ECAM ENGINEERING PROGRAM

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ECAM Engineering is an innovative program combining a strong mechanical and electrical engineering basis and a specialization in challenging rewarding fields. It is taught entirely in English.

PREREQUISITE FOR GRADUATION

Commitment & Responsibilities				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Commitment & Responsibilities				

DELF				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
DELF				

IELTS				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
IELTS				

EENG - Year 1

Semester 1 (September - January)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Engineering Sciences S1	3	**Mechanical Design 1**	Description : - Technical Drawing: - Theory of projections - Types of drawings - Standards- Drawing Rules - Threads: Assemblies Screwing and Bolting ,drawing Screw Threads and other threaded elements - Creating sheet drawing on paper based on 3D view - Surface-to-surface intersection - Assembly Drawing: - Recognize standard parts and elements - Mechanism understanding - Elementary technological Functions: - Assembly surfaces - Complete joints function - Guiding in translation - Guiding in rotation function - Analysis of Mechanism - External analysis - Internal analysis - Mechanical joints - Technical solutions for joints - Minimum kinematic diagram - Computer Aided Design (CAD): - Presentation of CAD software: PTC CREO - Software environment - 2D sketches principals - 3D constructing base features - Basic 3D functions	Tutorials : 12h00 Lab Work : 12h00
		Metrology	Description : 1 lecture provides theoretical background: precision & accuracy, systematic & random errors, uncertainty quantification (types A & B) 3 practical works provide applied situations: one in mechanics (period of a pendulum), one in chemistry (volume of gas produced during a reaction) and one in electricity (Ohm's law).	Lectures : 2h00 Lab Work : 6h00
Fundamental Sciences S1	9	**Chemistry**	Description : Electronic structures & periodic properties (atomic radius, ionization energy, electronegativity…) Types of chemical bonds between atoms (ionic, covalent, metallic) and between molecules (dispersion force, dipole-dipole, hydrogen bond) involving molecule polarity (dipole moment, VESPR model…) States of matter: gaseous state (concept of pressure including partial pressure & vapour pressure, ideal gas law, real gases, density, kinetic theory of gases, diffusion, effusion), condensed matter states (in particular crystallographic structures of solids). Aqueous solutions (solubility, different types of concentrations, colligative properties) Chemical equilibrium (advancement table for reversible reactions, equilibrium constant K & quotient of reaction Q, Le Châtelier's principle, introduction to thermochemistry) Chemical Kinetics (rate of reaction, half-life, orders of reaction & rate laws, Arrhenius equation) Chemical kinetics Chemical equilibrium Application to electrochemistry	Lectures : 18h00 Tutorials : 18h00

Semester 1 (September - January)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		DC Electric Circuit Theory	Description : 1. Circuit terminology (branches, nods, meshes & loops…) 2. Circuit variables (definitions of current & voltage, I & V measurements, characteristics, power, energy) 3. Ideal basic circuit elements: independent voltage and current sources, dependent voltage and current sources, resistors, main properties, sign conventions 4. Ohm's law, Kirchhoff's current and voltage laws 5. Resistive circuits (series and parallel combinations, voltage and current dividers, ?-to-Y transformation) 6. Methods for circuit analysis (node voltage and mesh current methods, number of independent equations) 7. Source transformation 8.Thévenin's and Norton's theorems 9. Superposition theorem 10. Maximum power theorem 11. Inductors and capacitors (description of the components, voltage and current relation, exchanged power formulas, mutual inductance and mesh current equations for circuits containing magnetically coupled coils) 12. 1st Order responses (natural and step functions, RL & RC circuits) and 2nd order responses (RLC circuits) 13. Beyond DC circuits (introduction to AC signals and frequency responses of RLC circuits	Lectures : 18h00 Tutorials : 24h00 Lab Work : 6h00
		General Mechanics 1	Description : The topics covered in General Mechanics 1 consist of a general introduction of Mechanics and the study of kinematics: 1- Introduction: generalities (particle vs body), vectors, reference systems (Cartesian, cylindrical, spherical) 2- Rectilinear motion of a particle: velocity and acceleration, motion equations, continuous and erratic motion 3- General curvilinear motion of a particle: rectangular components, projectile motion 4- Curvilinear motion of a particle: normal and tangential components, cylindrical components, circular motion 5- Two-particle motion analysis: dependent absolute motion, Relative motion 6- Kinematics of a rigid body: translation, rotation about a fixed axis, absolute and relative motions	Lectures : 12h00 Tutorials : 12h00
Mathematics for Engineering S1	9	**Introduction to Algorithms**	Description : Basics of Python Sorting and Searching Numerical Algorithms String Algorithms	Lectures : 2h00 Tutorials : 16h00
		Mathematics for Engineers 1	Description : o Basic Mathematics o Trigonometry o Complex Numbers o Vectors o Introduction to matrices o Introduction to vector spaces o Functions o Differentiation o Integration o Polynomials o Ordinary Differential Equations o Limits and Sequences o Infinite series	Lectures : 48h00 Tutorials : 48h00
Professional and Personal Development 1	6	**A&M-EENG LV2-EC1**	Description :	

Semester 1 (September - January)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		Academic Methodology 1	Description : This course aims to make students aware of their learning capacity and to raise their awareness of the learning process. It leads students to reflect on their learning experiences and identify the best practices working for them. It also provides self-management tools to improve their learning abilities. The work axes are learning reflection, organizing information, time management, and group learning.	Tutorials : 12h00
		Personal Development	Description : This module aims to promote self-awareness by introducing students to different theories and tools enabling them to know better themselves, understand differences in behavior and perceptions in groups and estimate how their environment affects them. Students will partake in a variety of individual and collective exercises to help them identify their values, motivations, strengths and weakness, assess the way they interact with others.	Lab Work : 9h00
		Seminar 1 - Integrating into Higher Education	Description : In a world in perpetual motion, marked by an acceleration of innovations and the appearance of more collaborative models, a learner, a future efficient and responsible worker, must have a solid knowledge of himself (observation / reflexivity). In addition, the latter will have to obtain a great capacity for adaptation, evolution (resilience), qualities of listening and empathy towards others, as well as a certain ability to communicate. This seminar aims to ease post-bac students into higher education by : • Prepare learners for their career at ECAM LaSalle Lyon • Become an actor in their studies • Learn to work in a team The following tools will be used: Retrospection DISC Blason	Lectures : 12h00
		Sports Activities 1	Description :	Tutorials : 30h00
Projects S1	3	**Engineering Practice 1**	Description : - FabLab Training: Prototyping of a gripper: - Manufacturing of parts with 3D printers - Manufacturing of parts by laser cutting - Manufacturing of a part by manual turning - Manufacturing of a part in wood - Assembling and testing of the gripper - Study and improve of a steering system: - Presntation of the method of work: Analyse, Search, Construct, Test, and Measure - Introduction to AKERMAN angle and history of steering system - Assembling of a LEGO car - Measure steering angle of the car - Calcul of the steering radius - Search a solution to reduce the steering radius - Realise the modification on the car - Test the car on a specific track - Competition beteween the students teams	Tutorials : 12h00 Lab Work : 12h00
		Sustainable Development 1	Description : Part 1: Discussion: - About the background of the students - About the role of engineers in the future, in the context of industry evolution. Course 1: Introduction to Sustainable Development: - Historical background - The 12 SD objectives of the United Nations - Main issues raised from technology development and current trends Choice of topics and constitution of pairs.	Lectures : 3h00 Tutorials : 6h00
Semester 1	30			

Semester 2 (January - June)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Engineering Sciences S2	6	**Electronic Principles & Technology**	Description : - Review of the basics of electronic: operating (biasing) points, superposition theorem - Capacitors and technology: types of capacitors - Diodes : N and P semiconductors, PN junction, analysis of a diode circuit - Bipolar Junction Transistors: Biasing ans small signal analysis - Junction Field-effect transistor (JFET): JFET operating and transfer characteristics - Operational amplifiers: structure, the ideal op-amp model, negative feedback and fundamental op-amp configurations	Lectures : 12h00 Tutorials : 12h00 Lab Work : 9h00
		Mechanical Design 2	Description : - Geometric Dimensioning and Tolerancing (GD&T): - Definition - How to indicate GD&T on a technical drawing - Meaning of standard contraint: - Form: Straightness, Flatness, Circularity and Cylindricity - Profile: of a line or a surface - Orientation: Angularity, Perpendicularity and Parallelism - Location: Position, Concentricity and Symmetry - Runout: Circular and Total Runout - Writing dimension and tolerance - Functional surfaces Operating conditions clearance conditions tightening conditions play conditions - The I.S.O. fit system Recommended fits Writing the fits on a drawing Fundamental deviations of the shafts and bores - Functional conditions, Functional dimensions, Chain of dimensions method - Computer Aided Design (CAD): - Dynamic assembly - Technical Drawing on CREO - improvement of an existing system - Design of a new mechanism according specifications	Tutorials : 10h00 Lab Work : 20h00
		Manufacturing Processes	Description : INTRODUCTION TO MANUFACTURING: -Fundamentals Manufacturing processes (turning , milling) -Cutting parameters -Engineering metrology and instrumentation -Numerical control machining -GDT (geometrical dimension and tolerencing) -Machining operations and machine tools : machining and part geometry, turning and related operations, drilling and related operation, milling Cutting-tool technology: tool life, tool materials, tool geometry ? Surface texture: Two dimensional METROLOGY o Geometrical and surface profile Roughness parameters o Measuring length o Filters and cut off o Amplitude parameter o The different types of profiles (ISO3247) o Analyze experimental data of roughness and waviness using the surface state measurement TP: Turning and Related Operations Milling and Related Operations Measurement of Surface state Coordinate measuring machine (CMM) Computer-aided manufacturing control (for milling)	Lectures : 4h00 Lab Work : 12h00

Semester 2 (January - June)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Fundamental Sciences S2	8	**AC Electrical Circuits Theory**	Description : Linear Time Invariant system. Focus on first and second order systems. Introduction to time domain analysis for LTI. Transient and permanent regime study for arbitrary deterministic source via ODE's. introduction to harmonic analysis via transfert functions to obtain a frequency response, response time. Basics of linear filtering, Bode plots. Fourier Series, Laplace Transforms.	Lectures : 14h00 Tutorials : 18h00 Lab Work : 4h00
		General Mechanics 2	Description : The topics covered in General Mechanics 2 continue the topics covered in General Mechanics 1 by addressing the topics of Statics and Dynamics: 1- Newton's laws: basic concepts (force, mass), the three laws of motion, common forces 2- System of forces: forces resultant, force-moment equivalent at a point, particle equilibrium and its conditions 3- Non-inertial reference systems: ficitious forces, types of friction (static and dynamic) 4- Oscillations: Free undamped oscillations, simple harmonic motion, spring-mass sytems, simple pendulum, damped oscillations basics 5- Work and Energy: work, energy, power, work of common forces, work-energy theorem 6- Work and Energy: kinetic energy, gravitational potential energy, elastic potential energy, energy conservation.	Lectures : 12h00 Tutorials : 12h00
		Thermodynamics	Description : The general objectives of this course are a) to introduce the basic concepts of thermodynamics and, b) to provide guidelines to apply the basic concepts of thermodynamics to practical applications. The student will be able to understand the basic thermal interactions involved in the engineering environment and to size simple thermodynamic systems by mastering the following competencies mentioned in the course content below: Lectures + tutorials (18h+18h) I) Fundamentals of thermodynamics: - Introduction to thermodynamics: Definition and different forms of energy - Physical properties and state description: Equations of state for gases, ideal gases VS real gas. - First law of thermodynamics and application to ideal gases for closed and open systems - Second law of thermodynamics: definition of entropy and evolution of system processes, temperature concept, heat engines, refrigerators and efficiency concept - Transformations and thermodynamic cycles. II) Applied thermodynamics: - Compressions and expansions of gases - Thermal machines: Internal combustion engine, Combustion processes. - Thermal machines: Combustion turbines - Summary and revision session	Lectures : 18h00 Tutorials : 18h00
Mathematics for Engineering S2	7	**Computer Programming**	Description : Basics of data structures : arrays and linked lists Dynamic arrays Queues efficiently. Applications of data structrue	Lectures : 2h00 Tutorials : 16h00
		Mathematics for Engineers 2	Description : o Limits & Functions o Taylor Series o 2D/3D Geometry o Asymptotic curves o Parametric representations o Functions with two variables	Lectures : 24h00 Tutorials : 24h00

Semester 2 (January - June)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Professional and Personal Development S2	6	**Advanced English Skills 2**	Description : Language classes aim to: - Strengthen vocabulary - Acquire grammatical accuracy - Improve listening and reading comprehension skills - Improve oral expression and fluency - Develop students' potential and self-confidence.	Lab Work : 14h00
		Cultural Awareness 1 (Psychology - Sociology - Anthropology - Political Science)	Description : This module gives students the opportunity to choose a field in the social sciences in which they are interested. An individual syllabus is established for each course. Therefore, the learning outcomes differ between subjects.	Tutorials : 12h00
		Foreign Language 2	Description : 2 hour lessons every week. Expanded vocabulary Revision of grammar points Improvement of phonological control Language skills according to different CEFR level groups: A1 Can establish basic social contact by using the simplest everyday polite forms of: greetings and farewells; introductions; saying please, thank you, sorry etc. A2/B1 Has a repertoire of basic language, which enables him/her to deal with everyday situations with predictable content, though he/she will generally have to compromise the message and search for words. Can produce brief everyday expressions in order to satisfy simple needs of a concrete type: personal details, daily routines, wants and needs, requests for information. Can use basic sentence patterns and communicate with memorised phrases, groups of a few words and formulae about themselves and other people, what they do, places, possessions etc. Has a limited repertoire of short memorised phrases covering predictable survival situations; frequent breakdowns and misunderstandings occur in non-routine situations. Has enough language to get by, with sufficient vocabulary to express him/herself with some hesitation and circumlocutions on topics such as family, hobbies and interests, work, travel, and current events, but lexical limitations cause repetition and even difficulty with formulation at times. B2 Can express him/herself clearly and without much sign of having to restrict what he/she wants to say. Has a sufficient range of language to be able to give clear descriptions, express viewpoints and develop arguments without much conspicuous searching for words, using some complex sentence forms to do so. Has a sufficient range of language to describe unpredictable situations, explain the main points in an idea or problem with reasonable precision and express thoughts on abstract or cultural topics such as music and films. C1 Can select an appropriate formulation from a broad range of language to express him/herself clearly, without having to restrict what he/she wants to say.	Lab Work : 18h00
		Academic Methodology 2	Description : This course aims to make students aware of their learning capacity and to raise their awareness of the learning process. It leads students to reflect on their learning experiences and identify the best practices working for them. It also provides self-management tools to improve their learning abilities. The work axes are learning reflection, organizing information, time management, and group learning.	Tutorials : 12h00
		Optional Foreign Language	Description : 1.5 hour lessons every week. Expanded vocabulary Revision of grammar points Improvement of phonological control	Tutorials : 18h00

Semester 2 (January - June)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		Professional Development	Description : This module is aimed to help students prepare for their operator internship. Students will be introduced to LinkedIn and other tools to help them find internship opportunities.	Tutorials : 9h00
		Sports Activities 2	Description :	Tutorials : 30h00
Projects S2	3	**Engineering Practice 2**	Description : - 2 separat projects of 8 hours each - Students team work - Based on specifications, each team must propose a technical solution to a problem - After validation by the teacher, each team have to manufacture , test and improve their solution	Lab Work : 16h00
		Sustainable Development 2	Description : Part 2: Presentation by the students of the topics they have chosen during Part 1. Followed by debates, Q&A. Discussions about: - Individual and collective actions in favour of Sustainable Development. - Expectations from the students regarding their engineering curriculum.	Lectures : 3h00 Tutorials : 6h00
Semester 2	30			

EENG - Year 2

Semester 3 (September - January)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Electrical Engineering S3	6	**Digital Design**	Description : Introductory concepts Number systems, operations, and codes Logic gates and circuits Boolean algebra and logic simplification including Karnaugh maps Combinational logic analysis and functions of combinational logic Latches, flip-flops, timers, shift registers and counters Programmable logic Data storage Signal conversion and processing Data transmission, data processing, and control Integrated circuit technologies	Lectures : 14h00 Lab Work : 8h00
		Electronic Circuits & Systems	Description : - Main types of filters and filtering response: low pass filter, high pass filter, band pass filter, band rejection filter - Study of oscillators - Sensors: a short introduction and guide line for basic implementation - Electronic functions and applications - Study of the key functions of the NE555: monostable and astable configuration	Lectures : 8h00 Tutorials : 8h00 Lab Work : 9h00
		Electrical Networks	Description : 1. Review of DC and AC circuit analysis methods - The Ohms's, Kirchhoff's laws - Node-voltages and mesh-currents methods - Thévenin-Norton and Maximum power theorems 2. Introduction to the three-phase systems - Presentation of three-phase electrical systems: definition, properties, configurations and common representations. - Presentation of balanced three-phase loads, relationships between load voltages and currents. 3. Power-calculations in the three-phase systems - Calculation of active and reactive powers in the three-phase sources and loads - Presentation of reactive power compensation in three phase electrical installations - Presentation of unbalanced three-phase loads, phase to neutral and phase to phase voltages and neutral line current calculation 4. Transformers - Presentation of the single-phase electrical transformers - Modelization of the single-phase transformers - Autotransformers - Power calculations of the transformers - Voltage regulation and efficiency calculations	Lectures : 18h00 Tutorials : 24h00
Mathematics for Engineering S3	7	**Databases**	Description : Introduction to Relational database Models of database systems Theory of database systems Implementation of database systems Introduction to SQL language • Reminder on the relational model • Characteristics of SQL Query data • Data selection • Restrictions or conditions • Sorts • Joins	Lectures : 2h00 Tutorials : 2h00

Semester 3 (September - January)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		Mathematics for Engineers 3	Description : - Multivariable calculus: ° multivariate calculus (coordinate systems, scalar functions, vector functions, conservative vector fields, differential operators, Taylor expansions for functions from R^n to R^p, Implicit function theorem, simple PDE, Local Inverse Theorem) ° multiple and line integral (substitutions, volume integrals, area integrals, curvilinear integrals, Green-Riemann Theorem) - Linear algebra ° Introduction to linear spaces/subspaces in R^n, bases. ° Fundamental subspaces of a matrix - Rank Nullity theorem. ° Orthogonality ° Eigenvalues and Eigenvectors	Lectures : 24h00 Tutorials : 24h00
		Introduction to Numerical Simulations	Description : Introduction to the programming language Matlab for numerical computing. Octave presentation (graphical interface, quick start, documentation, help …). Variables and elementary instructions (elementary instructions and matrices operations). Scripts and structures instructions (creation and execution, loops iterations, logic tests). Functions and graphical illustrations.	Lectures : 6h00 Tutorials : 6h00
Mechanical Engineering S3	6	**Fluid Mechanics**	Description : This course aims to master the basic laws and principles of fluid mechanics and to be able to solve simplified examples of fluid mechanics due to theoretical and practical work preparing students to apply the acquired knowledge and skills in professional and advanced fluid mechanics courses. 18 hours of lectures, 18 hours of tutorials: • Review of fundamental Concepts and fluid properties • Fluid Statics: Hydrostatics, the branch studying fluids at rest • Fluid Kinematics & fluid motion analysis approaches (focus on Reynolds Transport Theorem) • Conservation laws part I: fundamental to our understanding of the physical and thermos-fluid systems (mass, momentum and energy conservation) • Conservation laws part II: efficiency concept & Bernoulli equation and extended Bernoulli equation as an application • Dimensional analysis: non-dimensional equations, from prototypes to models due to similitude principle and method of the repeating variables • Internal flows: Viscous flows in piping networks and pressure losses, major and minor losses • Internal flows: Flows over bodies, Drag and Lift forces • Fluid flow governing equations: Navier Stokes equations 8 hours of labs: • Venturi tube study: Bernoulli equation application • Hydraulic jet study: application of Momentum conservation • Flowmeters: flow measurement techniques • Pressure losses in a piping system • Drug force study: Assessment of the drag coefficient of different obstacles • Pump study: operating condition identification	Lectures : 18h00 Tutorials : 18h00 Lab Work : 8h00

Semester 3 (September - January)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		General Mechanics 3	Description : 1. Linear Momentum and Center of Mass • Linear Momentum • Newton's Second Law • System of Particles • Center of Mass 2. Impulse, Reduced Mass, Kinetic Energy of a System • Impulse of a Particle and a System • Impulse due to a Constant Force • Reduced Mass of a System • Kinetic Energy of a System 3. Elastic and Inelastic Collisions • Types of Collision • Coefficient of Restitution 4. Momentum • Linear and Angular Momentum • Moment due to Resultant Forces • Rigid Body • Linear and Angular Momentum of a Rigid Body 5. Impulse and Variable Mass System • Linear and Angular Impulse • Variable Mass Systems 6. Rolling, Rigid Body, and Pendulum • Rolling Motion • Sliding and Rolling • Kinetic Energy and Work of a Rigid Body • Physical Pendulum	Lectures : 12h00 Tutorials : 12h00
		Mechanical Design 3	Description : Subject 1 (More advanced theoretical concepts of design) • PRECISION MACHINE DESIGN • Principal criteria for joint functioning (static and dynamic) • Guide Performances (without rolling elements) (shaft/housing) in rotation • Plain Bearings (Bushings) • Ball/roller bearing Design, Bearing Load Ratings and Life Calculations • APTE method (APplication to business TEchniques) • Mechnaism using CREO software + simulation + kinematics+ dynamics + static. They developed their understanding of theoretical design +kinematics+ dynamics using CREO software. • Mechanisms/Linkages: Kinematic Constraints, Degree of Freedom (Mobility) in Planar and Spatial Mechanisms Mechanisms, Gruebler's equation, Types of kinematic chains Subject 2: 2- Assembly Project of wind turbine system : The students apply all the theoretical design aspects and computer aided design on a project developed by the professor. Objectives of the project: -Starting from the old existent design to modify and improve or create a new design using CREO dynamic assembly and dynamic joints. -Find the design solution on the paper • Create the sub-assemblies • Create the assembly of final new design+ mechanism: dynamic joins, simulations, kinematics, • Create the drawing draft for the created and modified designed parts Subject 3- Mechanics calculation (machine cinematic) 1. POSITION ANALYSIS 2. VELOCITY AND ACCELERATION ANALYSIS -velocity/acceleration polygon for mechanisms- analysis (relative velocity method) -position, velocity and acceleration analyses for planar mechanisms using complex number method (analytical method)	Lectures : 12h00 Tutorials : 12h00 Project : 2h00

Semester 3 (September - January)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Multidisciplinary Projects S3	5	**Multidisciplinary Project 1**	Description : Project Based Learning: Mechanical Design: - using the CREO CAD software, create the parts starting from the real & sectioned prototype by measuring dimensions using adapted measurement tools (metrology) - Create the subassemblies - Create the final assembly using the necessary dynamic joints. - Create the assembly drawing draft with nomenclature. Represent at least one section to allow the visualization of the mechanism. - Represent in the assembly drawing two main necessary fittings and the functional conditions required in the mechanism. - Using CREO mechanism: run the simulation using the calculated data Electronics: - Sensors characterization (reading and interpreting the specifications). - Arduino Code development - Prototyping - Project demonstration with creation of a video	Lectures : 2h00 Tutorials : 6h00 Project : 4h00
		Sustainable Development 3	Description : This course reinforces the general knowledge on Sustainable Development (SD) acquired in the 1st year and proposes the students to develop some concrete actions towards Sustainable Development in their projects. During S5, students identify a concrete issue in their surrounding environment, and provide a diagnosis of the situation. They also develop an action plan to implement some concrete actions that could improve the problem situation. During S6, students must implement their solution : implementation can take different forms, and results must be ideally measured. Students must adopt a critical viewpoint on their results and present / demonstrate them during the European Sustainable Development week (May).	Lectures : 2h00 Tutorials : 6h00

Semester 3 (September - January)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		Pathway Discovery Workshops / Winter Schools	Description : Workshops are mixing three types of activities: - A practical work or experiment related to the pathway - Series of conferences or round tables with professionals - Visits of industrial companies' sites "Robotics & automation" workshop The goal of the workshop is to build a robotic system called Polargraph: the system receives an image as input and draws its contour on a whiteboard as output. First, the students study the mechanical structure of the system to define its specifications. Second, they learn the basics of computer vision during a 4-hours session lab. Third, they setup the system (electronic and mechanic) components, program the contour detection algorithm in Python, and the control algorithm on the Arduino board. Finally, they test the limits of the system by manipulating several parameters (e.g. frame rate). "Energy" workshop i. Students will design the blades, and plan the performance: power vs. wind speed velocity. At this step, aerodynamics and optimization of the design are the two main bricks to focus on. ii. then they will build the electric circuit, connect it to the DC generator and the Boost converter and verify and test the good operation of the circuit iii. Students should finally, assemble all the parts (blades on axis, motor on support/tower) "Mechanical engineering workshop 1- The students will design, using CREO, a mechanical crane that should be able tohold and transport an object in space. The model is sized based on the mechanical components given to the students at the beginning of the workshop (bearings, gears). The total weight of the crane and its volume should be minimized. 2- The CAD design of the crane arm will be then imported to the numerical simulation Ansys software where a FEM (Finite Element) analysis is performed to check the ability of the arm to withstand the maximum force acting upon it. A topology optimization is also performed and the design can be then improved accordingly (A tutorial video about this simulation: https://www.youtube.com/watch?v=qLBpQVhfXIc). 3- Finite element programming of the basic equations with the help of MATLAB language should be realized to study the deformation of the crane arm. The FEM results of the arm using Ansys software should be compared with the analytical solution of finite element method. Please refer to annex for details 4- Once the design is finalized, the final CAD model is 3D-printed using PLS or ABS materials. 5- The prototype is run by servo motor controlled by Arduino to control the speed and the direction of the arm. 6- A test is performed to assess the ability of the prototype to carry the weight.	Project : 40h00
Professional and Personal Development S3	5	**Communication**	Description : This module has been strategically placed in semester 3 so that the students take it before their workshops in January. Students will have a basic overview of the main theories in communication such as Information Theory, Interpersonal Communication, and Organizational Communication, as well as: Rhetorical devices Negotiation Non-violent communication	Tutorials : 24h00

Semester 3 (September - January)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		Microeconomics	Description : This module is designed to give students a basic understanding of Microeconomics that is necessary for entrepreneurship.	Lectures : 6h00 Tutorials : 12h00
		Seminar 2 - Reflecting on the 1st Year	Description : As part of its development, and in a logic of supporting its employees as best as possible in the changes in the world of today and tomorrow, ECAM LaSalle Lyon wants to set up 4 half-days of support which will allow employees of : • Allow its learners to analyze their first year of studies • Develop their reflective analysis • Set goals for the year	Lectures : 12h00
		Sports Activities 3	Description :	Tutorials : 30h00
Semester 3	30			
Semester 4 (January - June)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Electrical Engineering S4	6	**Electrical Networks**	Description : 1. Review of DC and AC circuit analysis methods - The Ohms's, Kirchhoff's laws - Node-voltages and mesh-currents methods - Thévenin-Norton and Maximum power theorems 2. Introduction to the three-phase systems - Presentation of three-phase electrical systems: definition, properties, configurations and common representations. - Presentation of balanced three-phase loads, relationships between load voltages and currents. 3. Power-calculations in the three-phase systems - Calculation of active and reactive powers in the three-phase sources and loads - Presentation of reactive power compensation in three phase electrical installations - Presentation of unbalanced three-phase loads, phase to neutral and phase to phase voltages and neutral line current calculation 4. Transformers - Presentation of the single-phase electrical transformers - Modelization of the single-phase transformers - Autotransformers - Power calculations of the transformers - Voltage regulation and efficiency calculations	Lectures : 14h00 Tutorials : 14h00 Lab Work : 12h00
		Electronic Circuits & Systems	Description : - Main types of filters and filtering response: low pass filter, high pass filter, band pass filter, band rejection filter - Study of oscillators - Sensors: a short introduction and guide line for basic implementation - Electronic functions and applications - Study of the key functions of the NE555: monostable and astable configuration	Lectures : 8h00 Tutorials : 6h00 Lab Work : 6h00

Semester 4 (January - June)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		Electrostatics & Magnetostatics	Description : 1. Introduction - Elements of vector analysis - Scalar and vector fields - Derivatives and integrals - Cartesien, cylindirical and spherical coordinate systems. 2. Electrostatics - Electrical force (Coulomb's law) - Superposition principle, Curie's theorem - Gauss's law used to express electric field in simple situations) - Electric potential and work, conservative field - Electrostatics in metals (emphasizing the study of capacitors) 3. Magnetostatics - Magnets (historical background) - Magnetic field (Biot-Savart law) due to a line, a loop. - Ampère's circuital law (used to express magnetic field in simple situations) - Magnetic force (Lorentz) - Ampère's force law and magnetic torque. Their application to electrical machines. - Faraday's law and Lenz's law. Their application to alternators. - Introduction to Maxwell's equations	Lectures : 14h00 Tutorials : 14h00 Lab Work : 12h00
		Embedded Software	Description : 1. Introduction to embedded systems and C programming using Arduino Microcontroller 2. Introduction to Arduino programming : Basic sketches, digital hardware consideration, arrays, functions and pointers 3. Sensors and actuators (analogue and digital inputs and outputs) 4. Port Manipulation : Serial communication (simplex and duplex) 5. Timers, counters and interrupts	Lectures : 12h00 Lab Work : 12h00
Mathematics for Engineering S4	7	**Mathematics for Engineers 4**	Description : 1 - Improper integrals 2 - Power series 3 - Vector space and linear map 4 - Pre-Hilbert space 5 - Systems of differential equations 6 - Orthogonal transformation - Linear isometry 7- Spectral theorem and SVD	Lectures : 36h00 Tutorials : 36h00
		Simulations & Numerical Methods	Description : Introduction to numerical simulations, mathematical formulations and computer programming. Description of classical numerical methods (discretization, Bisection method, Newton's method, Euler's method, Gaussian elimination, curve fitting, numerical integration, numerical differentiation, finite elements) Implementing appropriate numerical algorithm using Octave. Numerical approximation and error estimation. Graphical representation.	Lectures : 18h00 Tutorials : 18h00

Semester 4 (January - June)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Mechanical Engineering S4	6	**Materials 1**	Description : 1. Introduction to Material Science and Engineering • Classes of Materials • Manufacturing Processes 2. Materials in Atomic Scale • Atomic Structure and Bonding • Different Crystalline Structures • Atomic Arrangement • Crystallographic Directions and Planes 3. Material Properties • Elastic Moduli • Bond Force 4. Failure • Mechanisms of Failure: Fracture, Fatigue, Creep • Ductile and Brittle Materials 5. Dislocations and Strengthening • Dislocations and Plastic Deformation • Mechanisms of Strengthening 6. Introduction to Phase Diagram • Unary and Binary Phase Diagrams • Phase Composition	Lectures : 12h00 Tutorials : 12h00
		Mechanical Design 4 - Gearing Modelling & Force Analysis	Description : Subject 1-study the translation and rotation. We also introduce the notion of Homogeneous transformations which combines the operations of rotation and translation into a single matrix multiplication. Subject 2-Mathematical modeling of the aerodynamic equations and programming using Matlab is performed to calculate all the required forces and parameters. Wind turbines are designed to generate the maximum power from the wind with keeping the cost of construction reasonable. In this work, we have developed a mathematical modeling and numerical simulation using Finite volume method to optimize the geometry of the blades and thereby extract the maximum power. Modeling was performed using the Blade Element Momentum Theory, numerical values and Aerodynamic equations were developed for geometry optimization Applying conservation of angular momentum equations and using the blade element theory we derive the differential forces, torque, power, angles and the power coefficient. Then, we calculated the total thrust T, torque, Q, and power, P as the sum of the differential power from each of the spanwise segments. All the geometrical blade parameters that maximize the power extracted from the wind was chosen for geometrical modeling and CFD simulations. These results were obtained as functions of different inputs like the speed ratio and the number of blades and many other geometrical parameters. The obtained values that maximize the maximum power were used to design the geometry of the blade using CREO software. The simulation results show the importance of numerical simulation to optimize the blades geometry and improve wind turbine performance Subject 3 gears 3-• Principal of gearing • (forces analysis) • CREO modeling, assembly and simulation of different type of gears (Advanced level); spur gear, helical gear, bevel gear)	Lectures : 8h00 Tutorials : 12h00 Project : 4h00

Semester 4 (January - June)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		Solid Mechanics	Description : - Introductory concepts: Normal and shear stress, strain and deformation - Stress state: stress tensor, stress transformation, Mohr's circle - Strain state: strain tensor, relation between strain component and deformation, Mohr's cirlce - Behavior of materials: constitutive equations, tensile test, linear elastic material properties: Young's modulus, shear modulus, Poisson's ratio - Application: analysis of stresses in thin-walled pressure vessels - Plane elasticity: plane stress and plane strain configurations, 3D Mohr's circle - Yield criteria: yielding and plastic deformation in general configurations, Tresca and Von Mises criteria	Lectures : 12h00 Tutorials : 12h00 Lab Work : 8h00
Multidisciplinary Projects S4	6	**Multidisciplinary Project 2**	Description : Mechanical Design: - using the CREO CAD software, create the parts starting from the real & sectioned prototype by measuring dimensions using adapted measurement tools (metrology) - Create the subassemblies - Create the final assembly using the necessary dynamic joints. - Create the assembly drawing draft with nomenclature. Represent at least one section to allow the visualization of the mechanism. - Represent in the assembly drawing two main necessary fittings and the functional conditions required in the mechanism. - Using CREO mechanism: run the simulation using the calculated data Electronics: - Sensors characterization (reading and interpreting the specifications of mode of operation). - Arduino Code development - Prototyping - Project demonstration with creation of a video	Lectures : 2h00 Tutorials : 10h00 Project : 12h00
		Sustainable Development 4	Description : A format based on conferences given by non-profit organizations speakers and visits is planned.	Lectures : 2h00 Tutorials : 6h00

Semester 4 (January - June)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		Pathway Discovery Workshops / Summer Schools	Description : Workshops are mixing three types of activities: - A practical work or experiment related to the pathway - Series of conferences or round tables with professionals - Visits of industrial companies' sites "Robotics & automation" workshop The goal of the workshop is to build a robotic system called Polargraph: the system receives an image as input and draws its contour on a whiteboard as output. First, the students study the mechanical structure of the system to define its specifications. Second, they learn the basics of computer vision during a 4-hours session lab. Third, they setup the system (electronic and mechanic) components, program the contour detection algorithm in Python, and the control algorithm on the Arduino board. Finally, they test the limits of the system by manipulating several parameters (e.g. frame rate). "Energy" workshop i. Students will design the blades, and plan the performance: power vs. wind speed velocity. At this step, aerodynamics and optimization of the design are the two main bricks to focus on. ii. then they will build the electric circuit, connect it to the DC generator and the Boost converter and verify and test the good operation of the circuit iii. Students should finally, assemble all the parts (blades on axis, motor on support/tower) "Mechanical engineering workshop 1- The students will design, using CREO, a mechanical crane that should be able to hold and transport an object in space. The model is sized based on the mechanical components given to the students at the beginning of the workshop (bearings, gears). The total weight of the crane and its volume should be minimized. 2- The CAD design of the crane arm will be then imported to the numerical simulation Ansys software where a FEM (Finite Element) analysis is performed to check the ability of the arm to withstand the maximum force acting upon it. A topology optimization is also performed and the design can be then improved accordingly 3- Finite element programming of the basic equations with the help of MATLAB language should be realized to study the deformation of the crane arm. The FEM results of the arm using Ansys software should be compared with the analytical solution of finite element method. Please refer to annex for details 4- Once the design is finalized, the final CAD model is 3D-printed using PLS or ABS materials. 5- The prototype is run by servo motor controlled by Arduino to control the speed and the direction of the arm. 6- A test is performed to assess the ability of the prototype to carry the weight.	Lab Work : 40h00
Professional and Personal Development S4	5	**Macroeconomics**	Description : This course is designed to give students a basic understanding of Macroeconomics that is necessary for entrepreneurship.	Lectures : 6h00 Tutorials : 12h00
		Management	Description : Students will have an overview of the history of management and contemporary theories. They will be able to understand, and discuss types of managers and the functions, strategic, international, and interpersonal challenges they face.	Lectures : 6h00 Tutorials : 12h00
		Sports Activities 4	Description :	Tutorials : 30h00
Semester 4	30			

EENG - Year 3

Semester 5 (September - January)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Electrical Engineering S5	5	**Electrical Machines**	Description : This course provides engineering students with in-depth knowledge of electrical machines theories. It teaches the students the necessary techniques of solving problems. The concept of magnetic field and the principle of operation of machines are covered. DC machines, their construction, their operation and their equivalent model are studied in depth. The principle of rotating magnetic field and AC machinery are underlined. AC machines including three-phase Synchronous machines and three-phase induction machines are explained. Analysis and calculations to find the voltage regulation and efficiency of a machine at a certain load are included. The different applications of each machine are studied as well.	Lectures : 14h00 Tutorials : 14h00 Lab Work : 8h00
		Power Electronics	Description : This course introduces a comprehensive overview of different power electronics components and applications. It presents the basics of devices, their characteristics, their principle of operation, and their range of applications as well. The course also underlines the principle of operation of converters used in DC drives (diodes rectifiers, controlled rectifiers and choppers). It discusses the principle of harmonics, performance parameters and filtering techniques. Furthermore, upon completion of this course, the student will be able to outline the characteristics and operation principle of power AC drives (inverters and AC-AC controllers). Mainly full bridge and three phase circuits are highlighted. The effect of inductive loads and protection schemes are discussed as well. The student will understand and be able to describe switching techniques and conduct both performance and harmonical studies. The student will be able to demonstrate a certain familiarity with the various configurations and applications and to develop models and simulations.	Lectures : 8h00 Tutorials : 6h00 Lab Work : 8h00
Industrial Organisation S5	5	**Industrial Methods**	Description : • Processes for the transformation and processing of metallic and plastics materials. • Introduction to unconventional and CNC (Computer Numerical Control) Manufacturing processes. • Study of workpiece fixturing and development of machining process planning for mechanical parts.	Lectures : 8h00 Tutorials : 10h00
		Industrial Organisation	Description : • Schools of the organization • PDCA, "What? who? where? when? How, Why? How much?" , PARETO, 5M, 5 Why & Action Plan. • Industrial Planning courses 1, 2 & 3 • Technical Database (Bill Of Materials and Ranges) • Hourly rate, costing • The MRP2 system with its 3 levels: S&OP (Sales & Operations Planning), determination of the MPS (Master Production Schedule), load calculations and introduction to MRP (Materials Requirements Planning). Link with capacity planning. • Lean Management • Notions around TPM: OEE, OOE, 6 major losses	Lectures : 24h00 Tutorials : 24h00
Mathematics for Engineering S5	6	**Mathematics for Engineers 5**	Description : * Lebesgue integration and Hilbert Spaces - Parameter dependant integrals. * Fourier Series * Fourier Transform * Laplace Transform * Some Classical examples in Partial Differential Equations * optimization: non linear optimization (unconstrained and constrained optimisation for functions of several variables) linear optimisation (simplex method)	Lectures : 30h00 Tutorials : 30h00
		Networks & Security	Description : Diagnosing and repairing security issues Deploying and managing LANs and WANs Wireless computer technology Network infrastructure and applications	Lectures : 8h00 Tutorials : 4h00 Lab Work : 8h00

Semester 5 (September - January)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Mechanical Engineering S5	7	**Introduction to Heat Transfer**	Description : 12 hours (lecture), 12 hours (tutorial), 8 hours (Practical Work) - General introduction : fundamentals of heat transfer, heat transfer mechanisms, relationship to thermodynamics, methodology of analysis. - Fundamentals of conduction : Heat conduction equation, Fourier's law, one-dimensional heat conduction equation solutions with/without heat generation, variable thermal conductivity, boundary and initial conditions. - Steady heat conduction : heat conduction in plane walls, cylinder wall and spherical shell, thermal resistance concept, generalized thermal resistance network, notion of thermal contact temperature, critical radius of insulation, heat transfer from finned surfaces. - Fundamentals of convection : physical mechanisms, hydrodynamic/thermal boundary layer equations, Nusselt and Prandtl numbers, boundary layer similarity, Reynolds analogy. - External forced convection : laminar and turbulent flow, heat transfer correlations for the parallel flow over flat plates and the flow over cylinders and spheres, flow across tube banks. - Internal forced convection : laminar and turbulent flow in tube, thermal entry length, general thermal analysis, log mean temperature difference, heat transfer correlations for circular/non-circular tubes. - Introduction to radiation: spectral and directional distribution, notion of solid angle, blackbody radiation, Stefan-Boltzmann law, emission from real surfaces, radiative properties (emissivity, absorptivity, transmittivity, reflectivity), Kirchoff's laws.	Lectures : 12h00 Tutorials : 12h00 Lab Work : 8h00
		Materials 2	Description : 1. Diffusion • Mechanisms of Diffusion • Diffusion Flux • Factors of Diffusion 2. Phase Diagrams I • Microstructure • Equilibrium and Non-Equilibrium Cooling 3. Phase Diagrams II • Binary Eutectic Systems • Hypoeutectic and Hypereutectic • Relative Amounts in the Micro-constituents • Equilibrium and Non-Equilibrium Cooling of Binary Systems	Lectures : 6h00 Tutorials : 6h00 Lab Work : 12h00
		Strength of Materials	Description : - Introduction: review of Statics and Solid Mechanics (stress and strain) - Axial loads: stress concentrations, stresses due to temperature change, solutions of hyperstatic systems - Torsional loads: torsion of shafts due to applied torques, design of transmission shafts, stress concentrations - Analysis of beams under later loads: shear and moment diagrams - Pure bending of beams: normal stresses, properties of cross-sections - Deflection of beams: elastic curve equation, resolution of hyperstatic systems	Lectures : 12h00 Tutorials : 12h00 Lab Work : 8h00
Multidisciplinary Projects S5	3	**Ecodesign Project Part 1 - Environment**	Description : The project contains 3 expected content types: courses & tutorials, project sessions (labs), and personal work. Content of Semester 5: 1. Courses & tutorials: basics of environmental evaluation & LCA. - Courses topics: global environmental issues, impacts and indicators, life cycle thinking, environmental evaluation using LCA - Tutorials on Simapro 2. Project sessions (labs) supervised by the teacher. - Energy measurements: data acquisition using a data logger - Dismantling (tools available) and BoM definition - Life cycle modelling on Simapro 3. Personal work: information search, interpretation of LCA results.	Lectures : 5h00 Tutorials : 8h00 Project : 8h00

Semester 5 (September - January)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		Ecodesign Project Part 1 - Technical	Description : The project contains 3 expected content types: courses & tutorials, project sessions (labs), and personal work. For each semester, this projects represents ~40h of work on-site + 20h-30h of personal work. The total workload for each semester is estimated to 60- 70h/student. Content of Semester 5: 1. Courses & tutorials: basics of environmental evaluation & LCA. - Courses topics: global environmental issues, impacts and indicators, life cycle thinking, environmental evaluation using LCA - Tutorials on Simapro 2. Project sessions (labs) supervised by the teacher. - Energy measurements: data acquisition using a data logger - Dismantling (tools available) and BoM definition - Life cycle modelling on Simapro 3. Personal work: information search, interpretation of LCA results.	Lectures : 3h00 Lab Work : 8h00 Project : 4h00
Professional and Personal Development S5	4	**Accounting & Finance**	Description : This course has been designed to give students a basic and broad understanding of accounting and finance that is necessary for entrepreneurship.	Lectures : 6h00 Tutorials : 12h00
		Advanced English Skills 5: IELTS Preparation	Description : 14 hour module concentrating on the different elements of the IELTS test, with the objective of reaching a minimum global band score of 7. Introduction to test Mock Listening paper and feedback Mock Reading paper and feedback Introduction to Writing paper, focus on task 1, achieving band 7 Sample papers Focus on task 2, structure and coherence and understanding question Full mock IELTS paper Mock speaking tests (individual on student request).	Lab Work : 14h00
		Entrepreneurship 1	Description : In the engineering program this course is the first step before other activities, projects and courses related to Innovation and Entrepreneurship. Hence, Entrepreneurship 1 aims to instill an entrepreneurship mindset in students and provide them a first overview of the management or business world. Students will be partake in a variety of individual and collective exercises to help “test” and “debate” some key steps an Entrepreneur goes through.	Tutorials : 12h00
		French as a Foreign Language	Description : 6 hour lessons every week : 4h face-to-face +2h guided autonomy Expanded vocabulary Introduction of grammar points Improvement of phonological control A1 Can establish basic social contact by using the simplest everyday polite forms of: greetings and farewells; introductions; saying please, thank you, sorry etc.	Lab Work : 18h00
		Optional Foreign Language	Description : 1.5 hour lessons every week. Expanded vocabulary Revision of grammar points Improvement of phonological control	Tutorials : 18h00
		Seminar 3 - Preparing for the Job Market	Description : As part of its development, and in a logic of supporting its learners as well as possible in the evolutions of the world of today and tomorrow, students will: • Identify their professional profile • Identify their motivations and values • Set goals for their life	Lectures : 12h00

Semester 5 (September - January)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Students Life Commitment	3	**Students Life Commitment Sem 5**	Description :	
Students Life Involvement	2	**Students Life Involvement Sem 5**	Description :	
Semester 5	30			
Semester 6 (January - June)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Control Engineering S6	6	**Introduction to Control Theory**	Description : 1. Introduction to continuous Linear Time-Invariant (LTI) systems 2. Mathematical models of LTI systems 3. Block diagram and the reduction rules 4. Time-domain analysis of a first order system 5. Time domain analysis of a second order system 6. PID controllers for TLI systems	Lectures : 14h00 Tutorials : 10h00 Lab Work : 8h00
		Electrical Machine & Drives	Description : This course covers the basic characteristics of DC and AC motors and describe their principle of operation and control within a power electronic environment. Basics in power electronics, electric machines and control circuits are reviewed and the overall systems is studied. Control techniques for DC drives are underlined and the four-quadrant operation is analysed. Control strategies for AC drives are discussed as well, mainly the scalar control, the field oriented control and the direct torque control. Detailed modelling of the control of induction motors using the FOC method is carried out.	Lectures : 8h00 Tutorials : 6h00 Lab Work : 4h00
Energy Engineering Courses S6	8	**Advanced Heat Transfer**	Description : 12 hours (lecture), 12 hours (tutorial), 12 hours (Practical Work) - Steady Heat conduction : heat transfer in common configuration, conduction shape factors. - Transient conduction : lumped system analysis, Biot number, transient heat conduction in large plane walls, long cylinders, and spheres with spatial effects, transient heat conduction in semi-infinite solids. - Numerical methods in heat conduction : finite difference formulation of differential equations, two-dimensional steady heat conduction. - Natural convection : physical mechanisms, equation of motion and the grashof number, natural convection over surfaces, natural convection inside enclosures, combined natural and forced convection. - Boiling and condensation : boiling heat transfer, pool Boiling, flow boiling, condensation heat transfer, film condensation, dropwise condensation - Heat exchangers : heat exchanger types, overall heat transfer coefficient, the log mean temperature difference, the effectiveness-NTU method, heat exchanger design and performance calculations. - Radiation heat transfer : the view factor, view factor relations, black surfaces, diffuse and gray surfaces, radiation shields and the radiation effect.	Lectures : 12h00 Tutorials : 12h00 Lab Work : 12h00

Semester 6 (January - June)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		Heating, Ventilation and Air Conditioning HVAC	Description : The purpose of this course is to deeply understand Heat, Ventilation and Air Conditioning technologies and their importance in the building and industry sectors (buildings energy consumption, thermal comfort, ...) and to manage to size and optimize and HVAC system. The course addresses also the future of the HVAC&R industry (EU F-Gas regulation, use of new refrigerant fluids, improvement of energy efficiencies, etc.). course content (10h of lectures + 10h of tutorials) • Introduction to HVAC (Importance of HVAC processes in our current society, cold production, cold chain management, energy consumption, environmental consequences) and classic mechanical refrigeration • Different Refrigeration technologies, and their performance (specificities and comparison) • Heat pumps specificities and performance (different heating technologies) • Humid air: Psychrometrics and thermodynamics of moist air. • Air Handling Units for air conditioning (components and technology evolution) Labs: (12h) Study of a volumetric compressor of a refrigerating machine Study of a refrigeration machine with a water secondary circuit Study of an Air Handling Unit with a recycling option	Lectures : 10h00 Tutorials : 10h00 Lab Work : 12h00
		Hydraulics	Description : - Minor (/ local) and major (/ friction) head losses formulations for viscous flows - Presentation of head losses adding (/ coupling) laws: series coupling and parallel coupling head losses – Presentation of Electrical analogy and drawing of network characteristic curve - Study of hydraulic networks and sizing of pumping systems and hydroelectric energy setups. Implementations of Generalized Bernoulli equation – Duty/operation point concept: selection of a pumping system adapted to a required flow rate in an existing hydraulic network - Pump curve, Affinity laws, parallel and series operation - Modification of the operating point - NPSH and cavitation (available and required NPSH) - Basics of Fluid power: generation, distribution, deployment, and regulation systems	Lectures : 8h00 Tutorials : 12h00
System Engineering S6	3	**Quality**	Description : Introduction to Quality, its history and evolution. Learn about quality management with the main tools related to it. Analysis and understanding of the ISO 9001 standard, its purpose, context and stakes. Audit: Preparing and conducting an Audit. QRQC : Operational method of quality management and problem solving. Discovery and appropriation of A3 and Kanban communication tools. Experience plan: Initiation to the PEX tool, mathematical approach and method.	Lectures : 8h00 Tutorials : 10h00
		Vibrations	Description : The presentation of the relations between the physical properties of a mechanical system and its vibratory behavior is carried out in the form of lectures on the following points: 1 - Vibration of a system with one degree of freedom: Conservative System: Free Movement - Clean Pulsation - Kinetic Energy and Deformation Energy. Non-conservative system: Viscous damping model - Frequency response - Resonance. 2 - Vibrations of discrete systems with n degrees of freedom: Modes of vibration - Calculation of modal characteristics - Decoupling of equations of motion - Proportional damping model - Modal superposition - Frequency response - Experimental modal analysis. 3 - Vibration reduction methodology: Vibration isolation - Modification of a natural frequency - Increase of the damping - Use of a dynamic dampener granted	Lectures : 12h00 Tutorials : 8h00

Semester 6 (January - June)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Industrial and Supply Chain Management Courses S6	8	**Introduction to the Industrial & Supply Chain Project Management**	Description : - Project management introduction : Organization of a project team, Project and planning management software - Ergonomy, Health and Security at work - Creativity and Problem Solving Methodology - To know the main global performance indicators (Overall Equipment Effectiveness, ...) - The Fresh Connection: serious game in a web-based simulation - Inventory Management: Define and manage the economic quantity, the safety stock and the stock classification - Approach of Inventory Management - Knowledge in Financial Management in industries	Lectures : 8h00 Tutorials : 16h00 Project : 16h00
		Introduction to Product/Process Link & Related Design	Description : • To study process flows before implementation of a manufacturing plant • Workstation analysis, determination and optimization of times • Design, methods and tools for industrialization • Exploring the challenges facing Total Productive Maintenance • Analysis & specifications of product • Being able to define standard documents • To understand the types and levels of maintenance • Establish a simple version of the maintenance plan • Flow simulation with FLEXSIM	Lectures : 12h00 Tutorials : 24h00 Project : 16h00
Mathematics for Engineering S6	6	**Mathematics for Engineers 6**	Description : Introduction to statistics and probability - Graphical Tools to represent data Meaningful Values Probability Theory Common Discrete and Continuous Probability Distributions Convergence Theorems Sampling Estimations and Confidence intervals Statistical Tests Comparison of Normal Distributions Normality Assumption checking Homogeneity of a population: ANOVA Chi-Square test Correlation and linear regression	Lectures : 16h00 Tutorials : 16h00
		Object-Oriented Programming	Description : Basics of Java Introduction to Object Oriented Programming Classes and Methods Inheritance Standard Library of Java	Lectures : 6h00 Tutorials : 12h00
Mechanical Design Engineering Courses S6	8	**Advanced Heat Transfer (Mechanical Pathway)**	Description : 12 hours (lecture), 12 hours (tutorial) - Steady Heat conduction : heat transfer in common configuration, conduction shape factors. - Transient conduction : lumped system analysis, Biot number, transient heat conduction in large plane walls, long cylinders, and spheres with spatial effects, transient heat conduction in semi-infinite solids. - Numerical methods in heat conduction : finite difference formulation of differential equations, two-dimensional steady heat conduction. - Natural convection : physical mechanisms, equation of motion and the grashof number, natural convection over surfaces, natural convection inside enclosures, combined natural and forced convection. - Boiling and condensation : boiling heat transfer, pool Boiling, flow boiling, condensation heat transfer, film condensation, dropwise condensation - Heat exchangers : heat exchanger types, overall heat transfer coefficient, the log mean temperature difference, the effectiveness-NTU method, heat exchanger design and performance calculations. - Radiation heat transfer : the view factor, view factor relations, black surfaces, diffuse and gray surfaces, radiation shields and the radiation effect.	Lectures : 12h00 Tutorials : 12h00

Semester 6 (January - June)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		Heating, Ventilation and Air Conditioning HVAC (Mechanical Pathway)	Description : The purpose of this course is to deeply understand Heat, Ventilation and Air Conditioning technologies and their importance in the building and industry sectors (buildings energy consumption, thermal comfort, ...) and to manage to size and optimize and HVAC system. The course addresses also the future of the HVAC&R industry (EU F-Gas regulation, use of new refrigerant fluids, improvement of energy efficiencies, etc.). course content (10h of lectures + 10h of tutorials) • Introduction to HVAC (Importance of HVAC processes in our current society, cold production, cold chain management, energy consumption, environmental consequences) and classic mechanical refrigeration • Different Refrigeration technologies, and their performance (specificities and comparison) • Heat pumps specificities and performance (different heating technologies) • Humid air: Psychrometrics and thermodynamics of moist air. • Air Handling Units for air conditioning (components and technology evolution) Labs: (12h) Study of a volumetric compressor of a refrigerating machine Study of a refrigeration machine with a water secondary circuit Study of an Air Handling Unit with a recycling option	Lectures : 10h00 Tutorials : 10h00
		Hydraulics (Mechanical Pathway)	Description : - Minor (/ local) and major (/ friction) head losses formulations for viscous flows - Presentation of head losses adding (/ coupling) laws: series coupling and parallel coupling head losses – Presentation of Electrical analogy and drawing of network characteristic curve - Study of hydraulic networks and sizing of pumping systems and hydroelectric energy setups. Implementations of Generalized Bernoulli equation – Duty/operation point concept: selection of a pumping system adapted to a required flow rate in an existing hydraulic network - Pump curve, Affinity laws, parallel and series operation - Modification of the operating point - NPSH and cavitation (available and required NPSH) - Basics of Fluid power: generation, distribution, deployment, and regulation systems	Lectures : 8h00 Tutorials : 12h00
		Materials 3	Description : 1. Introduction to Phase Transformation • Processes and Types of Phase Transformation • Types of Nucleation • Phase Transformation Rate 2. Part 1: Heat Treatment • Equilibrium and Non-equilibrium States • Eutectoid, Hypereutectoid and Hypoeutectoid Points • Martensite Transformation 3. Part 2: Heat Treatment • Mechanical Properties of Martensite • Tempering of Steel Alloys • Continuous Cooling Transformation Diagrams 4. Structural Hardening of Aluminum • Equilibrium Diagram of Aluminum Alloys • Heat Treatments of Aluminum Alloys 5. Corrosion • Redox Reactions • Types of Corrosion • Methods for Corrosion Prevention	Lectures : 10h00 Tutorials : 10h00 Lab Work : 12h00

Semester 6 (January - June)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Multidisciplinary Project S6	10	**Ecodesign Project Part 2 - Environment**	Description : The project contains 3 expected content types: courses & tutorials, project sessions (labs), and personal work. For each semester, this projects represents ~40h of work on-site + 20h-30h of personal work. The total workload for each semester is estimated to 60- 70h/student. Content of semester 6: 1. Courses & tutorials: Ecodesign approaches and strategies. - Courses topics: Ecodesign regulations & strategies, Materials & environment, Design for Sustainable behaviour, Thermal insulation & downsizing, Ecodesign of packaging, design for End-of-life, Innovation for ecodesign. - Tutorials: CES EduPack (choice of materials), Simapro, CREO (CAD modelling) 2. Project sessions (labs) supervised by the teacher: Developing 3 levels of ecodesigned solutions - Solutions developments: calculations, CAD modelling, LCA modelling of the 3 levels 3. Personal work: information search, interpretation of LCA results.	Lectures : 5h00 Tutorials : 3h00 Project : 8h00
		Ecodesign Project Part 2 - Technical	Description : The project contains 3 expected content types: courses & tutorials, project sessions (labs), and personal work. For each semester, this projects represents ~40h of work on-site + 20h-30h of personal work. The total workload for each semester is estimated to 60- 70h/student. Content of semester 6: 1. Courses & tutorials: Ecodesign approaches and strategies. - Courses topics: Ecodesign regulations & strategies, Materials & environment, Design for Sustainable behaviour, Thermal insulation & downsizing, Ecodesign of packaging, design for End-of-life, Innovation for ecodesign. - Tutorials: CES EduPack (choice of materials), Simapro, CREO (CAD modelling) 2. Project sessions (labs) supervised by the teacher: Developing 3 levels of ecodesigned solutions - Solutions developments: calculations, CAD modelling, LCA modelling of the 3 levels 3. Personal work: information search, interpretation of LCA results.	Lectures : 3h00 Tutorials : 1h00 Project : 8h00
Professional and Personal Development S6	4	**Advanced English Skills 6**	Description : The Advanced English Skills modules aim to have students develop their language skills across a wide range of topics, often consolidating material from other modules. Proect management Team work Working with deadlines Managing gateways Running effective meetings - creating an agenda, time management, report etc.	Lab Work : 14h00
		Cultural Awareness 2 (Art - Literature - Music - Cinema)	Description : This module gives students the opportunity to choose a field in the social sciences in which they are interested. An individual syllabus is established for each course. Therefore, the learning outcomes differ between subjects.	Tutorials : 18h00
		French as a Foreign Language	Description : 6 hour lessons every week : 4h face-to-face +2h guided autonomy Expanded vocabulary Introduction of grammar points Improvement of phonological control A1 Can establish basic social contact by using the simplest everyday polite forms of: greetings and farewells; introductions; saying please, thank you, sorry etc.	Lab Work : 18h00
		Optional Foreign Language	Description : 1.5 hour lessons every week. Expanded vocabulary Revision of grammar points Improvement of phonological control	Tutorials : 18h00

Semester 6 (January - June)				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		Principles of Marketing	Description : This course is designed to provide with students with an introduction to the marketing system. They will be exposed to the major concepts of marketing known as the marketing mix or 4 P's (product, place, price, and promotion). The course presumes no prior understanding of marketing, provides a complete overview of the marketing process, and touches on a variety of topics. Students will gain a sound understanding of the core concepts in marketing and its role in business and consumers' lives.	Lectures : 6h00 Tutorials : 12h00
Robotics & IT Courses S6	8	**Introduction to Robotics**	Description : -Introduction to robotic systems and controllers -Robots in their contexts -Mechanical structures: serial and parallel robots, mobile robots -Forward, Inverse and Differential Kinematics for Robot Arm -Differential Drive robots -Motion planning for mobile robot (Dijkstra, A*) -Practical introduction to robot programming (mBot, poppy)	Lectures : 10h00 Tutorials : 12h00 Lab Work : 8h00
		Sensing & Perception	Description : -Inertial sensors, GPS and odometry / sonar sensing / vision, bio-inspired sensors, force sensors -Transformation of information into electric properties and its implication -Signal conditioning -ADC: sampling, quantization, windowing -MCU: Application of data acquisition, data analysis, data processing -Introduction to image processing	Lectures : 8h00 Tutorials : 4h00 Lab Work : 12h00
		Signal Processing + Wireless Communications	Description : -Signals: general properties and transformations (convolution…) -Spectral analysis (DFT, FFT…) -Sampling -Signals and systems (stability, causality…) -Filters (FIR, IIR) -Random signals (autocorrelation, intercorrelation…) -Time-frequency analysis -Image processing	Lectures : 12h00 Tutorials : 12h00 Lab Work : 8h00
Students Life Commitment	3	**Students Life Commitment Sem 6**	Description :	
Students Life Involvement	2	**Students Life Involvement Sem 6**	Description :	
Semester 6	30			

EENG - Year 4

SEMESTER 7				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Energy Engineering courses S7	12	**Advanced Electrical Machines & Applications**	Description : This course covers the basics needed for the design of an electrical machine. It introduces the different electrical machines, their components, and the main definitions / technical vocabulary needed for the design. It also sheds the light on the different methods of numerical modelling of magneto static systems as well as the finite element approach for the synchronous machine modelling. This course presents the basic analytical method for designing the various parts of a machine while relying on the client requirements (operating voltage, needed speed, geometrical sizing…). It also provides the student with the in depth knowledge needed to simulate the machine's construction using CAD and Matlab software.	Lectures : 4h00 Tutorials : 2h00 Lab Work : 12h00
		Compressible Flows & Propulsion Systems	Description : • Jet propulsion systems and their performance criteria applied to Air-Breathing and Rocket engines: Thrust; Specific Impulse; Propulsion efficiency; Tsiolkovsky rocket equation; Breguet aircraft equation. • Fundamental of Compressible flows: Mach number and thermodynamics of compressible flows; Shockwaves; Conservation laws; application to Isentropic flows. • Rocket engine design: Stagnation and critical states; operating mode of nozzles in rocket engines; influence of combustion pressure and temperature and of nozzle geometry on the thrust finally produced. Calculation of the resulting specific impulse. • Propulsion systems combustion processes: influence of fuel composition and of Air-Fuel Ratio on the performance of air-breathing combustion processes; use of liquid and solid propellants in rocket engine combustion processes. • Air-breathing propulsion turbomachines: Thermodynamic cycles used in turbojet or turbofans engines; influence of pressure ratios, air and fuel mass flow rates, blades geometries on the engine performances (specific impulse, propulsion efficiency and specific fuel consumption).	Lectures : 12h00 Tutorials : 24h00
		Computational Fluid Dynamics	Description : This course introduces the student to the subject of Computational Fluid Dynamics, as well as numerical methods for predicting fluid flows and heat transfer in flows. This course aims to help students get a good level of expertise in flow modeling for engineering applications by conducting practical work on a well-known commercial tool. Lectures content (6h) • Introduction to CFD: CFD fundamentals, principles, and steps • Turbulence modeling for CFD part I: Turbulence characteristics and properties, Mean-flow equations • Turbulence modeling for CFD part II: Turbulent-viscosity models (RANS models), Near-wall treatments Practical work: (16h) • Introduction to Ansys Fluent CFD tool: Fluid Flow and Heat Transfer in a Mixing Elbow • Practice on Ansys Fluent CFD tool: Modeling external Compressible Flow • Practice on Ansys Fluent CFD tool: Modeling Transient Compressible Flow • Practice on Ansys Fluent CFD tool: Assessment project	Lectures : 6h00 Lab Work : 16h00

SEMESTER 7				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		Control Theory 2a (Digital Control Systems)	Description : 1. Introduction to signals : continuous/ sampled/ discrete 2. Distinction between Difference equation (used to describe Discrete systems) and differential equation (used to describe continuous systems) 3. Signal sampling and quantization *Sampling of continuous signals *Signal reconstruction *Practical considerations for signal sampling : anti-aliasing filter *Practical reconsiderations for signal reconstruction :anti-image filter and equalizer *Analog to digital conversion *digital to analog conversion/quantization 4. Determination of the z-transform *Introduction to the z-transform and its properties *Illustration of how we determine the inverse of z-transform using the partial fraction expansion *The use of the z-transform to solve linear difference equations 5. Digital Proportional, PI and PID controllers *Determination of the equation of the digital controller (case of P , PI and PID) *The implementation of digital P, PI and PID on real systems and the evaluation of the system performances	Lectures : 6h00 Tutorials : 6h00 Lab Work : 8h00
		Gas Turbines	Description : • Gas turbine technologies (Heavy Duty, aeroderivatives, etc.), improvements (cogeneration, combined cycles) and uses. • Gas turbines specific combustion processes: operating modes, thermodynamics models, practical fuels and pollutants management. • Theory of turbomachines applied to compressible flows and gas turbines. • Gas turbines thermodynamic cycles. • Main components and technological aspects of gas turbine technologies.	Lectures : 10h00
Industrial and Supply Chain Management courses S7	12	**Manufacturing Digital Transformation**	Description : • Information Systems & ERPs (Enterprise Ressource Planning) in Supply Chain, Information Systems Project Management, Enterprise Resources Planning - ERP : - Strong theoretical knowledge about IS & ERP and the link with project management + Application on an actual ERP, using the connected speaker • Robotization Methodology : - Initiation to a method of implementation of robotic equipment - To determine the cost effectiveness of robotization on workstation - Difference robot/cobot (strategic, productivity, safety ...) - Risk analysis - Robotisation criteria • Product Lifecycle Management - PLM : - PLM Introduction - Windchill PLM software - Project view • Total Productive Maintenance 2 - TPM : - Reliability functions, probability density functions. Serie and Parallele systems Failure rate, MTTF (Mean Time To Failure), MTBF (Mean Time Between Failure), MTTR (Mean Time To Repair) • Plant Layout 2 : - Redo the implementation from last year, with the simulation flows of a robotic equipment	Lectures : 8h00 Tutorials : 20h00 Project : 22h00
		Global, External and Circular Supply Chain	Description : - Information Systems in Supply Chain - Focus on ERP - Demand Management - Forecasting Management - Warehouse and Distribution Management - Procurement strategies and Suppliers Management - The Blue Connection: serious game in a web-based simulation environment about Circular Economy	Lectures : 8h00 Tutorials : 20h00 Project : 22h00
Innovation project S7	8	**Innovation Project**	Description : The core contents are all related to the developed skills aforementioned and follow the structure of the project.	Lectures : 38h00 Tutorials : 66h00 Project : 96h00

SEMESTER 7				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Mechanical Design Engineering courses S7	12	**Advanced Vibrations**	Description : The presentation of the relations between the physical properties of a mechanical system and its vibratory behavior is carried out in the form of lectures on the following points: 1 - Vibration of a system with one degree of freedom: Conservative System: Free Movement - Clean Pulsation - Kinetic Energy and Deformation Energy. Non-conservative system: Viscous damping model - Frequency response - Resonance. 2 - Vibrations of discrete systems with n degrees of freedom: Modes of vibration - Calculation of modal characteristics - Decoupling of equations of motion - Proportional damping model - Modal superposition - Frequency response - Experimental modal analysis. 3 - Vibration reduction methodology: Vibration isolation - Modification of a natural frequency - Increase of the damping - Use of a dynamic dampener granted	Lectures : 16h00 Lab Work : 8h00
		Compressible Flows & Propulsion Systems (Mechanical Pathway)	Description : • Jet propulsion systems and their performance criteria applied to Air-Breathing and Rocket engines: Thrust; Specific Impulse; Propulsion efficiency; Tsiolkovsky rocket equation; Breguet aircraft equation. • Fundamental of Compressible flows: Mach number and thermodynamics of compressible flows; Shockwaves; Conservation laws; application to Isentropic flows. • Rocket engine design: Stagnation and critical states; operating mode of nozzles in rocket engines; influence of combustion pressure and temperature and of nozzle geometry on the thrust finally produced. Calculation of the resulting specific impulse. • Propulsion systems combustion processes: influence of fuel composition and of Air-Fuel Ratio on the performance of air-breathing combustion processes; use of liquid and solid propellants in rocket engine combustion processes. • Air-breathing propulsion turbomachines: Thermodynamic cycles used in turbojet or turbofans engines; influence of pressure ratios, air and fuel mass flow rates, blades geometries on the engine performances (specific impulse, propulsion efficiency and specific fuel consumption).	Lectures : 12h00 Tutorials : 24h00
		Computational Fluid Dynamics	Description : This course introduces the student to the subject of Computational Fluid Dynamics, as well as numerical methods for predicting fluid flows and heat transfer in flows. This course aims to help students get a good level of expertise in flow modeling for engineering applications by conducting practical work on a well-known commercial tool. Lectures content (6h) • Introduction to CFD: CFD fundamentals, principles, and steps • Turbulence modeling for CFD part I: Turbulence characteristics and properties, Mean-flow equations • Turbulence modeling for CFD part II: Turbulent-viscosity models (RANS models), Near-wall treatments Practical work: (16h) • Introduction to Ansys Fluent CFD tool: Fluid Flow and Heat Transfer in a Mixing Elbow • Practice on Ansys Fluent CFD tool: Modeling external Compressible Flow • Practice on Ansys Fluent CFD tool: Modeling Transient Compressible Flow • Practice on Ansys Fluent CFD tool: Assessment project	Lectures : 6h00 Lab Work : 16h00
		Materials 4 (Polymers)	Description : Macromolecules: degree of polymerization, tacticity, synthesis. Polymers: structures, thermoplastics, thermosets, state changes, thermal and mechanical properties, additives. Specific applications of polymers. The use of conductive polymers, bio-sourced and biodegradable polymers, polymers for packaging or fuel cells are discussed. The interest of developing copolymers is also treated.	Lectures : 10h00 Tutorials : 10h00 Lab Work : 8h00
Professional and Personal Development S7	3	**Business and Sales**	Description : Students will be asked to draw on the concepts learned in previous classes such as Communication, Management, and Principles of Marketing in order master various sales techniques.	Tutorials : 12h00

SEMESTER 7				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		Entrepreneurship 2	Description : The course will immerse students into the key themes and debates in entrepreneurship. The focus will be on the most common questions asked by entrepreneurs willing to start a company from scratch. The practical aspects of building a startup will be discussed. The main takeaways from the best and the worst practices will be seen. The course addresses mainly students who are interested in/curious about creating a start-up. It does not require any specific prerequisites for the 2022-2023 academic year. The following questions will shape the content of the course: What is the motivation behind building a start-up? Should you start a company? How to go from an idea to a high-tech product? How to make a product that users want? How to talk to customers? When should you launch? All about pivoting: strategy and growth When, why, and how is fundraising?	Tutorials : 12h00
		International Relations & Natural Resources	Description : The academic discipline of International Relations traditionally focuses on political relationships between sovereign nation-states and non-state actors in the modern world. This module aims to understand our contemporary international system using three frameworks: realism, liberalism and identity theory. We pay special attention to the role of natural resources in conflict as these resources are directly related to many fields of engineering. There will also be a historical analysis, because you cannot understand our contemporary system, without understanding the events that have shaped it!	Lectures : 6h00 Tutorials : 6h00
Robotics & IT Courses S7	12	**Advanced Robotics**	Description : -Numerical Jacobian, singularity avoidance -Trajectory and path planning for robot arms -Performance evaluation : accuracy, precision, load, repeatability, workspace -Dynamics of a robot arm (inertia, Coriolis) -Visual servoing -Programming a robotic arm and a mobile robot	Lectures : 12h00 Tutorials : 12h00 Lab Work : 12h00
		Control Theory 2a (Digital Control Systems)	Description : 1. Introduction to signals : continuous/ sampled/ discrete 2. Distinction between Difference equation (used to describe Discrete systems) and differential equation (used to describe continuous systems) 3. Signal sampling and quantization *Sampling of continuous signals *Signal reconstruction *Practical considerations for signal sampling : anti-aliasing filter *Practical reconsiderations for signal reconstruction :anti-image filter and equalizer *Analog to digital conversion *digital to analog conversion/quantization 4. Determination of the z-transform *Introduction to the z-transform and its properties *Illustration of how we determine the inverse of z-transform using the partial fraction expansion *The use of the z-transform to solve linear difference equations 5. Digital Proportional, PI and PID controllers *Determination of the equation of the digital controller (case of P , PI and PID) *The implementation of digital P, PI and PID on real systems and the evaluation of the system performances	Lectures : 6h00 Tutorials : 6h00 Lab Work : 8h00

SEMESTER 7				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		Control Theory 2b (Multivariable Control Systems)	Description : 1. System representation : the state-space representation SSR of monovariable and multivariable systems 2. Determinantion of the system's Block diagram 3. Determinantion of the State space representations in canonical forms : Controllable,Observable,Diagonal/Jordan 4. Evaluation of the Controllability and the observability of a given LTI system using the Kalman citerion 5. Design of State-feedback controller using the Ackermann's formula 6. Analysis of system performances : precision, rapidity, robustness against the presence of disturbances 7. System linearization using the Tylor expansion	Lectures : 6h00 Tutorials : 6h00 Lab Work : 8h00
		IT & Robotic Labs	Description : The scrum methodology is introduced to the students. Then, they apply this agile framework during the whole duration of the project. Each group of students receives a project of robotic application. They state the problem before designing the robotic system that corresponds to the specifications. Then, they build their system and test it extensively. Finally, each group presents their work and write a report describing the technical and managerial aspects of the project.	Lab Work : 28h00
Students Life Commitment	3	**Students Life Commitment Sem 7**	Description :	
Students Life Involvement	2	**Students Life Involvement Sem 7**	Description :	
Sustainable Management S7	4	**Carbon Footprint**	Description : This course is an introduction to the carbon footprint calculation method proposed by a French association, "Association Bilan Carbone". It will consist of a : - Reminders about Green House Gases and introduction to global warming potential - Definition of carbon footprint - Definition of the 3 scopes - Presentation of the carbon Footprint computation method - Presentation of th Carbon Footprint approach	Lectures : 4h00 Tutorials : 5h00
		Corporate Social Responsibility	Description : This course is an introduction to the CSR, it will consist of : - An introduction to the CSR - An explanation of how to build a CSR strategy	Lectures : 4h00 Tutorials : 10h00
		Operational Quality and Lean Management	Description : Introduction to experience plans : - What is an experience plan and how to implement it ? - Several notions : factors, levels of the factors, mathematical model - Experience plans : 2 factors and 2 levels - Experience plans : 3 factors and 2 levels Product FMECA : One case of study to understand what is the purpose of product FMECA and how to implement it : how to reduce the problem at the conception phase of a product Lean-6 sigma tools : Discovery of the different lean tools in the context of a problem-solving approach : - What is the Lean (context and historical approach) - What is 6 sigma (context and historical approach) - What are the tools related to these topics (DMAIC, 5S, Ishikawa, root causes : 5W…) - Possiblity to implement all of these tools with one tutorial : A3 problem solving method.	Lectures : 4h00 Tutorials : 12h00
SEMESTER 7	30			

SEMESTER 8				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Energy Engineering courses S8	12	**Energy Project**	Description : Group Project structured around various sessions of group work with access to the necessary computer resources.	Project : 36h00
		Energy Storage	Description : • Presentation of different types of energy storage systems (heat, mechanical and electrochemical); • Definition of energy and power densities; • Description of the operating principle of rechargeable batteries and their fundamental electrochemistry (lithium-ion batteries, lead-acid batteries, etc.); • Definition of the electrical characteristics present in the data sheet of each electrochemical storage system; • Description of the operating principle of conventional supercapacitors using the double layer capacitance theory; • Presentation of the chemical constitution of hybrid supercapacitors such as lithium-ion capacitors; • Description of aging mechanisms that may arise in different types of batteries and supercapacitors; • Comparison of different energy storage systems using the Ragone Diagram; • Presentation of electrical modeling methods of electrochemical energy storage systems; • Presentation of power converters used with energy storage systems; • Description of the tools integrated in management systems that aim to control energy storage systems; • Presentation of an example of a complete system integrating an energy storage system, the corresponding management system and the power converters.	Lectures : 12h00 Tutorials : 12h00
		Environmental Aspects of Energy	Description : • Fundamental concepts of energy engineering: primary energy, final energy, embodied energy, lost energy, etc. • Performance criteria used to assess existing systems or processes: efficiency, effectiveness, energy returned on energy invested (EROI), etc. • Definitions and limitations of today's energy resources: peak oil, GHG emissions, etc. • Carbon cycles and balances: why it is important and how to use them. • The energy transition and its numerous challenges.	Lectures : 18h00
		Exergy Analysis	Description : • The exergy and anergy concepts and their relation with energy. • Applications of exergy and energy balances to closed or open systems, housing or not internal reactive processes : heat engines, refrigeration machines, heat exchangers, internal combustion engines, HVAC systems; • Exergy efficiency and effectiveness of energy systems; • Environment, sustainability and use of natural resources, from the standpoint of exergy analysis.	Lectures : 8h00 Lab Work : 8h00
		Power Systems	Description : - Electrical AC grids. - Electrical DC grids. - Electrical safety measurements. - Autonomous energy grid (smartgrid) sizing and control.	Lectures : 8h00 Tutorials : 8h00 Lab Work : 8h00
Industrial and Supply Chain Management Courses S8	12	**Industry of the Future**	Description : • Understanding the challenges of the Digital Factory and the Digital Twin : - convert an eBOM (engineering Bill of Materials) into a mBOM (manufacturing of Bill of Materials) - make a process planning - allocation of resources (machine tool operator, etc.) • Analyse the product/process impacts and propose improvements • To be able To manipulate robots virtually and physically • Organisation and management of a production through a challenge in the "School Factory" platform	Lectures : 8h00 Tutorials : 12h00 Project : 28h00

SEMESTER 8				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		Sustainable and Integrated Supply Chain	Description : - CSCA certification (Certified Supply Chain Analyst): an international certification, recognize world wide within the world of Supply Chain - Analyse the carbon footprint of a factory - Warehouse Management System (WMS) - Reverse Logistics - Distribution Logistics and Transports	Lectures : 8h00 Tutorials : 24h00 Project : 28h00
Innovation project S8	10	**Innovation Project**	Description : The core contents are all related to the developed skills aforementioned and follow the structure of the project.	Lectures : 27h00 Lab Work : 6h00 Project : 120h00
Mechanical Engineering courses S8	12	**Heating, Ventilation and Air Conditioning HVAC**	Description :	Lectures : 12h00 Tutorials : 8h00
		Advanced Manufacturing & Processes	Description : Integration of the digital chain in the preparation work. Cutting conditions for solid materials. Optimization of the machining parameters (cutting conditions, CAM "Spirit", process studies, choice of tools ...).	Lectures : 2h00 Lab Work : 28h00
		Hydraulics	Description : - Minor (/ local) and major (/ friction) head losses formulations for viscous flows - Presentation of head losses adding (/ coupling) laws: series coupling and parallel coupling head losses – Presentation of Electrical analogy and drawing of network characteristic curve - Study of hydraulic networks and sizing of pumping systems and hydroelectric energy setups. Implementations of Generalized Bernoulli equation – Duty/operation point concept: selection of a pumping system adapted to a required flow rate in an existing hydraulic network - Pump curve, Affinity laws, parallel and series operation - Modification of the operating point - NPSH and cavitation (available and required NPSH) - Basics of Fluid power: generation, distribution, deployment, and regulation systems	Lectures : 12h00 Tutorials : 8h00
		Tribology	Description : 1. Introduction • Definition of Tribology and Tribological Systems • Applications and Scales in Tribology • Types of Motion • Tribological Testing and Types of Tribometers • Roughness 2. Lubrication and Lubricant Properties • Classification of Lubrication and Lubricant Properties • The Stribeck Curve and Lubrication Regimes • Types of contacts and film thickness • Hertzian Contact Theory • Solid-Solid Contact-Asperity Deformation 3. Friction • Friction Coefficient • Types of Friction • Laws of Dry Friction • Basic Mechanisms of Sliding Friction • Adhesion and Deformation • Stick-Slip Phenomenon 4. Fluid Film Lubrication • Classification of Fluid Film Lubrication • Newtonian and Non-Newtonian Fluids • 1-D Flow between Parallel Plates • Hydrostatic and Hydrodynamic Thrust Bearings 5. Wear • Parameters and Stages of Wear • Wear Types and Mechanisms • Wear Rate • Causes of Wear and Prevention Methods	Lectures : 12h00 Tutorials : 8h00

SEMESTER 8				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
Professional and Personal Development S8	4	**Business Games**	Description : A conference-based format is scheduled.	Lectures : 21h00
		Ethics	Description : During the lectures, students will be introduced to basic theories and principles in ethics such as utilitarianism, relativism and deontology. The tutorials will be focused on ethical dilemmas from the areas of engineering in the program's pathway specializations.	Lectures : 6h00 Tutorials : 6h00
		International Openness	Description : The teaching unit 'International Openness' in semester 7 incorporates the following modules (not followed by all students): Optional Foreign Language (different languages and level groups) French Cultural Awareness Interculturality 4	Lab Work : 32h00
		Personal and Professional Development	Description : Students will learn intercultural skills necessary for their departure during their 5th year of studies. They will also update their CVs and cover letters written during EENG1.	Tutorials : 12h00
		Research Methods	Description : Lectures and tutorials are given as follow : -Lecture 1 : Introduction and tools for bibliographic research -Tutorial 1 : Application of the methodology to find relevant research papers -Lecture 2 : Analysis of literature review and introductions to the project phase -Tutorial 2 : Cross analysis of a set of research papers -Tutorial 3 and 4 : Project kick-start -Autonomy sessions : redaction of a literature review.	Lectures : 4h00 Tutorials : 8h00 Project : 20h00
Robotics & IT Courses S8	12	**Ethics for Robotics**	Description : -Introduction to ethics and ethical dilemmas -Practical exercises on simple case studies -Ethics and Autonomous systems and/or Robotics -Applied ethics in Robotics -Practical analysis of a chosen case study in Robotics	Lectures : 10h00 Tutorials : 2h00
		Introduction to Controllers	Description : -Definition of a PLC -Hardware components of a PLC -Connection of I/O modules -Program a filling machine using Ladder, Function block, Structured text, Grafcet -Train on data types, variables	Lab Work : 12h00
		IT & Robotic Labs	Description : The scrum methodology is introduced to the students. Then, they apply this agile framework during the whole duration of the project. Each group of students receives a project of robotic application. They state the problem before designing the robotic system that corresponds to the specifications. Then, they build their system and test it extensively. Finally, each group presents their work and write a report describing the technical and managerial aspects of the project.	Lab Work : 28h00

SEMESTER 8				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		IT Expertise - Machine Learning	Description : * Introduction to IA and Machine Learning ° Model Based Learning - main concepts and definitions ° Exact solution, iterative solutions, Gradient Descent ° First algorithms: Regressions - Linear Regression - Logistic Regression ° Data preprocessing ° Hyperparameter tuning * Towards Deep Learning ° more on preprocessing (categories encoding) and data sets ° From biological neuron to perceptron ° Multilayer Perceptron ° Convolutional Neural Networks ° Transfer Learning * Introduction to Natural Language Processing ° Some important ideas about NLP ° Example of statistical NLP (Multinomial Naive Bayes) ° NLP with Deep Learning (LSTM) * Other algorithms * Group project (text classification, image classification, recommendation, regression...)	Lectures : 8h00 Lab Work : 12h00
		IT expertise - Machine Vision	Description : -Introduction to camera features -Introduction to the importance of lighting in image acquisition -Introduction to various technologies in image acquisition -Practical application on quality control, robot guidance and deep learning	Lectures : 4h00 Lab Work : 8h00
		Robotic Expertise - Motion Planning & Control	Description : -Definition of industrial networks: Ethercat, Profinet, OPC-UA, IO-Link… -Practical on PLC/sensors/actuators communication using several industrial networks. -Definition of safety regulations -Procedure to perform risk analysis -Definition of drive-based and controller-based motion planning followed by practicals	Lab Work : 12h00
		Robotic Expertise - Automation & Industrial Robotics	Description : This course divided into four parts. In the first part will give an overview of industrial robots basic components and structures. Part 2 depicts principles and methods of programming robots. Part 3 describes industry robotisation and robots workstations. The final part touches the safety of industrial robots and cobots. In this course, we will explore Arm construction and drives, Coordinates systems (BASE • TOOL • TCP • Part frame/User frame/Working frame), programming methods (Online • Offline), Robotized workstations/cells, risk assessments of robotic cells and standardizations/normalizations. • Introduction to industrial robotics • Basic components of industrial robot systems • Structure of industrial robots • Collaborative, non-collaborative, and mobile industrial robot applications • Industrial robot's motion • Methods of programming robots • Hazards associated with industrial robot applications • Safety considerations for employers and workers • Risk assessments • Risk reduction measures • Applicable industry standards for industrial robot system safety	Lectures : 6h00 Tutorials : 2h00 Lab Work : 12h00

SEMESTER 8				
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**	**TEACHING HOURS**
		Wireless Communications & Networks	Description : -Introduction to IoT devices and their architectures (microcontroller, antenna…) -Introduction to radio waves and principles of modulation (amplitude, frequency and phase) -Definition of the various IoT networks (Short-range, LPWAN, Cellular) -Practical case study to choose the best IoT solution given technical specifications -Practical introduction to IoT programming with Sigfox modules for Arduino board	Lectures : 4h00 Lab Work : 8h00
Sustainable Management S8	1	**Circular Economy**	Description : This course is an introduction to the circular economy concept. In this course, student will learn about the 7 pillars of the circular economy with many examples.	Lectures : 3h00 Project : 2h00
		Innovation Management & Intellectual Property	Description : - Innovation management for companies (different types) - Intellectual property: patent deposit, management of patents - General management of organizations for keeping the company's strategic advantages.	Lectures : 3h00 Project : 2h00
		Sustainable Finance	Description : Conference-based format dealing with the aforementionned topics.	Lectures : 3h00 Project : 2h00
SEMESTER 8	30			

EENG - Year 5

Academic Year Abroad in a Partner University					
TEACHING UNIT	**ECTS**	**TEACHING UNIT COMPONENT**	**Content**		**TEACHING HOURS**
Academic Year Abroad in a Partner University		30			