INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

INDUSTRIAL ENGINEERING DEPARTMENT

IMPROVING THE OVERALL PERFORMANCE OF A COMPANY

2021-2022

SAINT-GOBAIN

GROUPE SAVENCIA Saveurs & Spécialités

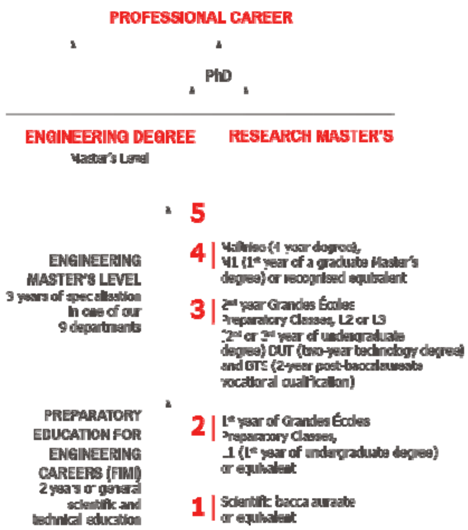
SAFRAN

INSA LYON
Campus LyonTech La Doua
20, avenue Albert Einstein - 69621 Villeurbanne cedex - France
Tél. +33 (0)4 72 43 83 83 - Fax +33 (0)4 72 43 85 00
www.insa-lyon.fr

membre de UNIVERSITÉ DE LYON

INSA ENGINEERS

They combine **in-depth knowledge and expertise** in one or more sectors of the engineering profession with **a balanced general culture**, covering science and technology as well as managerial and human skills.
They are experts in their field of specialization, while having **a solid overall foundation** on which to develop their career and continually draw on the flow of information they will encounter throughout their life.



Aware of their human and social responsibilities, INSA engineers are able to understand the issues facing society and make decisions accordingly.
Their skills allow them to adapt to many situations, to evolve in complex and uncertain environments, to understand others, to manage projects and motivate teams of employees.
As driving forces in their professions, they are capable of defending a point of view and bringing about qualitative advances.

Trained in several languages and inter-cultural awareness, INSA engineers are able to work in a European and multinational environment.

ECOLOGICAL AND ENERGY TRANSITION

INSA Lyon draws on the Research excellence of the LyonTech-La Doua campus with **22 recognized laboratories**, 18 of which are associated with Public Scientific and Technical Research Establishments (EPST) such as the CNRS, INSERM, INRIA and INRA.
The INSA laboratories also draw on their disciplinary and transdisciplinary excellence, and are organized to meet the five structural societal challenges:

- Digital Society and Information;
- Energy for a Sustainable Development;
- Environment: Natural, Industrial, and Urban Environments;
- Global Health and Bioengineering;
- Transport: Structures, Infrastructures, and Mobilities.

INSA Lyon has integrate **the energy-climate issue**, and more generally sustainable development and social responsibility (**SDRS**), in its teaching, throughout the training course, from the first-year up to doctorate.
The aim of this approach is twofold:

- Train engineers and doctors aware of DDRS issues, capable of understanding and analyzing the growing complexity of the world in which they operate professionally;
- Respond to the growing **demand for meaning** from students (both in their training and in their future professional career).

NB: for the sake of simplicity, the persons referred to in this document are designated "he"

DIGITAL TRANSFORMATION

Artificial Intelligence as well as the ethics of Artificial Intelligence will in the short term constitute the building blocks of our graduates with the help of interdisciplinary artificial intelligence institutes with which we are associated.
(Tribune Groupe INSA – 04/06/2020)

INDUSTRIAL ENGINEERING

Industrial strategy, relationships with suppliers and customers, organization, management style, culture evolve with the globalization of the workforce and markets, the emergence of large amounts of data, the controlled approach of the projects.
Industries, confronted with **international competition**, have to **innovate** to diversify, to conquer new markets, to better produce, to satisfy customer requests.
To remain competitive, they must adopt a continuous improvement process, by using tools and methods to:

- Innovate;
- Establish "smart" factories (connected objects, internet of things, …);
- Manage large masses of data;
- Manage the life cycle of their products;
- Manage and optimize their Supply Chain;
- Valuing and protecting their know-how;
- Improve their production and associated services;
- Respond to environmental and societal requirements.

Industrial engineering concerns production systems, supplying and/or distribution of goods or services, their design, their implementation, their management and their improvement with a systemic vision.

INDUSTRIAL ENGINEERING ENGINEERS

Industrial engineering engineer is required to manage and optimize the flow of information and goods while respecting the costs and deadlines set, to improve industrial performance, to manage and report on the progress of projects for which he is responsible.
In particular on the aspects of quality, cost and deadlines by relying on different information systems.
He guarantees the proper use of means of production and resources to satisfy all stakeholders, in line with his company's strategy.
He can intervene at different phases of the product and process system life cycle, from industrialization to end-of-life management, including production-

distribution optimization and maintenance in operational condition.
He is **multidisciplinary**.
He is a **production manager**, able to design, implement and manage complex industrial systems while considering all the technical, organizational, financial and human factors.
He is involved in organizing the company in accordance with the principles of sustainability. The skills involved serve to enhance performance, safety and quality.
His personal evolution will lead him to take on responsibilities. He must then, be able to accompany and lead collaborators towards the aims by implementing human relations qualities to explain, convince, justify, control...

He is able to:

- Model the process of any activity (industrial, logistics and tertiary);
- Design and size systems required for a given activity of production, service, distribution...;
- Identify and correct discrepancies in a continuous improvement process (material, human and information systems) by the implementation of analytical and simulation tools;
- Manage and configurate of supplies and purchases for single, serial or continuous productions;
- Lead any type of project (management of teams, resources, budget, customers and suppliers) at all levels (operational, strategic, transverse or pilot);
- Initiate and manage innovations and direct change;
- Ensure quality reporting through the establishment of appropriate indicators, based on a systemic view of organizations (matrix, silo, and project) for any scope and any type of activity;
- Enhance, protect and sustain the expertise of entities in the activity scope.

MAIN EMPLOYMENT FIELDS

Any type of structure and any branch of industry seeks the industrial engineering engineer's competences and knowledge (tools and methods of optimization)**.**

- IT sector and electronics;
- Automobile industry, aeronautics, transport;
- Pharmaceutical, cosmetic, metallurgical and energy industries;
- Services, engineering and technical studies …

As a project leader, s/he may exert his/her functions in various fields such as:

- Management, leadership;
- Engineering, studies and technical advice;
- Project or program management;
- Production, exploitation, maintenance, tests, quality, safety;
- Information systems …

NB: for the sake of simplicity, the persons referred to in this document are designated "he"

INDUSTRIAL ENGINEERING DEPARTMENT

Thanks to a solid methodological and technical foundation, students develop an array of fully exploitable skills that respond to employers' demands.

With a generalist approach to training, the department facilitates their entry into professional life and the best career advancement possible, in France and abroad.

Each year more than 90 students receive a Master's degree after having completed 3 years' studies in the department.

Industrial engineers trained by the department are able to practice a variety of careers in virtually all economic sectors. The training prepares them for this as it develops the necessary competences, allied with strong relational skills.

The department aims to make its aspiring engineers aware of the context in which they will intervene.

The diversity of professional sectors and the globalization of the economy lead us to consider and draw from experiences gained in companies and in foreign countries as priority goals.

INDUSTRIAL PARTNERSHIPS

From its creation in 1992, the Industrial Engineering Department has formalized a durable partnership with its professional environment.

These partners take an active part in the evolution of the department by identifying the problems and emerging themes in their respective fields.

Partners get involved in different actions:

- Sponsorship of a promotion;
- Research issues;
- Industrial internship;
- Subjects for collective projects;
- Topics for industrial projects;
- Testimonials of companies, industrialists;
- Site visits;
- Participation in "Journée des Métiers" (round tables, job interview simulation, curriculum vitae correction…).

SAINT-GOBAIN SAFRAN GROUPE SAVENCIA Saveurs & Spécialités

Sponsors : promotions 2021 / 2022 / 2023

RESEARCH

4 associated research laboratories

UNIVERSITÉ DE LYON

- **DISP** Decision and **Information Systems for Production Systems**: research deals with the design and application of decision-making methods and information systems in order to improve the performance of systems producing goods and services, networked companies and global supply chains.
- **AMPERE** **Electrical Engineering, Electromagnetism, Automatic Control, Environmental Microbiology and Applications Lab.**
- **LAMCOS** **Contacts and Structural Mechanics Laboratory:** research focuses on the prediction and analysis of performance and integrity of mechanical and live systems under static, cyclic, dynamic or extreme conditions from the component or component to the complete system.
- **LIRIS** Laboratory of **Images and Information Systems Information Technology**: Computer Vision and Pattern Recognition; Geometry and modelling; Data Science; Services Distributed Systems and Security, Simulation, virtuality and computational sciences; Interactions and cognition.

The links between the department and these research laboratories make it possible to offer industrial practitioners answers adapted to their needs:

- Research project within the framework of a partnership agreement;
- Research project within the framework of a CIFRE convention;
- Collaborative multi-partner research project (FUI, ANR, CEE, ...);
- Industrial Chair in the context of a sponsorship agreement with the INSA Foundation.

INTERNATIONAL OUTLOOK

An engineer should be able to evolve within multicultural teams, understand geopolitical issues, and integrate socio-economic issues in a context of globalization.
Student mobility is a response to these challenges and, as such, **INSA Lyon makes the international mobility a strategic focus in the engineering curriculum**.
The Industrial Engineering department is internationally oriented. Openness to other cultures and mastery of foreign languages hold a strong place.

During schooling, students have many opportunities to live rich experiences:

- Year or semester in exchange in a foreign university;
- Industrial internship or End of Studies Project in a foreign company;
- Welcoming of many foreign students;
- Participation in ESTIEM (European Student of Industrial Engineering and Management).

ASSOCIATION

Exercising responsibility: an education in itself

In accordance with its tradition and educational vision, INSA Lyon considers that students taking responsibility for association life can constitute an educational element in addition to actual teaching such that it is likely to promote the development of real student citizenship and represents participation in the School's dynamism.

Consequently, the establishment likes to take a variety of promotional measures with the aim of reconciling:

- the quality of studies and the successful delivery of the course which remains the main objective, and;
- students taking responsibility for association life.

The IE department values **the project management experience that IE engineering students acquire by taking on important responsibilities** (President, treasurer, etc.) in major INSA associations (Rhône-Alpes Forum, INSA Gala, 24h00 of INSA, Students' Office).

Within the department, the IE associations also take care to organize student-industrial meetings and in particular, la Journée Des Métiers (JDM).

AG2I Association of Industrial Engineering of INSA aims to connect IE students as well as alumni with companies.
Contact: association.ag2i@gmail.com

L'As de Pique is to animate the department by organizing evenings, meals and other festivities for all promotions.
Contact: asdepique@insa-lyon.fr

ESTIEM aims to develop communication and cooperation between IE students in Industrial but also between different European universities. http://estiem.insa-lyon.fr

NB: for the sake of simplicity, the persons referred to in this document are designated "he"

COMPETENCY FRAMEWORK

School Skills

- Analyze a system (real or virtual) or a problem;
- Exploit a model of a real or virtual system;
- Implement an experimental approach or a production approach;
- Design a system that meets a set of specifications;
- Process data;
- Communicate an analysis, a scientific approach, a proof or a solution in a reasoned and logical way.

Transversal School Skills

- Know oneself, to handle oneself physically and mentally;
- Work, learn, evolve independently;
- Interact with others, team work;
- Show creativity, innovate, undertake;
- Act in a responsible way in a complex world;
- Move, work, evolve into a business, socio-productive organization;
- Work in an international and intercultural context.

School Skills: IE Specific

INDUSTRIAL ENGINEERING AND SUPPLY CHAIN

- Observing, measuring, analyzing and interpreting an activity or a system from data;
- Modeling and designing an information, decision and production system, of goods and services;
- Evaluating, prototyping and simulating a system;
- Sizing the hardware and / or software of a system;
- Managing a production system and react to malfunctions;
- Selecting appropriate production tools, integrating them into an environment and configuring them, and setting up a production system;
- Developing and implement a sourcing strategy;
- Managing supply in connection with the planning and inventory management policy;
- Localizing and assigning the production, storage and transportation processes to different members of the supply chain.

CONTINUOUS IMPROVEMENT

- Developing and implementing an action plan as part of a quality and continuous improvement approach;
- Understanding and evaluating a structure holistically, through socio-economic frames of reference;
- Changing organizations to meet new constraints or opportunities;
- Considering technological and methodological innovation.

PROJECT MANAGEMENT

- Collectively managing a project: organization, communication, group coordination;
- Managing a project based on a master plan (planning, budgeting, definition of monitoring indicators);
- Identifying, analyzing and controlling the risks inherent to a project;
- Identifying, formalizing and contractualising the requirements of a client, following their evolution and validating their compliance (requirements traceability).

HUMAN AND ORGANIZATION

- Identifying the critical skills and knowledge of an organization and implement tools and methods to sustain them;
- Conducting a socio-organizational analysis to better understand the effects of change and to adapt strategies;
- Implementing Corporate Social Responsibility (CSR).

AWARDING THE DIPLOMA

To obtain the diploma in Industrial Engineering, the student must have completed by the end of the 5th year:

- Industrial internship (16 weeks minimum) during the 4th year;
- Each study unit and End of Studies Project during the 5th year (18 weeks minimum);
- A "B2 level" TOEIC score of 785 or equivalent ("C1 level" TOEIC score of 945 or equivalent are recommended);
- A "B1 level" (recommended) in a second language other than English.

CURRICULUM

Poles of interest called **Teaching Units** structure the program.

These Units are composed of different **Constituent Elements** (EC): conceptual lessons, lab work and projects.
Each EC leads to an evaluation of the knowledge and skills acquired according to assessment methods defined by the teacher and communicated to the students at the beginning of the year.

NB: for the sake of simplicity, the persons referred to in this document are designated "he"

3 RD YEAR: APPROACHING

Broad-spectrum teaching prepares the future industrial engineer to communicate with specialists from different fields (automation, computer science, mechanics, etc.) in a project management situation.

- Acquisition of technical and methodological bases;
- Introduction to production management;
- Initiation to the industrial organization;
- Visit of industrial sites.

An **integration week**, created and led by teachers and students, is proposed the first week of the start of the academic year.
This week offers among other activities:

- A climate fresco;
- A fresco of Industrial Engineering;
- Games around production management;
- Workshops on the posture of the engineer ...

In the first semester of 2021, a course related to Sustainable Development and Social Responsibility (SDSR) has been inaugurated. **"Thinking about systems and life cycle" (32h).**

4TH YEAR: INTEGRATING

The student discovers **new techniques focused on production management, industrial data processing and management methods** that he learns to place in a transversal vision of the company.

- Appropriation of industrial management methods and techniques;
- In-depth production management;
- Sociological analysis of organizations;
- Collective project;
- Industrial internship (minimum 16 weeks);
- Possibility of academic exchange (1st semester);
- Possibility of industrial internships abroad.

During the 4th year, the student becomes **an actor of his training**. He can choose to achieve his international mobility during an academic exchange semester (S1) or during his industrial internship (S2).

He begins to build his professional project during his internship search using this opportunity to test a sector of activity, a type of company, ….

He also chooses two options among the following 3:

- **OPTION 1: AUTOMATIC**
  Safe design and management of a production system;
- **OPTION 2: PRODUCTION MANAGEMENT**
  Scheduling and flow management (offered in French and English);
- **OPTION 3: COMPUTING**
  Optimization of the decision-making chain (offered in French and English).

Finally, he chooses an option in Human and Social Sciences, among:

- Economics of globalization
- Europe in all its States;
- Human Sciences for Engineers in Transition Training;
- # VALUE! Because our future is well worth it ...;
- Us and the Others;
- Transhumanism: science fiction or reality?;
- Art (s), commitment, transgression.

These lessons are given by teachers from the Humanities Center. These are transversal lessons, which allow IE students to meet and share with students from other specialized departments of INSA.

In 2022, a dedicated SDRS course will be offered in the 4th year: **"Industrial ecology and circular economy".**

5TH YEAR: MASTERING

Some courses aim to reinforce the knowledge of the company as well as its environment: management of human resources, business strategies, Corporate Social Responsibility...
Others develop the technical knowledge already acquired: **logistics, scheduling, management in real time, Lean management, purchasing/sourcing**.

- Industrial project: real business projects (logistics, quality, re-engineering, business creation, ...);
- End of Studies Project: mission in an industrial environment with the support of the Department's resources;
- Industrial testimonials;
- Possibility of academic exchange in 5GI-S1;
- Possibility to realize End of Studies Project abroad;
- Option – R&D: Supply Chain Optimization in Industry 4.0**.**

A CSR (Corporate Social Responsibility) course for all. An RSI (Social Responsibility of the Engineer) project for 5GI "classic course" students.
In 2023, a dedicated SDRS course will be inaugurated: **"Environmental management".**

NB: for the sake of simplicity, the persons referred to in this document are designated "he"

PROFESSIONAL TOOLS

The pedagogy of the department is interactive, efficient and oriented towards professional situations.

Partner companies' projects, serious games, collaborative learning environments, reference tools, and software packages.

- SAP S/4HANA as ERP: production management;
- MS Project: project management;
- Minizinc;
- Incoplan: scheduling;
- Qlikview et Rapidminer : Business Intelligence
- Global Screen Intra: Manufacturing Execution System (MES);
- MEGA and Visual Paradigm
- Gurobi, Cplex : Optimization
- Minitab: advanced statistics calculations;
- Carl software: Computer Aided Maintenance Management Software;
- Anylogic, Flexsim : flow simulation;
- Solidedge: Computer Aided Design;
- PCVUE : SCADA (Supervisory Control And Data Acquisition) + MES (Manufacturing Execution System

PROJECT MANAGEMENT AND PROFESSIONAL EXPERIENCE

✓ DURING THE 4TH YEAR

COLLECTIVE PROJECT

Duration: 7 months, over 2500 hours / group

Each year, project owners propose 10 to 12 projects.
A group of about eight students accompanied by three tutors (technical, management and educational) leads each project.

Knowledge:

Tools and methods: project management, system engineering, quality management, communication.

Capacity:

- Implement management tools;
- Learning to collectively lead a real-life project: collective organization of the group, communication, animation, coordination;
- Apply rigorously a structured, coherent and relevant approach to designing an industrial solution by integrating performance factors: Risks + Costs + Quality + Usage;
- Collecting, extracting, structuring and analyzing information;
- Evaluate one's strengths and limitations, negotiate, be a force of proposition;
- Analyze in a global, systemic approach a company, an organization, a project, a problem.

INDUSTRIAL INTERNSHIP

Period: mid-April to mid-September (Minimum 18 weeks)

The student improves his mastery of the tools studied during the academic year.
He discovers new techniques that focused on production management, industrial computing and management methods that s/he learns to place in a transversal vision of the company.

Objectives: The industrial internship is an opportunity to live an industrial experience similar to that which the engineer will exercise in his future job. This internship involves not only a technical and operational work, but also the possibility to observe the functioning of the company with its history, its activities, its stakes, its organization, its internal social dynamics, ...

Knowledge:

- Sociotechnical functioning of organizations.

Capacity:

- Observe and analyze the strategy of an entity;
- Oral and written communication;
- Analyze a situation.

✓ DURING THE 5TH YEAR

INDUSTRIAL PROJECTS

Duration: 6 weeks/project

The industrial project is a real business project.
The industrial owners supervise and lead the project (each student will deal with two projects). The students are working out a solution in response to a set of conditions.
Each group, as the manager of the project proposes and defends its technical, organizational, economic and time-bounded solutions.
Each group is competing to win the market.

Knowledge:

- Industrial organization;
- Continuous improvement;
- Production data analysis and system sizing;
- Sourcing and material supply

Capacity:

- Develop the capacities of observation and strategic analysis of an organization;
- Integrate the technical and socio-economic aspects of a project or a process (of production, management ...);
- Improve communication and analysis skills, through a precise identification of the professional environment, by increasing the number of contacts and working relationships in the company, and so on.

NB: for the sake of simplicity, the persons referred to in this document are designated "he"

INTRODUCTION TO RESEARCH

Period: beginning of October to end of January

Groups of 2 to 3 students propose innovative solutions to an applied research problem in industrial engineering. Research professors of the department's partner laboratories supervise each project. The problem can be proposed and supervised in collaboration with a company

Knowledge:

- Research institutions and actors in France;
- The place of engineers - doctors;
- Research issues in industrial engineering

Capacity:

- Develop an approach to scientific questioning on a research issue.

OPTION: RESEARCH

Optimization of the supply chain in industry 4.0

During the 5th year, students have the possibility of enrolling, in an R & D course, entitled **"Optimization of the Supply Chain in Industry 4.0".**

Four modules:

1. Joint optimization of Transport and Production;
2. Data science;
3. Industry of the future;
4. Research in Industrial Engineering including one research project (56h). Research professors of the department's partner laboratories propose and supervise each project. It can also be proposed and supervised in collaboration with a company.

During the 5th year, the student chooses to realize

END OF STUDIES PROJECT/MASTER THESIS

For 18 weeks (minimum), the End of Studies Project aims to solve an industrial problem within an enterprise. The End of Studies Project provides a mission similar to that of an engineer. In a general manner, it is question of adopting project management behavior: product analysis and design phases, implementation of the manufacturing process, production system organization.

If the subject of the assignment includes in addition to the engineering dimension, a dimension "research" or «innovation " and if the company agrees, that End of Studies Project with Research component is supported by a laboratory, partner of IE department. This laboratory will be able to bring its expertise and skills to the proposal of innovative solutions.

STUDENT ENTREPRENEUR PROGRAM (FEE LYONTECH)

Training for entrepreneurship

The objective of the Student Entrepreneur Program is to train engineers in entrepreneurial skills, through a real-life project, which forces students to consider, assimilate and assume the risks that are inherent to business.

This is a six-month option, from February to September, during the last year of the engineering cycle. It replaces the End of Studies Project (after acceptance of the application).

The Student Entrepreneur section provides future engineers with an additional skill, developing their capacity to manage a team, drive an innovative project or create a business.

The Student Entrepreneur program allows students to become familiar with the major tools of business and project management, and to control processes and behaviors, through experiential learning.

The Student Entrepreneur program awards the specialized "Technology Entrepreneur and Manager" Certificate.

LEAN MANAGEMENT

Professionalization contract

Period: February for a duration of 8 months
¼ of the time in training course (300 h)
¾ time in the company

Students issued from four departments of INSA Lyon, are eligible for this program, during the last year of their training course:

- Biosciences;
- Electrical Engineering;
- Mechanical Engineering;
- Industrial Engineering.

Prerequisite: have validated the 4th year in one of the departments mentioned.

- CQPM Animator of the Lean approach
- Master's degree in Industrial Engineering
- Lean Six Sigma-Green Belt Certification

There is no correlation between graduation (Master's degree) and certification.

NB: for the sake of simplicity, the persons referred to in this document are designated "he"

3rd year – Semester 1

Educational Units contribute to the competencies specified in the COMPETENCY FRAMEWORK and allow the engineering student to work and to be evaluate on a set of knowledge and abilities.

UE GI-3-MOI-S1 INDUSTRIAL ENGINEERING METHODS AND TOOLS

GI-3-IGP-S1 Introduction to production management

Knowledge

- Production management process (time horizon / period of different decisions, decision interdependence);
- PM vocabulary, concepts of pull/push systems for production flows;
- Decoupling point, inventory management methods.

Capacity

- Locate the functions and goals of production management in a goods-producing company;
- Managing supply and inventory;
- Choose the suitable management method for a given context;
- Calculate the costs and manage the production resources in the mid and long term.

GI-3-PEX-S1 Design of experiments DoE

Knowledge

- Setting of an optimal organization of experiments;
- Regression model and mathematical predictor;
- Statistical model associated to Analysis of Variance (ANOVA);
- Implementation of a Design of Experiments.

Capacity

- Submit planification of experiments;
- Perform measurements;
- Construction of a numerical tool for design of experiments calculation;
- Analysis of obtained results (model and influent factors);
- Finding of an optimal solution for factors settings.

PRE-REQUISITE : BASIC KNOWLEDGE OF DESCRIPTIVE STATISTICS TOOLS (MEAN, VARIANCE, AND STANDARD DEVIATION), BASIC LAWS OF STATISTICS (NORMAL DISTRIBUTION).

GI-3-PSC-S1 Think system and life cycle

The knowledge:

- General knowledge of environmental issues;
- Concept of systemic, anthropocene;
- Energy and distribution:
- Inventory of energy resources,
- Associated issues,
- Energy saving,
- Distribution networks,
- Environmental cost of the different energy sources;
- Modes of transport.

And the capacities to:

- Generate data for LCA (Life Cycle Analysis);
- Produce an LCA based on the data produced;
- Use simple tools for LCA

GI-3-PRS -S1 Probability - Statistics

Knowledge

- Probability notion;
- Combinatorial analysis cases;
- Probability calculation rules;
- Conditional probabilities and independent events;
- Random variable;
- Main indicators for random variables (expected value, standard deviation ...);
- Main probability distributions;
- Central limit theorem;
- Sample, population and statistical inference;
- Customer risk and supplier risk;
- Point estimate;
- Confidence interval;
- Unilateral / bilateral statistical test;
- Estimation tests; Comparison tests; Adequation tests;
- Independence tests.

Capacity

- Calculate the probability of a complex event based on simple events or by combinatorial analysis;
- Model a random phenomenon choosing an adequate probability law;
- Calculate and interpret the main indicators related to a random variable;
- Determine the average behavior of a phenomenon based on a large number of experiments;
- Calculate the customer risk / supplier risk depending on a control quality procedure;
- Estimate the parameters of a statistic population based on a data sample (with a point estimate and with a confidence interval);
- Carry out a statistical test to validate (or not) a hypothesis related to a population.

GI-3 IOI -S1 Basics in industrial organization

Knowledge

- Problem-solving steps: specifying the problem to solve, identifying its possible origins, finding solutions, implementing them and verifying that the stated objectives are met;
- Quality tools: QQOQCP, statement sheet, curves, Pareto diagrams, Brainstorming, Ishikawa, voting matrix;
- Business organization: logistic of physical and information flows and their interactions, identifying the causes of slowing of flows and possible solutions;
- Process improvement tools such as PDCA, DMAIC.

Capacity

- Acquire a problem-solving methodology based on a case study around logistic problem;
- Use quality tools in project management;
- Discover the different steps of problem resolution;
- Evaluate logistics performances and industrial activities of a company;
- Analyze performance indicators;
- Identify sources of slowdowns and propose corrective actions;
- Develop a PDCA approach as well as an industrial and commercial development strategy.

UE GI-3-INFO-S1 COMPUTER SCIENCES

GI-3-ALP-S1 Algorithmic and programming

Knowledge

- Types, variables, objects and elementary actions;
- Control structures (sequential, iterative, conditional);
- Procedures and functions;
- Class and instance concepts, encapsulation, inheritance, polymorphism;
- Fundamental algorithms about tables (sorting, dichotomic research, ...);
- Fundamental algorithms about linked lists.

Capacity

- Develop a structural programation method in order to solve a complex problem;
- Establish input specifications of a complex problem;
- Build an algorithm in pseudo-language from specifications;
- Translate an algorithm into Python language.

GI-3-MOC-S1 Object oriented modelling and design

Knowledge

- Class and instance concepts;
- Encapsulation, Inheritance and Polymorphism mechanisms;
- Overview of UML diagrams;
- Use cases and sequence diagrams;
- Class diagrams in practice;
- Activity diagram and State diagram;
- Tools.

Capacity
- Model a system using standard formalisms;
- Discover bases of UML language and practice with small models;
- Implement an algorithm in Python language.

UE GI-3-MECA-S1 MECHANICS

GI-3-CNU-S1 Numerical control
Knowledge
- Architecture of a CNCM;
- Command structure architecture, CN ISO language;
- Other machining methods

Capacity
- Understanding the challenges of CAD / CAM;
- Understanding the economic stakes of machining strategies.

GI-3-ANF-S1 Manufacturing analysis
Knowledge
- Mold design;
- Precedence constraints in machining;
- Isostatism;
- Cutting parameters

Capacity
- Design of a mechanical manufacturing sequence by choosing a suitable material;
- Design of a metal mold, respecting the geometric constraints, considering the economic constraints and machine capabilities.

GI-3-ECC-S1 Order chain environment
- Hydraulics, actuators, modulators;
- Measuring chains;
- Electric actuators;
- Real case study – choice of actuators and sensors (guiding principles).

GI-3-MPI-S1 Materials for Engineering
Knowledge
- Families of materials and main mechanical properties of metals and composite materials;
- Basic knowledges of ceramics and polymeric materials;
- Fracture of materials;
- Method of material selection.

Capacity
- Describe and explain the main mechanical properties of the main classes of materials;
- Use of method of materials selection in mechanical design.

PRE-REQUISITE : PHYSICS: BASIC KNOWLEDGE - MATHEMATICS: INTEGRAL AND DIFFERENTIAL CALCULATION BASES AND MATRIX ALGEBRA

GI-3-RDM-S1 Strength of Materials
Knowledge
- Behavior of mechanical components: stress modelling under simple load, static balance and torque of mechanical actions, stress tensor, strain tensor and strength criteria, constitutive laws (Hooke's laws), bending deflection.

Capacity
- Design a mechanical part (beam) and identify the mechanical loads and stresses;
- Determine the torque of mechanical actions and the stress distribution in a cross section;
- Verify mechanical strength of a beam.
- Calculate the bending deflection.

PRE-REQUISITE : MECHANICS: STATIC BALANCE - MATHEMATICS: INTEGRAL AND DIFFERENTIAL CALCULATION BASES AND MATRIX ALGEBRA

UE GI-3-HU EPS-S1 LINGUISTIC & SPORT ACTIVITIES

GI-3-COM–S1 Theatre, Communication
Knowledge
- Main notions of theatrical work applied to public speaking (eyesight, body, voice, and argumentation).

Capacity
- Identify one's working style;
- Find meaning and personal enrichment in one's education;
- Use acquired skills when confronted with need to adapt to a diverse situation;
- Acquire new skills through initiative and autonomous search for the necessary resources;
- Develop critical thinking skills; think independently;
- Communicate in an appropriate manner;
- Put original discourse into context using explicit references;
- Master non-verbal communication: posture and gesture;
- Participate actively in a group, know and maintain one's role within it; Commit to a collective project;
- Mobilize acquired skills to produce original artistic work;
- Problematize, organize and conduct a research in social sciences;
- Accommodate cultural differences on a team project.

EPS-3-S1	Sport activities
HU-L-ANG-3-S1	English
HU-L-LV2-3-S1	2nd language

3rd year – Semester 2

EDUCATIONAL UNITS CONTRIBUTE TO THE COMPETENCIES SPECIFIED IN THE COMPETENCY FRAMEWORK AND ALLOW THE ENGINEERING STUDENT TO WORK AND TO BE EVALUATE ON A SET OF KNOWLEDGE AND ABILITIES.

UE GI-3-AUTOM-S2 AUTOMATIC CONTROL

GI-3-CSL-S2 Linear system control
Knowledge
- The concept of stability of a system;
- Performance concept;
- Single-input, single-output correctors.

Capacity
- Study the stability of a system;
- Determine the performance parameters of the system and compare them with the specifications characteristics;
- Synthesize a controller;
- Simulate a dynamic system and its controller;
- Experimental control of a physical system.

GI-3-CSR-S2 Robot Control
Knowledge
- Strength of materials, control, closed-loop control and PID.

Capacity
Design a first prototype model for the control of an industrial robot arm from requirements:
- Mechanical and electrical sizing;
- Environment;
- Sensors and information acquisition;
- Transmission and effectors;
- Ordering algorithms;
- Global system behavior;
- Project management.

PRE-REQUISITE : GI-3-IAC-S1, GI-3-ECC-S1, GI-3-RDM-S1

GI-3-SED-S2 Discrete-event systems
Knowledge
- Finite or non-finite discrete states;
- Stable state switching;
- Petri nets;
- Concepts of deterministic or random behaviors;
- Performance indicators;
- Identification and verification of hypotheses;
- Markovian models, queueing networks.

Capacity
- Exploiting specifications;
- Appreciating a system through the production/ consumption and client/server paradigms;
- Dimensioning and evaluating steady-state performance;
- Establishing properties and verifying hypotheses.

PRE-REQUISITE : PROBABILITY - STATISTICS

UE GI-3-INFO-S2 COMPUTER SCIENCES AND OPTIMIZATION

GI-3-ARO-S2 Computer architecture and operating systems
Knowledge
- Memories;
- CPU / Machine Language;
- Hardware Communication;
- Operating System Principles (Memory and File Management, Drivers);
- Concurrent Programming and Process Synchronization.

Capacity
- Choose the technical characteristics of a computer hardware according to hardware and software requirements;
- Use standard operating systems and optimize resource management;
- Identify and synchronize resource-sharing processes.

GI-3-BDD-S2 Database and XML
Knowledge
- Architecture of a Data base system management;
- Model entity – association;
- Functional and multivaluate dependences;
- Transitive closure notion, Minimal cover;
- Normal forms;
- Relational algebra, calculus;
- SQL language;
- Structure of an XML document, well-formed XML document;
- Document type definition, XSLT document.

Capacity
- Design an entity/association model;
- Translate an entity/association model to relational model;
- Write queries in relational algebra, in SQL;
- Write a well-formed XML document;
- Validate an XML document from a DTD;
- Transform an XML document with XSLT language.

GI-3-MAC-S2 Analysis and design method
Knowledge
- Model IDEF0 (IEEE standards 1320.1-1998);
- Data modelling language IDEF1X;
- ARIS tools: Organizational chart of the actors;
- Media for the data exchange between the actors;
- Processes diagram from data flows;
- Process event chains.

Capacity
- Designing a functional model and / or a physical model of a production system; specifying an information system; Identifying and detailing the processes of a system.

PRE-REQUISITE : BASIC KNOWLEDGE IN COMPUTER SCIENCE.

GI-3-PLO-S2 Linear programming and optimization
Knowledge
- Linear programming, simplex algorithm, duality;
- Linear programming in whole numbers, branch & bound algorithm;
- Use of Excel and OpenSolver solver for decision support.

Capacity
- Specify a linear program from the description of a problem expressed in natural language
- Design a decision support tool to manage a production or transport process...

PRE-REQUISITE : DISCRETE MATHEMATICS – PRODUCTION MANAGEMENT

GI-3-RIP-S2 Problem solving by IT
Knowledge
Capacity

UE GI-3-MECA-S2 MECHANICS

GI-3-CSM-S2 Mechanical system design and technology
Knowledge
- Identification of loads and solicitations by isolating components;
- Fatigue design and strength design (Wöhler curves, Miner theory);
- Design of joints and connection with tolerances estimation;
- Mechanical component design and choice (bearings, bolts).

Capacity to know and understand
- Mechanical interaction phenomena between system components;
- Classical and basic technologies for mechanical actuation (friction transmission, electro-magnetism, hydraulics);
- How some safety mechanical systems work (brake, clutch, spring ...);
- Estimate some classical values of basic mechanical characteristics (stiffness, load, friction ...).

PRE-REQUISITE : FIRST LEVEL OF DRAWINGS AND MECHANICAL DATA MANAGEMENT, INTRODUCTION TO STRENGTH RESISTANCE OF MATERIALS UNDER STATIC LOADINGS, FIRST LEVEL OF KNOWLEDGE ON MATERIALS AND PROCESSES.

GI-3-INS-S2 Systems engineering
Knowledge
- Be acquainted with System Engineering;
- IS tools (SysML).

Capacity
- System modelling.

GI-3-CMP-S2 Design of production machines
Knowledge
- General Reliability of a Mechanism;
- Rolling bearing calculation.

Capacity
- Manage a project; Respect norms, costs and deadlines;
- Size a mechanically welded frame; Dimension bearings and belts;
- Dimension a shaft in static and dynamic states.

UE GI-3-HU EPS-S2 THE MAN AND THE COMPANY/LINGUISTIC & SPORT ACTIVITIES

GI-3-DFI-S2 Business and financial diagnosis
Knowledge
- Financial diagnosis (activity and financial structure);
- Notion of risks;
- Funding arrangements;
- Company rating

Capacity
- Identify the main function of an industrial business, its logic of action and management modes;
- Characterize the relations of a company with its environment;
- Understand and read the accounts, analyze their evolutions, assess their strengths and weaknesses.

GI-3-COMM-S2 Theatre, Human and social sciences, Communication (see GI-3-COMM-S1)

GI-3-RED-S2 Basics of document search
Knowledge
- Sources and type of scientific and technical information;
- Structuring a summary document;
- Citation rules;
- Criteria for the evaluation of information.

Capacity
- Searching for scientific and technical information; qualifying information; producing a summary note;
- Collaborate remotely.

EPS-3-S2	Sport
HU-L-ANG-3-S2	English)
HU-L-LV2-3-S2	2nd language

NB: for the sake of simplicity, the persons referred to in this document are designated "he"

4th YEAR – Semester 1

Educational Units contribute to the competencies specified in the COMPETENCY FRAMEWORK and allow the engineering student to work and to be evaluate on a set of knowledge and abilities.

UE GI-4-AUT-S1 DECISION SUPPORT AND AUTOMATION

GI-4-AUT-S1 Automation - Design and management of a production system

Knowledge
- Automation architectures (from physical layer (sensors and intelligent actuators, industrial networks ...) to the supervision layer);
- Methods in automation projects;
- Automation design and realization tools.

Capacity
- Analyze, dimension and design an Automated Production System (APS): in terms of production tool driving;
- Specify the requirements of APS;
- Use an analysis and design method for an APS.

PRE-REQUISITE : Industrial Machine environment: sensors, actuators - basic PLC programming Manufacturing systems technology. Modelling of software and control systems: GRAFCET, RdP, UML...PLC programming.

OPTION AUTOMATIC: Safe design and management of a production system

GI-4-CPS-S1

Knowledge
- Defining a rationale for dimensioning;
- MTBF MTTF MTTR;
- State graph, Markov chain;
- Fault Tree, Reliability Diagram;
- Decision support.

Capacity
- Apprehend the phenomena of malfunctioning;
- Preliminary Risk Analysis;
- Lifetime, Reliability, Availability, Maintainability of material and organizational structures;
- Contract, commitment and penalties;
- Negotiate solutions to increase fault tolerance;
- Performance indicators;
- Dimensioning.

UE GI-4-GP SIM-S1 FLOW SIMULATION AND PRODUCTION MANAGEMENT

GI-4-GPA-S1 Production management

Knowledge
- Workshop scheduling techniques and methods (single machine, parallel machines, flow shop, job shop, hybrid organizations);
- Project scheduling methods (PERT ...);
- Forecasting methods and their role in demand management;
- Software application component of enterprise information systems (ERP ...) and their relationships;
- ERP implementation methodology

Capacity
- Specify a scheduling problem;
- Select or propose a method to solve a workshop scheduling problem appropriate to a given context, and apply it;
- Understand the problem of demand management and forecasts;
- Select and apply an appropriate method in a given context;
- Choose a software application of an enterprise information system (ERP ...) which is the most the appropriate to a given context;
- Manage an ERP implementation project.

PRE-REQUISITE : GI-3-IGP-S1 + Probabilities and statistics, computer sciences

GI-4-PSF-S1 Flow simulation project

Knowledge
- Physical behavior of a chain of actuators and sensors;
- Distribution laws of random variables, stochastic behavior of discrete flows;
- Permanent regime condition and instability.

NB: for the sake of simplicity, the persons referred to in this document are designated "he"

Capacity
- Sizing and analyzing physical and flow systems;
- Validate by simulation physical and flow processes;
- Input / output abstraction, input flow output flow;
- Define and validate hypotheses;
- Statistical interpretation of the outputs;
- Choice of scenarios;
- Operate a simulation tool;
- Exploit specifications to understand a system through physical and discrete flows.

OPTION PRODUCTION MANAGEMENT: Scheduling and flow management

GI-4-ORD-S1 Scheduling and flow management

Knowledge
- Optimization methods;
- Scheduling policy according to the workshop workload;
- Calculation of a project cost-effectiveness

Capacity
- Identify methods to calculate the operating time and forecast workload (personnel and equipment);
- Characterize the technical data (operations, resources, operating times, manufacturing sequence, production orders ...);
- Infinite and finite capacity scheduling;
- Study the effects of selecting a sequencing heuristic, as well as periods of work;
- Consider the constraints (overlap, preemption, indivisibility, etc.) and manage the uncertainties of production (machine failure...);
- Analyze and evaluate the technical and financial characteristics of a scheduling software.

UE GI-4-HU EPS-S1 LINGUISTIC & SPORT ACTIVITIES

HU-L-ANG-4-S1	English
HU-L-LV2-4-S1	2nd language
EPS-4-S1	Sport activities

UE GI-4-INFO-S1 COMPUTER SCIENCES

GI-4-CSI-S2

Knowledge

Capacity

GI-4-IHM-S1Human-computer interaction

Knowledge
- Know the methods and tools required for the design of interactive systems;
- Paradigms of innovative interactions;
- Methods and models for HCI design;
- Analysis of user requirements;
- Modelling the activity;
- Sketching and prototyping of interactive systems;
- Ergonomic criteria for HCI design;
- Methods of evaluation of HCI.

Capacity
- Know how to apply a user-centered method to design an interactive system;
- Know how to make an ergonomic critique of an interactive system;
- Developing creativity to meet a need for technological innovation.

GI-4-ADD-S1 Data analysis

Knowledge
- Data pre-processing methods; Data analysis methods: segmentation;
- Classification;
- Visualization;
- Performance Indicators.

Capacity
- Master structured data processing tools (Excel and xlstat);
- Be able to make a decision based on numerical results;

- Choose a processing method based on data and objectives;

PRE-REQUISITE : STATISTICS, DATABASE

GI-4-EDD-S1 Data warehouse + project

Knowledge

- Operational and analytical data diagrams;
- The basic data transformation actions and their sequence;
- Methods and tools for data visualization.

Capacity

- Collecting customer needs for analysis;
- Identify the sources of production data that are useful in an analytical approach;
- Processing big data for analysis;
- Use data with the perspective of the activity analyzed.
- Successfully manage a project through group work;

PRE-REQUISITE : RELATIONAL DATABASES, SQL

GI-4-SID-S1 Distributed information systems

Knowledge

- Understand process mining techniques: the construction of Petri nets from activity log, conformity analysis of the model, performance analysis of the system;
- Know how to modify and adapt the structure of a distributed information system structured around processes, such as the Odoo ERP, and analyze the performance of such a system using process mining tools.

Capacity

- Design and develop a distributed application that stores and provides a remote access of data involved in a workflow process;
- Analyze the process performance from the traces generated by the information system using process mining tools;
- Working in team

OPTION Optimization of the decision-making chain

GI-4-OCD-S1

Knowledge

- Extract knowledge from data and use it for decision making
- Raise awareness of Industry 4.0 concerns related to merging, consolidating and reliably exploiting corporate data
- **Capacity**
- Building a Data Warehouse from raw data
- Introduction to data modeling for machine learning
- Methodology for the application of machine learning
- Application: predictive maintenance, building a model for failure prediction
- Application: Construction and operation of a model for failure prediction.

UE GI-4-PCO-S1 TEAM PROJECT MANAGEMENT

GI-4-GCP-S1 Project management

Knowledge

- Taking place, working and evolving in a company or any socio-productive organization.

Capacity

- Identify and bridge gaps in a continuous improvement approach (material, human, information systems) by using analysis and cross-simulation tools;
- Lead any type of project (team, resources, budget, clients and supplier's management) at any level (operational, strategic, transversal or pilot);
- Ensure good-quality reporting by setting up relevant indicators, based on a systemic view of the involved organizations (matrix, silo, project) for any perimeter and activity type.

GI-4-PCO-S1 Team projects

Knowledge

- Tools and methods: project management, system engineering, quality management, communication.

Capacity

- Implement management tools;
- Learning to collectively lead a real project: collective organization of the group, communication, animation, coordination;
- Apply rigorously a structured, coherent and relevant approach to designing an industrial solution by integrating performance factors: Risks + Costs + Quality + Usage;
- Collecting, extracting, structuring and analyzing information;
- Evaluate one's strengths and limitations, negotiate, be a force of proposition;
- Analyze in a global, systemic approach a company, an organization, a project, a problem.

4th YEAR – Semester 2

Educational Units contribute to the competencies specified in the COMPETENCY FRAMEWORK and allow the engineering student to work and to be evaluate on a set of knowledge and abilities.

UE GI-4-GOP-S2 MANAGEMENT & OPTIMIZATION OF PRODUCTION

GI-4-GPR-S2 Project: Production management, ERP

Knowledge

- SAP ERP (structure, concepts, applications);
- Basic data required for production and sales planning processes (customer, article, bill of materials, workstation, routing, cost center);
- Production planning processes (make-to-stock, assemble-to-order strategies);
- Sales order management process.

Capacity

- Master the use of an Enterprise Resource Planning system (ERP) for production management in the context of discrete manufacturing (functional customizing);
- Understand the challenges of business integration through an ERP system.

PRE-REQUISITE : GI-3-IGP-S1 AND GI-4-GPA-S1

BASICS ABOUT PRODUCTION PLANNING AND MANAGEMENT; THEORETICAL KNOWLEDGE ABOUT ERP SYSTEMS: CONTENTS, STAKES, AND ERP PROJECT MANAGEMENT

GI-4-ROP-S2 Operational research

Knowledge

- Basics of the theory of complexity, Basics of Graph theory,
- Bases of operational research,
- Representations of a graph,
- Connectivity, related components,
- shorter way and longer way,
- Maximum coupling, Maximum flow.

Capacity

- Recognize a graph problem,
- Modeling an optimization problem as a graph problem
- Evaluate the complexity of an algorithm

UE GI-4-PEP1-S2 OPERATION MANAGEMENT

GI-MES-S2 MES Project

Knowledge

- MES functions;
- Performance analysis and OEE;
- Production traceability;
- Control of production execution.

Capacity

- Use a MES implementation process, which includes capabilities: defining the functional needs of a MES, designing the functional solution elements of this MES;
- Realize the MES solution;
- Integrate this MES into its environment;
- Verify and validate the MES solution.

FR - PRACTICAL WORK IN FRENCH PRE-REQUISITE : GI-4-ADD AUT-S1 AUTOMATED MANUFACTURING SYSTEMS: ROLE, ARCHITECTURE, COMPONENTS (SENSORS, ACTIVATORS), CONTINUOUS AND BATCH PROCESS CONTROL - INFORMATION SYSTEMS: ROLE, ARCHITECTURE, DESIGN - PRODUCTION MANAGEMENT: ROLE, METHODS.

GI-4-QMA-S2 Quality – Maintenance
Knowledge
- Six sigma;
- Statistical Process Control (SPC);
- Total Productive Maintenance (TPM), reliability.

Capacity
Understand the issues and tools of quality (quality system and tools of quality) and maintenance (impact of the organization of maintenance on the other company's functions). Understand the utility and operation of some tools (control charts, Gauge R&R, reliability, etc.).
PRE-REQUISITE : GI-3-PRS-S1

UE GI-4-HU EPS-S2 THE MAN & THE COMPANY

GI-4-BCG-S2 Budget and management control
Knowledge
- Management control: budgets, production costs, break-even point.

Capacity
- Create budgets (company, service, monthly or yearly);
- Calculate production costs (break-even point, direct and indirect costs, cost price);
- Gap analysis to make new forecasts.

PRE-REQUISITE : BASIC KNOWLEDGE OF THE OPERATION OF THE INDUSTRIAL ENTERPRISE AND ITS INTERACTIONS WITH ITS ENVIRONMENT. THE PRINCIPLES OF FINANCIAL ACCOUNTING.

GI-4-ASO-S2 Sociological analysis of the organizations
Knowledge
- Basics of sociology. The tools for sociological analysis of organizations. Guide for observation and organization analysis;
- The theory of conventions: key concepts. The cultural analysis of the organizations;
- Change management: sociological approach to change;
- The anticipation of the behavior's method;
- Mapping of actors;
- Method to choose a process for transformations.

Capacity
- Know and master the key concepts in sociological analysis of organizations;
- Diagnose a situation of organizational dysfunction, to understand the reasons, suggest courses of action argued;
- Contribute to the management of organizational change;
- Observe, understand, interpret social situations and be recorded in a written report.

PRE-REQUISITE : FLUENT IN FRENCH (SPEAKING AND WRITING)

GI-4-AIR-S2 Introduction to research (Introduction to research: workshop)
Knowledge
- Research institutions and actors in France;
- The place of engineers - doctors;
- Research issues in industrial engineering.

Capacity
- Develop an approach to scientific questioning on a research issue

EPS-4-S1 Sport

UE GI-4-PCO-S2 TEAM PROJECT MANAGEMENT

GI-4-PCO-S2 Team projects (See GI-4-PCO-S1 Team projects)

UE GI-4-STI-S2 INDUSTRIAL INTERNSHIP

GI-4-STI-S2 Industrial internship
Knowledge
- Feedback;
- Sociotechnical functioning of organizations.

Capacity
- Observe and analyze the strategy of an entity;
- Oral and written communication;
- Analyze a situation.

5th YEAR semester 1

Classic course

EDUCATIONAL UNITS CONTRIBUTE TO THE COMPETENCIES SPECIFIED IN THE COMPETENCY FRAMEWORK AND ALLOW THE ENGINEERING STUDENT TO WORK AND TO BE EVALUATE ON A SET OF KNOWLEDGE AND ABILITIES.

UE GI-5-ENTR-S1 BUSINESS MANAGEMENT

HUMA-PPH Personal Project in Humanities
The Personal Project in Humanities (PPH) is a work of personal reflection, performed in semi-autonomy, on a subject freely chosen by the student in the field of Humanities and Social Sciences. An engineer can't only be a scientific and technical expert, he must also be able to think with rigor and method to social, ethical, economic, political, aesthetic questions ...

HU-SHS-5-S1: 1 module of your choice:
- Calling into Question?
- Economics of globalization;
- The theater in the city;
- Social, climate and environmental justice;
- Personal and Professional Project: to go further;
- Understand and analyze change;
- Analysis of an economic model.

GI-5-MRH-S1 Human resources management
Knowledge
- Purpose and methods of human resources management, trade unions, main issues of social relations in companies, human resources management: teamwork and information-communication;
- Roles of leaders and leadership styles;
- HRM principles and tools (recruitment, assessment and management of skills, remuneration, career management, etc.);
- Motivation and change management;
- Social relations and contract of employment: social dialogue, IRP, trade unions and collective bargaining;
- Collective agreements;
- Elements of labor law; Intercultural management.

Capacity
- Analyze the advantages and limits of different management policies and practices in different contexts.
- Consolidate management knowledge acquired through group projects and industrial internships;
- Learn about human resources management and social relations;
- Clarify one's professional project and position as a manager; Strengthen listening and interpersonal communication skills, including in new cultural contexts;

PRE-REQUISITE : EXPERIENCE OF SEVERAL MONTHS IN BUSINESS IN AN ENGINEERING STUDENT INTERNSHIP. CONCEPTS OF MANAGEMENT CONTROL AND INDUSTRIAL MANAGEMENT. GENERAL KNOWLEDGE ABOUT THE INDUSTRIAL ENTERPRISE

GI-5-RSE-S1 Corporate social responsibility
Knowledge
Capacity

GI-5-KNM-S1 Knowledge management
Knowledge
- Knowledge-based industrial heritage;
- Data;
- Information and knowledge;
- Knowledge management method in industry, collaborative knowledge management tools;
- Digital knowledge management tools;
- Knowledge management strategies and continuous improvement;
- Technological, human and organizational knowledge and structure.

Capacity
- Distinguish the types of knowledge created through information and communication;
- Identify industrial (human, technological, organizational, informational) capital related to knowledge management;
- Assess the limits of knowledge management systems

UE GI-5-TAI 1A-S1 ADVANCED ENGINEERING TECHNIQUES

GI-5-ACH-S1 Sourcing process and supplier survey
Knowledge
- What is sourcing in the firm? From specification to continuous suppliers' improvement, the complete sourcing process;
- Definition of needs, "make or buy", from request to quotation to suppliers scoring: best offer;
- Negotiation, contractualization; Audit;
- Improvement in and out in sourcing activity;
- Simple tools: Sourcing scoring tools, worth admissible offer, cost analysis, incoterms, and use of consulting.

Capacity
- Model the process of conducting an activity;
- Ensure quality by reporting the development of relevant indicators;
- Promote, protect and sustain the expertise of entities;
- Put into perspective the scientific knowledge with the evolution of knowledge and technology;
- Observe, measure, analyze and interpret an event;
- Define and implement an action plan;
- Identify and sign contracts formalize the needs of a client, follow their evolution and validate compliance (traceability needs).

PRE-REQUISITE : FRENCH EUROPEAN LANGUAGE LEVEL RECOMMENDED B1

GI-5-LOG-S1 Supply chain and implementation of production systems
Knowledge
- Demand forecasting methods;
- Production planning methods;
- Stochastic inventory management methods;
- Methods of design and configuration of production systems

Capacity
- Determine the Supply Chain Performance;
- Identify the best location in the supply chain for a plant, warehouse, hub, and so on;
- Design distribution networks under uncertainty;
- Forecasting demand in a supply chain;
- Supply chain planning;
- Identify inventory management strategies under uncertainty;
- Optimize transport and routing in a supply and distribution chain;
- Joint optimization of transport and inventory; assembly line balancing; Designing a warehouse;
- Configuring manufacturing cells through group technology;
- Designing a smart manufacturing system, the factory of the future; Determine decision support methods for production system configuration in the context of Industry 4.0, the Internet of things;
- Big Data.

PRE-REQUISITE : PRODUCTION PLANNING AND MANAGEMENT, SCHEDULING, OPTIMIZATION

GI-5-LEA-S1 Lean
Knowledge
- 7 wastes, 3M, Just In Time, Jidoka, standardization;
- Changes in behavior for lean transformation;
- Relationship between Lean and other operational excellence approaches (Six Sigma, TOC);
- Lean tools (production leveling, continuous flow, SMED, 5S, 8D, Short Interval Management);
- Key factor of success in Lean transformation and traps to avoid;
- Steps to draw a Value Stream Mapping and design a future state

Capacity
- Conduct a problem-solving approach and present the project on A3 poster;
- Use VSM method to map the existing value stream and design a future state including principles of just in time and total quality; Identify value added activities and wastes from case study and real situations;
- Define improvement action plan;
- Apply Lean tools on real case (simulation of a production workshop);
- Encourage changes in behavior in Lean organizations.

PRE-REQUISITE : GI-3-IGP-S1 ET GI-4-GPA-S1

GI-5-GMA-S1 Computerized Maintenance Management System
Knowledge
- The functions of a CMMS, the processes of maintenance;
- Optimization of maintenance;
- Tools of maintenance (manufacturer's documentation, reliability,).

Capacity
- Understand the issues of the purchase of a CMMS;
- Define a maintenance strategy.

PRE-REQUISITE : GI-4-QMA-S2

GI-5-OPA-S1 Advanced planning and scheduling
Knowledge
- Mathematical programming;
- Complexity;
- Single-criterion / multicriteria approach;
- Exact and approximate solving methods

Capacity
- Methods: formally analyze and model planning or scheduling problems for material and / or human resources;
- Single- and multicriteria decision support problems;
- Implement a structured approach to address this type of problem (from identification to validation of the results);
- Techniques: determining the complexity of a problem and proposing possible resolution tools.

PRE-REQUISITE : GI-3-IGP-S1 ET GI-4-GPA-S1
MONOCRITERION DECISION SUPPORT (LINEAR PROGRAMMING).

GI-5-PRH-S1 Human resources requirement planning
Knowledge
- Integer programming;
- Constraint programming;
- Meta-heuristics;
- Quantitative human resources management.

Capacity
- Evaluate human resource requirements;
- Staff sizing;
- Define personnel attendance hours;
- Employee timetabling.

PRE-REQUISITE : LINEAR PROGRAMMING. STATISTICS AND FORECASTING.

GI-5-PCI-S1 Communication for Engineer project
Knowledge
- SWOT analysis
- Project management by risks (in a context outside production and services)
- Mastery of his written and oral communication as well as those of external speakers.

Capacity
- Organize a round table (C13, C14, B3, B4)
- Identify an industrial problem (A1, A3, A4)
- Define the industrial and structural issues and risks at the organizational and structural levels (A5)
- Interpolate industrial stakeholders (B3, B4)
- Knowing how to control a debate (C14, B3)

PRE-REQUISITE : BACHELOR

GI-5-INR-S1 Introduction to research (Introduction to research: project)
Knowledge
- Research issues in industrial engineering;
- Feedback from research problems characterization;
- Feedback from solution development and experiments.

Capacity
- Develop a research / innovation approach: subject appropriation, formalization of the research problem and / or of the solutions, development of solutions and experimentations

UE GI-5-P/INDUS-S1 INDUSTRIAL PROJECT

GI-5-PI1 -S1 **Industrial project 1**
GI-5-PI2-S1 **Industrial project 2**
GI-5-RSI-S1 **RSI**

Knowledge

- Industrial organization;
- Continuous improvement;
- Production data analysis and system sizing;
- Sourcing and material supply

Capacity

- Develop the capacities of observation and strategic analysis of an organization, integrate the technical and socio-economic aspects of a project or a process (of production, management ...);
- Improve communication and analysis skills, through a precise identification of the professional environment, by increasing the number of contacts and working relationships in the company, and so on.

EPS-5-S1 Sport activities

5th YEAR semester 1

Option: R&D course

Educational Units contribute to the competencies specified in the COMPETENCY FRAMEWORK and allow the engineering student to work and to be evaluate on a set of knowledge and abilities.

UE GI-5-R&D1-S1

GI-5-OTP-S1 Joint optimization of transport and production

Knowledge

- The "classical" transportation problems: Traveling Salesman Problem (TSP), Vehicle Routing Problem (VRP), etc;
- The basic methods and tools to design logistic networks;
- The principles and tools for distributed decision-making: game theory, multi-agent systems and agent-based simulation coupled with flow simulation (for instance with Anylogic);
- The tools (especially decomposition methods) to perform joint optimization.

Capacity

- To formulate and solve a supply chain optimization problem, from the viewpoint of transportation and flow management

GI-5-DSC-S1 Data science

Knowledge

- The basis of data mining and knowledge discovery processes;
- Several techniques of supervised classification (ADB, Random Forests), boosting), non-supervised and pattern extraction.

Lab sessions

- Three 4-hours lab sessions aim at applying these techniques on actual data, related to industrial engineering and especially production and transportation problems.

GI-5-IFU-S1 Industry of the future - Project

Capacity

- To apply knowledge and skills in supply chain optimization and data science;
- To propose a scientific approach in response to a problem.

GI-5-RGI-S1 Research in Industrial Engineering
(Research in Industrial Engineering: project)

Capacity

- Mobilize the relevant theoretical knowledge to deal with today's "state-of-the-art" research issues;
- Write a state of the art on a given research question;
- Understand and formulate a research question on an open, yet unexplored industrial engineering problem;
- Carry out a research approach over a long-time span;
- Write a document according to the redactional standards of a research article;
- Propose contribution ideas to answer a problem.

NB: for the sake of simplicity, the persons referred to in this document are designated "he"

UE GI-5-ENTR-S1 BUSINESS MANAGEMENT

HUMA-PPH Personal Project in Humanities
Idem classic course

GI-5-MRH-S1 Human resources management
Idem classic course

GI-5-RSE-S1 Corporate social responsibility
Idem classic course

GI-5-KNM-S1 Knowledge management
Idem classic course

GI-5-SVE-S1 Strategy and economical monitoring
Idem classic course

GI-5-ERG-S1 Ergonomics
Idem classic course

UE GI-5-TAI 2A-S1 ADVANCED ENGINEERING TECHNIQUES

GI-5-ACH-S1 Sourcing process and supplier survey
Idem classic course

GI-5-LOG-S1 Supply chain and implementation of production systems
Idem classic course

GI-5-LEA-S1 Lean
Idem classic course

GI-5-GMA-S1 Computerized Maintenance Management System
Idem classic course

GI-5-OPA-S1 Advanced planning and scheduling
Idem classic course

GI-5-PRH-S1 Human resources requirement planning
Idem classic course

UE GI-5-P/INDUS-S1 INDUSTRIAL PROJECT

GI-5-PI1 -S1 **Industrial project 1**
GI-5-PI2-S1 **Industrial project 2**
Idem classic course

EPS-5-S1 Sport activities

5th YEAR semester 2

Classic and R&D options

Educational Units contribute to the competencies specified in the COMPETENCY FRAMEWORK and allow the engineering student to work and to be evaluate on a set of knowledge and abilities.

UE GI-5-PFE-S2 END OF STUDIES PROJECT

After the industrial internship, students are more familiar with companies, gain confidence in their skills and have a more accurate idea of their career goals. The 5th year is intended to synthesize the instruction received and to deepen some of the knowledge.

Objectives: This project is a personal work done in a professional situation that aims at developing the autonomy, the imagination, the curiosity, the scientific rigor and the responsibility of the students, like the sense of the work in team, by applying the knowledge and skills, while providing the added value expected by the host organization.

The company or a laboratory entrusts a problem to solve to the student. Beyond the strict application of knowledge and the theoretical and methodological tools acquired during its training, the future engineer must show his ability to analyze the situation, characterize the problem, look for potential external solutions, propose, build and implement solutions to achieve the objectives and/or deliverables. In general, this involves adopting a project manager's behavior in the context of the treatment of the issue, defining the tasks to be performed and respecting the associated schedule.

If the subject of the assignment includes in addition to the engineering dimension, a dimension «research» or «innovation» and if the company agrees, the project is supported by a research laboratory, partner of IE department. This laboratory will be able to bring its expertise and skills to the proposal of innovative solutions.

Knowledge

- Feedback;
- Functioning / operation of organizations;
- Self-awareness.

Capacity

- Carry out a personal work in a professional situation, solving an industrial and / or scientific problem;
- Analyze a situation and problematize it, achieve the objectives and / or expected deliverables;
- Develop autonomy, imagination, curiosity, scientific rigor and responsibility;
- Team working;
- Apply knowledge skills acquired during education

PRE-REQUISITE : ALL THE INDUSTRIAL ENGINEERING TRAINING.

STUDENT ENTREPRENEUR PROGRAM (FEE LYONTECH)

Training for entrepreneurship

The objective of the Student Entrepreneur Program is to train engineers in entrepreneurial skills, through a real-life project, which forces students to consider, assimilate and assume the risks that are inherent to business. This is a six-month option, from February to September, during the last year of the engineering cycle. It replaces the End of Studies Project (after acceptance of the application).

The Student Entrepreneur section provides future engineers with an additional skill, developing their capacity to manage a team, drive an innovative project or create a business.

The Student Entrepreneur program allows students to become familiar with the major tools of business and project management, and to control processes and behaviors, through experiential learning.

The Student Entrepreneur program awards the specialized "Technology Entrepreneur and Manager" Certificate.

LEAN MANAGEMENT

Professionalization contract

Period: February for a duration of 8 months
¼ of the time in training course (300 h)
¾ time in the company

Students issued from four departments of INSA Lyon, are eligible for this program, during the last year of their training course:

- Biosciences;
- Electrical Engineering;
- Mechanical Engineering;
- Industrial Engineering.

Prerequisite: have validated the 4th year in one of the departments mentioned.

- CQPM Animator of the Lean approach
- Master's degree in Industrial Engineering
- Lean Six Sigma-Green Belt Certification

There is no correlation between graduation (Master's degree) and certification.