
MASTER OF SCIENCE, TECHNOLOGY AND HEALTH

2022-2023

YEAR 1

INDUSTRIAL ENGINEERING

EIT MANUFACTURING

PROGRAMME SUPERVISOR(S):

Catherine DA CUNHA



YEAR 1 - Autumn Semester

CORE COURSES

Course code	Title	ECTS Credits
CSM	Basics of Computer Science and Mathematics	2
DESIMU	Discrete-Event Simulation	4
EcoGel	Economics and Management for Industrial Engineering	4
ENTMOD1	Enterprise Modelling	4
IND4PROC	Introduction to Ind4.0 Processes	4
METOP	Introduction to Optimization Methods	5
PRODMANAG1	Production Management	5

LANGUAGE COURSES

Course code	Title	ECTS Credits
CCE1	Cultural and Communication English	2
ESP1	Spanish Language	2
FLE1	French Language	2

YEAR 1 - Spring Semester

CORE COURSES

Course code	Title	ECTS Credits
ENTMGMT	Enterprise Management	4
INNOV	Innovation Engineering	4
IR2	Introduction to Research	2
SIMU2	Advanced Simulation	4
Sociol	Management and Socio-Organizational Aspects for Industrial Engineering	4
SSCHOOL	Summer School	5
STAD	Statistics and Data Analysis	5
SYSENG	System Engineering	4

LANGUAGE COURSES

Course code	Title	ECTS Credits
CCE2	Cultural and Communication English	2
ESP2	Spanish Language	2
FLE2	French Language	2

Master Programme - Industrial Engineering - EIT Manufacturing

YEAR 1 - Autumn Semester

Basics of Computer Science and Mathematics [CSM]

LEAD PROFESSOR(S): Raphaël CHENOUIARD

Objectives

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

- Know basics of programming languages (VBA, Python)
- Describe and implement an algorithm
- Understand object-oriented programming
- Understand basics notions for numerical analysis (vector, matrix, derivative)

Course contents

These lectures aim at introducing the following concepts:

- Basics of algorithmic;
- Basics of object-oriented programming;
- Vectors and matrices calculus;
- Derivatives and numerical applications

Languages such as Visual Basic and Python will be emphasized.

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

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

Master Programme - Industrial Engineering - EIT Manufacturing

YEAR 1 - Autumn Semester

Discrete-Event Simulation [DESIMU]

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

Objectives

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

- Understand a discrete-event simulation-based analysis
- Model simple industrial processes using a discrete-event simulation software
- Configure the simulation model
- Define the key performance indicators
- Gather key performance indicators from the simulation runs
- Analyse the results of the simulation

Course contents

These lectures constitute an introduction to the simulation of discrete event systems applied to manufacturing production systems. The main elements covered are:

- Principles of simulation
- Modelling for simulation
- configuration and tuning of a simulation model
- Analysis of key performance indicators values from simulation tool
- Optimization via simulation

After an introduction lecture, practical sessions will lead to a mini-project in full autonomy. Industrial software such as FlexSim will be used.

Course material

- Introduction to Simulation Using SIMAN, Pegden, C.D., Sadowski, R.P., Shannon, R.E., 2nd ed. McGraw-Hill, Inc., New York, NY, USA (1995)
- Simulation modeling and analysis, Law, A. M., Kelton, W. D., & Kelton, W. D. (Vol. 3). New York: McGraw-Hill (2007).

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	8 hrs	0 hrs	20 hrs	4 hrs	0 hrs

Master Programme - Industrial Engineering - EIT Manufacturing

YEAR 1 - Autumn Semester

Economics and Management for Industrial Engineering [EcoGel]

LEAD PROFESSOR(S): Simon ROUSSEAU / Yasamin ESLAMI

Objectives

Management Systems (MS) use accounting data to manage and analyze operations. This part of the programme focuses on the financial and economic operations generally applied in industrial engineering.

This course introduces current measurement and analysis standards, budget management, and economic indicators to run the business and explain operational results as well as performance outcomes.

Financial and economic aspects help and influence decision making. They play an important role in coordinating operational activities regarding performance goals and resource optimization.

Course contents

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

- Understand the data provided by financial statements and how the information can be used to assess the economic health of a company
- Calculate financial ratios based on financial statements and how to interpret them to analyse a company
- Understand the difference between cash flow and profit
- Understand how to measure the performance of a company, its economic sustainability and its competitiveness
- Calculate and analyze the profitability threshold
- Understand how companies choose strategic investments based on financial considerations in order to gain or retain competitive advantage
- Understand how a company can finance its investments and its activities
- Understand how to measure and analyze costs by using financial accounting data
- Focus on Activity-Based Costing (ABC): the method of allocating overhead expenses based on actual activities and processes, not arbitrarily.
- Understand what a budget is, how it is designed and constructed and how it fits into the long term planning of the company
- Understand how to set up financial KPIs and how to use them

Exercises will be completed during and between classes.

Course material

- Tukker, A., 2015. Product services for a resource-efficient and circular economy - A review. *Journal of Cleaner Production*, 97, pp.76–91.
- Berliner C. and Brimson J. (1988). *Cost management for today's advanced manufacturing, the CAM-I conceptual design*, Harvard Business School Press.
- Johnson H.T. (1992) *Relevance regained, from Top-down control to Bottom-up empowerment*, Free Press
- Johnson H.T. and Kaplan R.S. (1987) *Relevance lost: the rise and fall of management accounting*, Boston, Harvard Business School Press
- Malmi T. and Brown D. (2008). Management Control systems as a package – Opportunities, challenges and research directions, *Management Accounting Research*, vol. 19, n°4, p. 287-300.
- Vargo S. and Lusch R. (2008). Service-dominant logic: continuing the evolution, *Journal of the Academy of marketing Science*, vol. 36, n° 1, p. 1-10.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

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

Enterprise Modelling [ENTMOD1]

LEAD PROFESSOR(S): Farouk BELKADI

Objectives

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

- Understand the main concepts behind hierarchical organisations and industrial enterprises
- Conduct an operational management method
- Construct enterprise business models including various points of view and using several tools

Course contents

These introductory lectures aim to present the main elements that define the architecture of an enterprise. After this introduction, the following items will be presented in detail:

- Introduction to Enterprise organization
 - What is an organization as a system?
 - Different points of view for the analysis of an organization (structure, operation, collaboration, decision levels, etc.)
- Enterprise Modelling concepts
 - Definition of the concepts of process, tasks and activities
 - Definition of actors and roles
 - The concept of performance
- Business process modelling with IDEF0-SADT
 - Introduction to process modelling
 - IDEF diagram structure
- Business Process Modelling Notation (BPMN)
 - Introduction to BPMN principles and notations
 - BPMN diagram creation and validation
 - Examples of industrial process represented with BPMN
- Decision-based modelling with GRAI method
 - Main concepts: decision centers, functional view, temporal view, hierarchy, etc.)
 - Modelling concepts (decision and execution activities, objectives, constraints, etc.)
 - GRAI grid and Network
- Introduction to UML for the description of enterprise structure
 - UML class diagram for the description of the structure
 - UML use cases and sequence diagrams for the description of the functional view

Practical exercises and homework will help students to apply the learned modelling languages in various case studies. A mini project will be conducted by the students to apply all learned methods and tools in the design of their chosen company.

Course material

- Livre blanc - Introduction au BPM. Stéphane PLANQUART
- Business Process Model and Notation (BPMN) OMG official Standard document: <http://www.omg.org/spec/BPMN/2.0>
- BPMN 2.0 by Example. OMG official Standard document <http://www.omg.org/spec/BPMN/2.0/examples/PDF/10-06-02.pdf>
- The GRAI method <http://chen33.free.fr/M2/Courses/GRAI%20INTEROP%20part%201.BV.pdf>
- Integrating value modeling into ArchiMate. University of Twente
- Business Process Modeling Introduction to ARIS Methodology <http://www.training.com.br/download/Business%20Process%20Modelling%20-%20Introduction%20to%20ARIS%20Methodolgy.pdf>

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

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

Master Programme - Industrial Engineering - EIT Manufacturing

YEAR 1 - Autumn Semester

Introduction to Ind4.0 Processes [IND4PROC]

LEAD PROFESSOR(S): Gilles CARABIN

Objectives

At the end of the course the students will be able to understand the main processes in an industrial company and how Computer Aided tools are able to help the experts in their daily tasks. Concretely, the courses will be divided into five sections. Every section presents one topic with an introduction course and practical classes for training.

Course contents

This introductory course will address the following items:

- Introduction to Design and Computer Aided Design
 - o What is the main functions of a CAD tool
 - o Design of a simple product
- Introduction to Machining and Computer Aided Manufacturing for Machining
 - o Presentation of the main process of machining
 - o Explanation of CNC machines functioning
 - o Preparation of a job on a CAM tool
 - o Realization of a simple part with machining
- Introduction of Additive Manufacturing and Computer Aided Manufacturing for Additive Manufacturing
 - o Presentation of the main processes of Additive Manufacturing
 - o Explanation of the AM machines functioning
 - o Preparation of a job with CAM tool for AM
 - o Realization of a simple part with AM
- Introduction to the control of sequential production systems
 - o Recall of the basics of automation
 - o Introduction to grafcet
 - o Simulation: Control of a simple production process with automgen tool.
- Introduction to Computer Aided Maintenance
 - o Explanation of main processes in preventive and reactive maintenance
 - o Explanation of reliability models
 - o Case studies

Course material

1. Cad/Cam Theory and Practice, McGraw-Hill Series in Mechanical Engineering
2. Introduction to Manufacturing Processes, Schey, John A

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	10 hrs	4 hrs	16 hrs	2 hrs	0 hrs

Master Programme - Industrial Engineering - EIT Manufacturing

YEAR 1 - Autumn Semester

Introduction to Optimization Methods [METOP]

LEAD PROFESSOR(S): Raphaël CHENOUIARD

Objectives

At the end of the course the students will be able to:

- Understand an optimization problem
- Model a problem as a mathematical problem
- Choose a classical optimization method
- Analyse the result of the optimization

Course contents

These lectures constitute an introduction to classical optimization methods. The main elements covered are:

- Mathematical modelling
- Linear Programming
- Optimization without constraint
- Optimization with constraint

These lectures are applied to practical examples and implemented using SciPy Python library. SciPy generic optimization functions are used, but some classical algorithms are also implemented like gradient descent or Newton algorithm.

Course material

- Numerical Optimization, Pegden, Jorge Nocedal, Stephen Wright. 2nd ed. Springer (2006).
- Introduction to Numerical Analysis, Arnold Neumaier. Cambridge University Press (2001).

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	8 hrs	18 hrs	4 hrs	2 hrs	0 hrs

Master Programme - Industrial Engineering - EIT Manufacturing

YEAR 1 - Autumn Semester

Production Management [PRODMANAG1]

LEAD PROFESSOR(S): Catherine DA CUNHA / Rosa ABBOU

Objectives

At the end of the course, the students will be able to:

- Understand management techniques;
- Structure and manage information systems;
- Specify the different value generating activities (purchases, logistics, production of goods and services, marketing, sales, etc.);
- Structure information on ERP.

Course contents

This course constitutes an introduction to management techniques combined with the realities of human management. The main elements covered in the course are:

- The management of information systems;
- The management of various value generating activities (purchases, logistics, production of goods and services, marketing, sales etc.);
- Human resources management.

Industrial software ERP such as SAGE will be used.

Course material

- Gideon HALEVI, Handbook of Production Management Methods. Edition Butterworth-Heinemann, 2001.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	8 hrs	10 hrs	12 hrs	2 hrs	0 hrs

Master Programme - Industrial Engineering - EIT Manufacturing

YEAR 1 - Autumn Semester

Cultural and Communication English [CCE1]

LEAD PROFESSOR(S): David TROYA

Objectives

This course aims at improving your critical thinking and persuasion skills in English. Using documentaries, we will explore, discuss and debate a range of cultural, political, social, and environmental issues relevant to current world events.

Speaking and understanding English as a second or third language is a great achievement, but does it mean you are an effective communicator? The next step involves, among other things, critical thinking and persuasive skills, both of crucial importance in the modern professional environment. We will address these issues by analyzing documentaries that will lead to formal debates.

Several competencies will be developed through class exercises. Oral presentations will be an opportunity put your verbal as well as your non-verbal communication skills into practice. During debate, you will be able to sharpen your analytical skills, provide constructive feedback, defend an argument, and prove a point.

Course objectives

- Improving your communication skills
- Becoming an active listener
- Enhancing your non-verbal communication skills
- Developing critical thinking toward media
- Boosting leadership skills through moderating
- Organizing evidence and arguments

Course contents

Each session will be dedicated to a particular cultural, political, social or environmental topic of relevance in the wider anglophone world. Each topic will include multimedia material in the form of a short documentary or documentary excerpt. During class, students will lead a primer presentation, a moderated discussion and a formal debate.

Primer Presentation:

In pairs, you will hold a short talk to prime us on the topic of that week's documentary: you will introduce us to the topic by setting it in a wider context and establishing what's at stake.

Moderated Discussion :

In pairs, you will moderate a discussion related to the themes explored by the documentary. Moderators will come prepared with open-ended questions pertaining to the strengths and weakness of the documentary. They will distinguish between content and form and encourage critical, constructive opinions.

Formal Debate:

What's the difference between an opinion and an argument? You will soon find out. After the moderated discussion, we will brainstorm potential topics for debate, and follow the British Parliamentary model to sharpen your research, critical thinking,

and persuasive skills.

During the debate, each speaker will be assigned an audience member who evaluates their individual performance and provides a short debrief. A panel of two judges will determine which side wins.

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

Master Programme - Industrial Engineering - EIT Manufacturing

YEAR 1 - Autumn Semester

Spanish Language [ESP1]

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

Master Programme - Industrial Engineering - EIT Manufacturing

YEAR 1 - Autumn Semester

French Language [FLE1]

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 (2 semesters), 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.

Course contents

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

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

Master Programme - Industrial Engineering - EIT Manufacturing

YEAR 1 - Spring Semester

Enterprise Management [ENTMGMT]

LEAD PROFESSOR(S): Farouk BELKADI

Objectives

The teaching in this course will be based mainly on serious games reflecting industrial situations. At the end of the course (32 hours + personal homework) the students will be able to:

- Understand the main principles of operational enterprise management
- Conduct full project management approach including risk analysis and cost evaluation
- Understand and conduct lean management process

Course contents

- Introduction to Enterprise Management methods
 - o Main processes of operational enterprise management
 - o Human resources and organisational capabilities management
- Project management principles
 - o Project needs clarification and strategic/tactical decisions creation
 - o Tasks and Resources planning and organization
 - o Risk evaluation and management
- o Operational decision and project realization
- Introduction to lean management
 - o Lean principles
 - o Process optimization through waste reduction (Muda Serious game)
 - o Process optimization through just in time management (Kanban serious game)

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	12 hrs	18 hrs	0 hrs	2 hrs	0 hrs

Master Programme - Industrial Engineering - EIT Manufacturing

YEAR 1 - Spring Semester

Innovation Engineering [INNOV]

LEAD PROFESSOR(S): Farouk BELKADI / Guy CAVEROT

Objectives

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

- Understand and practice a customer-oriented and a value-driven process to assess a business opportunity
- Conduct activities associated with business planning and business modelling
- Assess the underlying dimensions of a business plan
- Leverage the tools and methodologies of strategic communication

Course contents

These introductory lectures aim to present a set of methods and tools used in the development of a business opportunity and how such development projects are managed and drive innovation. Based on active learning techniques, students will be tasked with conducting an entrepreneurial project. The concepts will be introduced as part of the process of business modelling of the innovation.

At the end of the course, students will tackle the strategic communication of their entrepreneurial project by putting together a pitch and a business plan.

The following items will be presented in detail:

- Introduction to innovation engineering
- Value creation behind a business opportunity: from a problem to a value creation process
- Prototyping a solution
- Business model
 - Monetizing a value proposition
 - The business system behind the value proposition
- R&D roadmapping
- Financial plans and need for funds
- Strategic communication
 - Pitch Communication
 - Business Plan Structure

Course material

- "Guide to Business Plan Writing," Gate2Growth supported by European Commission
- Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers
- Value Proposition Design: How to Create Products and Services Customers Want
- Other resources will be available on Moodle

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

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

Master Programme - Industrial Engineering - EIT Manufacturing

YEAR 1 - Spring Semester

Introduction to Research [IR2]

LEAD PROFESSOR(S): Farouk BELKADI

Objectives

Introduction to research via literature survey, conferences and journal papers.

Course contents

4 hours lecture classes will give the students an introduction to the duties and the work of researchers (What is research, its activities and role?)

Based on proven teacher experience, students will learn how to do literature survey in a scientific field and how to disseminate the research results using various types of supports.

Students will undertake a literature survey and present a poster/presentation on one topic of interest.

Students will attend, where possible, locally held research conferences.

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	2	4 hrs	4 hrs	0 hrs	16 hrs	0 hrs

Master Programme - Industrial Engineering - EIT Manufacturing

YEAR 1 - Spring Semester

Advanced Simulation [SIMU2]

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

Objectives

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

- Perform and analyse the results of a stochastic simulation
- Understand the basics of multi-agent systems
- Design multi-agent systems and evaluate their performance on given scenarios

The course also provides an introduction to multi-physics simulation.

Course contents

These lectures are split into two distinct parts.

The first part extends the lectures in Discrete-event simulation given in the autumn semester. It aims to introduce the concepts of stochastic simulation, and explores two main questions:

- How are random phenomena modelled in discrete-event simulation?
- How are the results of stochastic simulation meant to be analysed ?

The second part introduces a separate approach of complex discrete-event systems simulation: the multi-agent approach. The following questions will be answered:

- What are the main pillars of multi-agent simulation?
- What is the best design methodology of multi-agent models?

After an introductory lecture, practicals will lead to a mini-project in full autonomy. Industrial software such as Rockwell Arena, Netlog or Anylogic shall be used.

In addition, an introduction to the simulation of complex and multi-physics systems will be provided within the Systems Engineering perspective. The tool Open modelica is used to create and simulate system behaviour models.

Course material

1. Introduction to Simulation Using SIMAN, Pegden, C.D., Sadowski, R.P., Shannon, R.E., 2nd ed. McGraw-Hill, Inc., New York, NY, USA (1995)
2. Stochastic simulation: algorithms and analysis, Asmussen, S., Glynn, P. W., Vol. 57. Springer Science & Business Media (2007)
3. Multiagent Systems, G. Weiss, 2nd ed. MIT Press, Cambridge, MA, USA (2013)
4. The big book of simulation modeling: multimethod modeling with AnyLogic 6, Borshchev, A., AnyLogic North America (2013).

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

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

Management and Socio-Organizational Aspects for Industrial Engineering [Sociol]

LEAD PROFESSOR(S): Yasamin ESLAMI

Objectives

The purpose of this course is to explain how new enterprise strategies are incorporating new challenges of sustainability at environmental, societal and economic levels.

In the first part, the main foundations of sustainability will be explored to identify its main dimensions, problematics and processes.

The second part will introduce concepts and methods to analyze the internal and external environment of an organization from business strategy perspectives. Tools like SWOT and PESTEL will be explained to show how they can help managers make decisions in a complex socio-economic context.

Based on the previous sections, the relationship between the two concepts (sustainability and strategy) will be studied. The concept of sustainability inside the enterprise (sustainable enterprise) will be discussed and different types of sustainable enterprises will be studied.

Method of strategic management (like SWOT) will be applied to analyse the sustainable capacities of a given enterprise according to particular perspectives.

Through the course, students will gain an understanding of individuals and how they behave within organizations and how groups work together. They will try to catch the concept of sustainability in the field of business and how strategy and sustainability will reinforce each other.

Course contents

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

Principles of Sustainability

What is sustainability?

The three dimensions of sustainability

Main sustainable processes

Business Strategy

Understand strategy and strategic management

How alternative strategies help acquire and maintain competitive advantages for enterprise

Explore concepts and methods of scanning the external and internal environment of a firm: (PESTEL, SWOT, Porter's Five + 1 Forces, etc.)

Sustainable Enterprise

Understand the connection between sustainability and strategy

Acquire knowledge of organizational sustainability

Learn about Sustainability Management and Sustainable Enterprise

Practice the Evolution of sustainability inside an Enterprise

Practice inside-out thinking Vs. Outside-in thinking

Apply strategic management methods for sustainability perspectives

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

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

Master Programme - Industrial Engineering - EIT Manufacturing

YEAR 1 - Spring Semester

Summer School [SSCHOOL]

LEAD PROFESSOR(S): Catherine DA CUNHA

Objectives

The school is a three-week course which will be held outside ECN campus, potentially abroad. The exact location will be communicated during the first semester.

The school is addressed primarily to students attending all the programs of the EIT Manufacturing double degree master, but it is also open to external participants with an engineering background.

The objective is to develop innovation and entrepreneurship skills for the manufacturing world in an international setting. Participants are immersed in a stimulating learning by doing experience during which innovation experts and companies bring hand-on expertise by launching challenges, support team project works and share their experience, while international lecturers provide state-of-the-art knowledge.

During the summer school three different kinds of activities, linked by the common reference theme of sustainable manufacturing, can be identified:

- (i) provision of models, tools and frameworks to develop entrepreneurial and innovation ideas,
- (ii) company's testimonials and visits;
- (iii) team work on the challenges launched by the consortium participants and preparation of pitches.

Course contents

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

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

Master Programme - Industrial Engineering - EIT Manufacturing

YEAR 1 - Spring Semester

Statistics and Data Analysis [STAD]

LEAD PROFESSOR(S): Mathieu RIBATET

Objectives

The aim of this course is to provide the students with the necessary mathematical tools to address the fields of reliability under the framework of survival analysis. At the end of the lecture, students will fully understand the main statistical approaches for modelling "time to event" data with right censoring and will be able to conduct a whole statistical analysis of their data.

Course contents

- Remainder on statistics
- Specificities : skewness, censoring
- Non parametric estimation
- Cox-proportional hazards model
- Conclusion with a whole statistical analysis

Course material

[1] D. Collett. Modelling Survival Data in Medical Research. Chapman and Hall/CR, 3rd edition, 2014.

[2] J. P. Klein and M. L. Moeschberger. Survival analysis. Springer-Verlag, 2nd edition, 2003.

[3] D. G. Kleinbaum and M. Klein. Survival analysis: A self learning text. Springer-Verlag, New-York, 3rd edition, 2012.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	12 hrs	18 hrs	0 hrs	2 hrs	0 hrs

System Engineering [SYSENG]

LEAD PROFESSOR(S): Farouk BELKADI

Objectives

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

- Understand the main concepts behind complexity and systemic paradigms
- Understand the principles of systems engineering, main processes and standards
- Conduct requirement collection and traceability
- Create SysML models within a systems engineering perspective
- Conduct Model Based System Engineering approach with SysML

Course contents

These introductory lectures aim to present the main methods and tools of Systems Engineering as used in industry for the development of new complex systems. The course commences with an introduction to the main foundations of systems engineering, summarizing its main processes and presenting the potential organizations working on SE standards. After this introduction, SysML language is explored to illustrate how this modelling tool is used along the SE process. The following elements will be covered:

- Rapid introduction to complexity
- Introduction to the concept of system and system of systems
 - o What is a system? What is a system of systems?
 - o System analysis foundations with the concept of facet:
 - Core features; system lifecycle; business models and system decomposition
 - The design process and the concept of facet
- Systems Engineering (SE)
 - o Definition of systems engineering
 - Definitions from the standards
 - Main characteristics of SE
 - o Overview of main SE processes
 - Processes from the standards
 - Key Systems Engineering methods (V-model, Waterfall, incremental, etc.)
 - o Requirement management and functional analysis
 - The concept of requirement?
 - The requirement engineering and management process
 - From requirement engineering to functional analysis
 - o Design of systems architecture:
 - Concepts of functional (logical) and physical architecture.
 - Function allocation and design matrix
 - Modular architecture and Interface management
 - The RFLP approach
- System design and analysis with SysML language
 - o Main concepts of SysML
 - o Requirements management: Requirement diagram, Use Case diagram,
 - o Behavior analysis: Sequence diagram, State-Transition diagram, activity diagram
 - o Structure definition: Bloc definition diagram, Internal bloc diagram
 - o Connection between diagrams within a MBSE perspective
- Deploying a Model Based Systems Engineering (MBSE) approach

- o What is MBSE?
- o Practice and mini project on Eclipse Papyrus software

- Analyzing the system behaviour
 - o Implementing Parametric model as a simulation model
 - o Perform simulation with OpenModelica tool

Practical exercises and homework will help students to apply the learned modelling languages to several case studies. A presentation from an industrial partner is planned to discover the current industrial practices. A mini-project is also planned as a collaborative development project of an information system dealing with real industrial use cases.

Course material

- Kossiakoff, A., Sweet, W. N., Seymour, S. J., & Biemer, S. M. (2011). Systems engineering principles and practice (Vol. 83). John Wiley & Sons.
- Systems Engineering Fundamentals. DEFENSE ACQUISITION UNIVERSITY PRESS, FORT BELVOIR, VIRGINIA 22060-5565
- Mark Austin Introduction to Systems Engineering, ENES 489P Hands-On Systems Engineering Projects. Institute for Systems Research, University of Maryland, College Park
- Roland Renier, Raphaël Chenouard. De sysml à modelica: aide à la Formalisation de modèles de Simulation en conception. 12ème Colloque National AIP PRIMECA Le Mont Dore - 29 March to 1 April 2011
- Hubert Kadima. Méthodes et outils d'ingénierie de systèmes mécatroniques fiables; Journée Gdr MACS du 03.05.2010 – SupMéca Paris

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

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

Master Programme - Industrial Engineering - EIT Manufacturing

YEAR 1 - Spring Semester

Cultural and Communication English [CCE2]

LEAD PROFESSOR(S): David TROYA

Objectives

Interview techniques and communicational English:

- Understand the general concepts of interactive communication
- Build a media project
- Acquire interview techniques
- Understand the process of sourcing and checking facts and figures
- Understand issues related to plagiarism
- Create a bibliography
- 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.

Media project (for example: prepare, conduct and promote interviews for a radio programme: L'Heure Centralienne (<http://www.euradionantes.eu/emission/l-heure-centralienne>), with the contribution of professors, PhD students, industrial partners, industry players at fairs, etc.

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

Master Programme - Industrial Engineering - EIT Manufacturing

YEAR 1 - Spring Semester

Spanish Language [ESP2]

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

Master Programme - Industrial Engineering - EIT Manufacturing

YEAR 1 - Spring Semester

French Language [FLE2]

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 (2 semesters), 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.

Course contents

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

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