processes, the reduction of waste, and the improvement of the sustainable performance of production systems.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	6 hrs	14 hrs	12 hrs	0 hrs	0 hrs

Risk management [RISK]

LEAD PROFESSOR(S): Thomas LECHEVALLIER

Objectives

Make students aware of the impact of their decisions on health and safety at work
Understand the risks and know how to make a decision when designing a product or service.

Course contents

Lectures:
- Risks and dependability
- Ergonomics
- Regulatory
- Product risk
- Risk management

Tutorials:
- Re-design of ergonomic workstations
- Fault tree

Skills developed through this course

- C2 : Analyse a complex system from all angles (scientific, economic, human, social) and propose a solution
  - C2C3 : Think and act in an unpredictable and uncertain environments
    - Proficient

Skills assessed through this course

No skill observed

Sustainable Development Goals (SDGs) covered by this course

Goo health and well-being / Partnership s for the goals

Sustainable Development and Social Responsibility Positioning

Risk management helps ensure that objectives are met and therefore that targeted changes are implemented.

Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	12 hrs	20 hrs	0 hrs	0 hrs	0 hrs

Information Systems and Knowledge Management [SIGEC]

LEAD PROFESSOR(S): Raphaël CHENOUARD

Objectives

By the end of the course, students will be able to:
- Understand the role of information systems in business and their main functions
- Use the main functions of an ERP system
- Understand the principles of knowledge-based reasoning for decision support

Skills developed through this course

- C2 : Analyse a complex system from all angles (scientific, economic, human, social) and propose a solution
  - C2C1 : Represent and model
    - Proficient

Skills assessed through this course

No skill observed

Sustainable Development Goals (SDGs) covered by this course

Decent work and economic growth / Industry, innovation and infrastructure / Responsible consumption and production

Sustainable Development and Social Responsibility Positioning

The digital transformation of processes, along with the capitalization of knowledge, enables better management of corporate resources while promoting industrial performance.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	12 hrs	6 hrs	12 hrs	0 hrs	2 hrs

Change Management [CHANGE]

LEAD PROFESSOR(S): Thomas LECHEVALLIER

Objectives

A project is a collective and individual adventure. All the actors participating will be confronted with changes, and the acceptance or not of these will strongly influence the success of the project.
The objective of the course is to give simple and reliable methods allowing to lead the change with respect when one is in the position of project leader.
The learning will begin by questioning the certainties on the expected benefits of the change, then give step-by-step analysis tools to lead and carry the change.

Course contents

- 6h CM presentation of change management methods
- 3x2h TD in writing a change management deliverable on a chosen project (per group of students)
- 2x2h TP of presentation of the deliverable (by group of students) to all the students of the course with a shared analysis time

Course material

Administration industrielle et générale (1916) Henri Fayol

Kanter R, M Stein B.A, jick T.D., The challenge of organizational Change : How companies experience it and guide it, Free Press New york, 1992
Kanter R, M., Evolve! : succeeding in the digital culture of tomorow, Harvard Business school Press, cambridge, 2001
Kanter R, M., Change Pasters : Innovation an entrepreneurship in American corporation, Simon & schuster, New York city, 1983

Kotter J., Leadeing Change, Harvard Business school Press, 1996

Morgan G., Riding the waves of Change, Imaginization Inc, 1988

S. Covey, the 7 habits of highly efficient people

Michel crozier, Pouvoir et organisation, Archives européennes de sociologie, vol. 5, no 1, pages 52–64

Skills developed through this course

- C3 : Manage complex programmes or change responsibly
  - C3C2 : Manage/lead a project/programme
    - Proficient
- C4 : Manage multidisciplinary and multicultural programme or project teams ethically and responsibly
  - C4C3 : Lead transformation in one's organisation
    - Proficient

Skills assessed through this course

No skill observed

Sustainable Development Goals (SDGs) covered by this course

Climate action / Partnership s for the goals

Sustainable Development and Social Responsibility Positioning

Project management that ensures the achievement of objectives and therefore targeted changes.

Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	12 hrs	20 hrs	0 hrs	0 hrs	0 hrs

Costing, purchasing and pricing [HACOPG_GI]

LEAD PROFESSOR(S): Catherine DA CUNHA

Objectives

Understand the economic dimension of value chains.

Course contents

- Purchasing
- Costing
- Pricing
- Negotiation

Skills developed through this course

- C1 : Design and prototype innovative systems that create value
  - C1C3 : Deliver and create value
    - Proficient
- C2 : Analyse a complex system from all angles (scientific, economic, human, social) and propose a solution
  - C2C1 : Represent and model
    - Proficient

Skills assessed through this course

No skill observed

Sustainable Development Goals (SDGs) covered by this course

Decent work and economic growth / Responsible consumption and production

Sustainable Development and Social Responsibility Positioning

This course trains engineers to balance financial performance, ethical practices, risk reduction, and the creation of sustainable value for the company and its stakeholders

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	8 hrs	18 hrs	4 hrs	0 hrs	2 hrs

Project 2 [P2GI]

LEAD PROFESSOR(S): Raphaël CHENOUARD

Objectives

Apply theoretical knowledge to real industrial issues.

Course contents

Project undertaken in collaboration with an industrial partner.

Skills developed through this course

No skill teached

Skills assessed through this course

- C1 : Design and prototype innovative systems that create value
  - Intermediate
  - Proficient
- C3 : Manage complex programmes or change responsibly
  - Intermediate
  - Proficient

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Partnership s for the goals

Sustainable Development and Social Responsibility Positioning

Innovate technically to reduce the carbon footprint from the moment a product is created. Share best practices and create synergies between players in the sector.

Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	2	0 hrs	0 hrs	0 hrs	48 hrs	0 hrs

Value Networks [RVAL]

LEAD PROFESSOR(S): Catherine DA CUNHA

Requirements

Methods and tools for decision support

Objectives

Identify the issues with value networks and master the tools to address them.

Course contents

- Scheduling
- Location/allocation
- Logistics
- Physical internet

Course material

ASLOG 2008/2009 : L'état de l'art de la logistique globale des entreprises en France
Montreuil B., R.D. Meller & E. Ballot (2012). Physical Internet Foundations, In: Service Orientation in Holonic and Multi Agent Manufacturing and Robotics, edited by T. Borangiu et al., Springer
O'Brien, C., 2013. Fifty years of shifting paradigms. International Journal of Production Research 51, 6740–6745. doi:10.1080/00207543.2013.852267

Skills developed through this course

- C2 : Analyse a complex system from all angles (scientific, economic, human, social) and propose a solution
  - C2C3 : Think and act in an unpredictable and uncertain environments
    - Proficient

Skills assessed through this course

- C2 : Analyse a complex system from all angles (scientific, economic, human, social) and propose a solution
  - Proficient

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure / Responsible consumption and production

Sustainable Development and Social Responsibility Positioning

This course contributes to the Sustainable Development Goal 12 "responsible consumption and production" by increasing the knowledge of the students about global production systems, their KPI, and improvement levers.

Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	10 hrs	12 hrs	8 hrs	0 hrs	2 hrs

Simulation and Operations Research [SIROP]

LEAD PROFESSOR(S): Raphaël CHENOUARD

Objectives

Provide students with the major principles of discrete-event simulation, flow simulation and value network optimization.

Course contents

- Discrete-event and flow simulation
- Introduction to operations research
- Graph algorithms and linear programming
- Constraint programming
- Meta-heuristics

Skills developed through this course

- C2 : Analyse a complex system from all angles (scientific, economic, human, social) and propose a solution
  - C2C1 : Represent and model
    - Proficient
  - C2C2 : Solve and arbitrate
    - Proficient

Skills assessed through this course

- C2 : Analyse a complex system from all angles (scientific, economic, human, social) and propose a solution
  - Intermediate

Sustainable Development Goals (SDGs) covered by this course

Decent work and economic growth / Industry, innovation and infrastructure / Responsible consumption and production

Sustainable Development and Social Responsibility Positioning

Simulation and operational research enable processes to be modeled digitally in order to define optimal solutions based on economic, social, and environmental criteria.

Assessment

Collective assessment: EVC 1 (coefficient 0.4)

Individual assessment: EVI 1 (coefficient 0.6)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	8 hrs	14 hrs	8 hrs	0 hrs	2 hrs