## Diplomation PreRequisite

| Commitment & Responsibilities | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| International | | | | |
| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| TOEIC | | | | |
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## A&M - Year 3

Semester 5

| Unité d'Enseignement | ECTS | Unité de Cours | Contenu | Nb d'Heures |
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| **Automation And Electronics** | 8 | **Java & Algorithms** | The concepts of object-oriented programming, algorithms and data structures will be implemented in Java during practical work.<br>This course alternates between Object-Oriented Programming and Algorithms:<br>- Introduction, classes, objects<br>- Algorithms: conditions, loops, methods<br>- Construction, instantiation<br>- Tables, lists<br>- Search tree<br>- Hashtables<br>- UML : class diagrams | TP : 20h00<br>Cours : 13h00<br>Travail personnel : 13h00<br>Durée totale: 46h00 |
| | | **Automation 1** | Chapter 1: Generalities and examples, the notion of regulation, the notion of the closed loop, the specifications loads, pose a regulation problem through an example.<br>- Chapter 2: Study of signals, modeling (knowledge model and a behavior model), place transform, transfer function, block diagram.<br>- Chapter 3: Temporal analysis (Fdt of order 1, Fdt of order 2 ...), map of poles and zeros, graphic modeling.<br>- Chapter 4: The classical control laws (PI, PD, PID, AvancePH, RetardPH ...), empirical methods of synthesis of correctors, methods of synthesis not compensation of the poles.<br>- Chapter 5: Summary of correctors by pole placement, reference system, Evans location.<br>- Chapter 6: Synthesis of correctors by frequency approach, frequency analysis of the behavior of a<br>process (Places of Bode, Black, Nichols, Nyquist….)<br>Practical work :<br>TP1: Direct current machine speed regulation.<br>TP2: Single column level control | TD : 6h00<br>TP : 8h00<br>Cours : 28h00<br>Travail personnel : 14h00<br>Durée totale: 56h00 |
| | | **Fundamentals Of Electronics** | The contributions of this module "Bases of Electronics" will be made through a lecture, and labworks. The understanding of the functioning of each component is supported by its semiconductor design aspect as well as by regular exercises and applications.<br>- Introduction to the design of semiconductor components: technologies and manufacturing principles, doping, limits and constraints due to miniaturization, resources and energies needed, approach of micro and nanotechnologies.<br>- Operation and use of diodes, LEDs and photodiodes, BIP and FET transistors, operational amplifier, DAC & ADC : structure, characteristic electrical quantities, thermal aspects (thermal Ohm's law and thermal limits), classical applications, PWM commands for switching components and use in concrete assemblies.<br>- Reading and analysis of diagrams, identifications of the role of components and functions performed. | TD : 6h00<br>TP : 8h00<br>Cours : 22h00<br>Travail personnel : 40h00<br>Durée totale: 76h00 |
| **Mechanical Design** | 2 | **Cad** | CAD is a digital tool which assists the mechanical designer in his daily work. The mechanical designer:<br>• Designs mechanical systems,<br>• Projects (draws),<br>• Sizes the mechanical components,<br>• Defines the technological characteristics,<br>• Specifies the technical features,<br>• Guides the production department.<br><br>Each session includes a theoretical part and a practical part.<br><br>The theoretical part allows the student to improve his knowledge in the following areas:<br>• Use of CAD software: brings together the computer tools that make it possible to carry out a geometric modeling of an object in order to be | TP : 8h00<br>Travail personnel : 12h00<br>Durée totale: 20h00 |

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| | | | able to simulate tests with a view to manufacturing,<br>• Use of PLM software: corresponds to all the processes, technologies, software and methods put in place to properly manage the life cycle of a product.<br><br>The practical part allows the student to apply his knowledge through a team project comprising the following phases:<br>• Discovery of the main functions of the CAD tool and configuration of the 3D model,<br>• Complete modeling of the project proposed by the teacher,<br>• Integration of CAD data into the PLM,<br>• Creation of definition plans for each part, and overall drawings,<br>• Writing of a complete mechanical design report. | |
| | | **Design** | Mechanical design is at the heart of the professional practice of an engineer. Based on specifications, the designer's objective is to quickly and efficiently arrive at an optimized pre-project. The mechanical designer:<br>• Designs mechanical systems,<br>• Projects (draws),<br>• Sizes the mechanical components,<br>• Defines the technological characteristics,<br>• Specifies the technical features,<br>• Guides the production department.<br><br>Each session includes a theoretical part and a practical part.<br><br>The theoretical part allows the student to improve his knowledge in the following areas:<br>• Tribology (friction, wear and lubrication of mechanical contacts),<br>• Functional quotation, dimensional and geometric tolerancing,<br>• Mechanical connections (pivot, embedding, helical and slide),<br>• Power transmission (gears, pulley/belt, constant velocity joints).<br><br>The practical part allows the student to apply his knowledge through a team project comprising the following phases:<br>• Analysis of the initial need and development of the Functional Specifications (CDCF),<br>• Production of kinematic diagrams, equivalence classes and linkage graphs,<br>• Realization of sketches and first diagrams of principles,<br>• Carrying out the sizing of the main components and mechanical parts,<br>• Creation of definition plans for each part, and overall drawings,<br>• Writing of a complete mechanical design report. | TD : 20h00<br>Cours : 10h00<br>Travail personnel : 4h00<br>Durée totale: 34h00 |
| **Energy 1** | 6 | **Electrical Circuits** | - Basic electrical circuits, current and power calculation methods ;<br>- Basic magnetic circuits, fundamental parameters, calculation methods including the influence of air gaps, losses, different technologies ;<br>- Different electrical components, conductors, resistances, capacitors, coils, magnetic materials, dielectric materials, characteristics and applications.<br>- Single phase electrical system, characteristics and operating principle, power calculation method (Boucherot method), reactive power compensation, electrical lines and cables ;<br>- Three phase electrical system, characteristics and operating principle, order of magnitude of frequencies, voltages and powers ;<br>- Three phase loads, coupling methods, star connection, delta connection, parameters calculations such as voltage, current and power ;<br>- Unbalanced three phase loads, neutral current calculation and the voltage between the common point and the neutral ;<br>- Measurement of active and reactive power in a three phase system ;<br>- Introduction to transformers and Kapp's model. | TD : 4h00<br>TP : 8h00<br>Cours : 16h00<br>Durée totale: 28h00 |
| | | **Fluid Mechanics** | - Scope of industrial Fluid Mechanics.<br>- Presentation of various kinds of fluids (liquids and gas, physical properties of fluids, etc.). | TD : 21h00<br>TP : 12h00<br>Cours : 24h00 |

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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | - Presentation of various kinds of industrial flows.<br>- Kinematics concepts: Lagrange and Euler approaches, total derivative, streamlines, streaklines and pathlines.<br>- Presentation of basic / governing equations of mass, momentum and energy.<br>- Presentation of these equations through their reduced formulations and analysis of their application conditions. Presentation of Euler, Navier-Stokes and Generalized Bernoulli Equations.<br>- Industrial implementations of these governing equations to simple flows (streamtube of steady state flow of incompressible viscous fluid).<br>- Minor (/ local) and major (/ friction) head losses formulations for viscous flows.<br>- Presentation of head losses adding (/ coupling) laws: series coupling and parallel coupling head losses – Presentation of Electrical analogy<br>- Study of hydraulic networks and sizing of pumping systems and hydroelectric energy setups. Implementations of Generalized Bernoulli equation – Operating point concept: selection of a pumping system adapted to a required flow rate in an existing hydraulic network.<br>- Boundary layer concept. Drag and lift forces - Implementations to aeronautics.<br>- Modeling a complex physical phenomenon through dimensional analysis (Vaschy-Buckingham theorem). Using similarity analysis in order to adjust established analytical models via experimental investigation on scaled models: defining experimental conditions on scaled model and transferring obtained results from scaled model to unity scale prototype. | Travail personnel : 25h00<br>Durée totale: 82h00 |
| **Student Life Commitment** | 3 | **Student Life Involvement** | | Durée totale: 0h00 |
| **Commitment & Responsibilities 1** | 0 | **Student Life Commitment** | This teaching unit is divided into 2 parts:<br>1. Agreement to actively promote ECAM during a minimum of 2 ½ days, including participation in open-house events at ECAM, information sessions at high schools, or study fairs.<br>2. Agreement to commit to a third party for community work during a minimum period of 25 hours. Each of the activities will start with a training and information session directly linked with the planned mission and followed up though the reporting by the associations.<br>These actions will be reviewed through an oral group report. This report will highlight the students' learning experience in a previously unknown environment. It will also highlight transferable skills and competencies developed during this experience. | TD : 2h00<br>Cours : 1h00<br>Durée totale: 3h00 |
| **Humanities 1** | 2 | **International Openness** | Each of these conferences will explore one of the social sciences | Cours : 4h00<br>Travail personnel : 6h00<br>Durée totale: 10h00 |
| | | **Professional Project** | After a general presentation of the functioning of a company and the different professions that make it up, a presentation of the sectors of activity open to engineers will be discussed. The internship search techniques will then be presented (from the definition of your project to preparation for the interview). Students will thus be encouraged to develop their employability and understand the challenges of recruitment, and be able, as future managers, to recruit new employees. | TD : 8h00<br>Durée totale: 8h00 |
| **Student Life Involvement** | 2 | **Student Life Commitment** | | Durée totale: 0h00 |
| **Foreign Language 1** | 2 | **English 1** | Expanded vocabulary and tests<br>Revision of grammar points<br>Strategies, techniques and practice papers to prepare for the TOEIC (lower-level groups)<br>Assigned presentations (individual and in pairs) on international current affairs | TD : 24h00<br>Travail personnel : 12h00<br>Durée totale: 36h00 |

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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | Assigned Masterclasses on engineering topics.<br>CV writing workshop.<br>Technical and non-technical interview questions.<br>Written assignment related to engineering themes. | |
| | | **A&M-Eeng Lv2-Ec1** | | Durée totale: 0h00 |
| **Industrial Management** | 4 | **Industrial Organization 1** | | TD : 8h00<br>Cours : 8h00<br>Durée totale: 16h00 |
| | | **Manufacturing 1** | - CAM approach learning (CAD/CAM Files Export/Import, choice of programming reference system, machining strategies, cutting conditions, tool path generation and machining simulation<br>- Discovering machining methods and setting up CNC machine tools for milling and turning.<br>- Tri-dimensional control of mechanical parts (Introduction to the measuring system, analysis of geometric tolerances, definition of reference systems, elaboration and completion of control ranges on tri-dimensional measuring machines). | TP : 12h00<br>Cours : 4h00<br>Durée totale: 16h00 |
| | | **Methods 1** | 1. Transformation processes of primary molded parts.<br>- Foundry: the main molding processes (fusion and elaboration of metals, sand casting, shell, lost wax, under pressure) and a few rules applying to mold design and part contours<br>- Main processes and equipment for transforming metals: ingot casting, hot rolling, cold rolling, hot forging, drop forging, smelting, sintering, welding (MIG, TIG, etc), cutting, forming.<br>- Main processes and equipment for transforming plastics: properties and common types of plastics, different types of plastic parts, injection, extrusion, blow-molding, rotomolding, calendering, compression, thermoforming, contact molding, projection and filament winding.<br><br>2. Dimensional and geometric metrology: Principal measurement and verification instruments, resolutions, measurable tolerance interval, adjustment standards, geometrical tolerance, etc.<br><br>3. Functional dimensioning: Analysis of an assembly drawing and calculation of condition dimensions.<br><br>4. Manufacturing analysis: Isostatism; drafting of range machining; determine and analyze geometric, technological and economic constraints; select the type of process for the fabrication. | TD : 10h00<br>Cours : 10h00<br>Durée totale: 20h00 |
| **Mechanical Design Upgrade** | 2 | **Design For Beginers** | "1) Basic elements, rules and standards of industrial design<br>2) Mechanical connections<br>2.1 Embedding links<br>Constructive solutions and sizing of standard elements (screws, pins, keys, etc.)<br>2.2 Pivot connections<br>Plain bearings, assembly rules and dimensioning of bearings<br>2.3 Helical Connections<br>Constructive solutions and sizing<br>2.4 Slide Links: constructive solutions and sizing<br>2.5 Ball Joints: constructive solutions<br>3) Classification of materials and designation of alloys<br>Criteria for choosing materials for mechanical parts / Real cases<br>4) Dimensional tolerances, fits and functional dimensioning<br>5) Sealing and lubrication | TD : 54h00<br>Durée totale: 54h00 |

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| | | **Cad For Beginers** | "The student will acquire the knowledge of the CAD tool necessary for the definition and use of a digital model and know how to use this comp<br>Classes :<br>• Through the Creo software, discovery of the main functions allowing the modeling of a part (extrusion, revolution, sweeping, smoothing ...) and parameterization of a digital model for easy use.<br>• Creation of a 3D assembly of a mechanical system by numerical modeling and interference analysis.<br>• Creation of 2D plans (definition drawing and overall drawing).<br>• Integration of CAD data into a server ensuring the lifecycle management of a PLM product (Product Life Management).<br>" | TP : 24h00<br>Durée totale: 24h00 |
| **Materials And Structures** | 6 | **Strength Of Materials** | The presentation of the methods of calculation used in Resistance of the Materials is made in the form of lectures and exercises, concerning the following points:<br>- writing of equilibrium equations and calculation of bond reactions in the case of isostatic structures,<br>- plots of the load diagrams along the average fiber of a beam,<br>- Application of stress calculation formulas in the case of stressed beams in tension / compression, bending, shearing and torsion.<br><br>There are two practical works :<br>- Gauge measurements: normal and tangential stress measurements, special gauge assemblies,<br>- dimensioning: use of the resistance of materials to pre-dimension a structure, verification of design using finite element calculation software. | TP : 8h00<br>Cours : 22h00<br>Travail personnel : 10h00<br>Durée totale: 40h00 |
| | | **Solid Mechanics** | The objective of structural design courses (solid mechanics,strength of materials , and structural design practice) is to give the ability to carry out a study in the field of structural analysis (strength of materials approach or finite element method). These courses enable you to choose a model, and to appreciate the influence of the modeling choices, then to analyze, interpret and justify the results.<br>"Classes are given in the form of lectures and practical exercises done in tutorials.<br>Practical works on an industrial finite element calculation software (ANSYS) make it possible to become familiar with a calculation model and illustrate the concepts seen in class; one session is notably devoted to the modeling of a pressurized cylinder in order to introduce the assumptions used for the calculation of thin vessels.<br>Contents:<br>Stress tensor: definition, normal stress and shear stress, local equilibrium equations, Mohr circles (3D and plane elasticity) principal stresses and maximum shear..<br>Tensor of infinitesimal strain: expression, physical meaning (normal strain and shear strain), Mohr circles, strain gauges.<br>Constitutive law, isotropic linear elasticity (Hooke's law), thermal strains.<br>Design criteria: yield stress criterion (von Mises, Tresca) , failure criterion (Rankine), ...<br>" | TD : 6h00<br>TP : 8h00<br>Cours : 14h00<br>Travail personnel : 22h00<br>Durée totale: 50h00 |
| | | **Materials For Engineers** | Objectives:<br>- To know, to understand and to be able to measure the material properties, especially thermomechanical properties.<br>- To know the atomic arrangment and microstructure of materials<br>- To know the material classes (main properties, microstructure features, applications).<br>- To understand the relatinships between the microstructure of materials, their properties and the processes.<br>- To be able to identify the key property(ies) to meet objectives or functional specifications of scope statements | TD : 6h00<br>TP : 8h00<br>Cours : 16h00<br>Travail personnel : 20h00<br>Durée totale: 50h00 |

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| | | | Courses:<br>- Theoretical contributions are made in the form of lectures and application exercises carried out in class or in self-training. The courses introduce the main properties of the materials, the notions of materials microstructure and present the microstructure relations – properties – processes.<br><br>- Course content:<br>material life cycle; material families; material properties; atomic organization and microstructure; mechanical behaviour and properties: elasticity, viscoelasticity, plasticity, rupture; effect of temperature on materials: thermal dependence of properties, glass transition, fragile-ductile transition, creep, thermal shocks.<br><br>-Tutorials:<br>Tutorials illustrate and apply the concepts develop in lectures. They are focus on the comparison of the characteristics and properties of the 3 major families of materials, the determination and manipulation of the thermomechanical properties and the study of process.<br><br>Lab practice:<br>They allow learning to measure, compare and interpret the thermal and mechanical properties of materials | |

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| **Humanities 2** | 2 | **Interculturality** | Each of these conferences will explore one of the social sciences | Cours : 4h00<br>Travail personnel : 2h00<br>Durée totale: 6h00 |
| | | **Organization And Markets** | This course aims to introduce students to how companies operate in different markets and how they take into account interculturality in their operations. | TD : 6h00<br>Cours : 6h00<br>Durée totale: 12h00 |
| | | **Professional Project** | The objective of the teaching is multifaceted: from the search for a professional project to obtaining their degree, the student is led to understand the challenges of recruitment, to define the favorable conditions for its achievement, and to open up to the external professional world. | TD : 6h00<br>Durée totale: 50h00 |
| **Advanced Software & Hardware 1** | 4 | **Advanced Software Development** | - HTML<br>- CSS<br>- PHP<br><br>Course Syllabus :<br>- Principles of the Client-Server approach<br>- Frontend and Backend development<br>- Concepts and syntax related to the chosen languages<br>- Exercises<br><br>The second part of the course consists of a project. This will make it possible to implement a real application. | Cours : 8h00<br>Projet : 12h00<br>Travail personnel : 12h00<br>Durée totale: 32h00 |
| | | **Advanced Electronics** | The Advanced electronics teaching unit will consist of lectures, tutorials, and laboratory sessions. More complete functions will be studied through the association of standard electronic components: Thryristor and TRIAC on AC networks, sinusoidal oscillators, astable multi-vibrators, ADC and | TD : 6h00<br>TP : 8h00<br>Cours : 30h00<br>Travail personnel : |

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| | | | DAC converters, sample and hold circuits, instrumentation amplifiers, linear and switch-mode power supplies, inverters and thyristors.<br>Reading and analysis of graphics and circuits, with different complexity levels. These exercises are based on technical documentation from industrial and domestic applications. | 45h00<br>Durée totale: 89h00 |
| | | **Ia** | | |
| **Innovation Project 1** | 2 | **Creativity** | Creativity is a skill that requires work and discipline. This course allows students to meet entrepreneurs from the region. This course also allows them to discover creativity tools and techniques in order to identify, collectively, an innovative idea of a mechatronic product that could lead to the creation of a company thereafter. The aim is to make students aware of entrepreneurship.<br><br>Supervised by entrepreneurs from the region, the module is structured around 3 highlights:<br>1. Divergent phase of creativity in which students produce many ideas,<br>2. Convergent phase of creativity in which students select the most innovative idea in order to detail it and investigate its potential,<br>3. Phase of publication, communication and pitch of the chosen idea in front of a jury in order to test the concept and convince fictitious investors. | TP : 8h00<br>Cours : 2h00<br>Travail personnel : 10h00<br>Durée totale: 20h00 |
| | | **Bibliographic Search** | Know the different types of documents, the tools to find them.<br>Know how to cite sources and write a bibliography.<br>Know the notion of plagiarism. | TD : 2h00<br>Durée totale: 2h00 |
| | | **Eco Innovation** | The purpose of this course is to guide students in their general eco-design approach. Ecodesign is the systematic integration of environmental aspects from the design and development of products with the aim of reducing negative environmental impacts throughout their life cycle. This early stage approach to a design process aims to find the best balance between environmental, social, technical and economic requirements in product design and development. The "NF X 30-264 Environmental management" standard helps to set up an eco-design approach.<br><br>Students will have a reflection in the upstream phases of the design, via generic questions and qualitative evaluations. The following strategy will be detailed:<br>• Aim for a high degree of functionality,<br>• Ensure safe use,<br>• Identify usage scenarios and their drifts,<br>• Eco design centered on use,<br>• Use less energy and material when using,<br>• Use the resources implemented as intensively as possible,<br>• Use the resources implemented for as long as possible,<br>• Reuse the materials implemented,<br>• Source with other materials/components. | Cours : 2h00<br>Durée totale: 2h00 |
| | | **Communication** | | TD : 16h00<br>Durée totale: 16h00 |
| **Industrial Design And Management** | 3 | **Methods 2** | "<br>Digitally Controlled Machine Tools (MOCN): Operative part, control part (DCN), kinematics & definition of axes, frames of reference & machining origins, typology of MOCNs.<br>- MOCN programming: Organization & structure of a CNC program, presentation of the main functions of the ISO code.<br>- CAD / CAM approaches: Export & Import of CAD / CAM files, selection criteria for programming references, geometry of parts to be machined & choice of machining strategies, cutting conditions, generation of toolpaths and 2D simulation & 3D of the machining program. | TD : 12h00<br>Durée totale: 12h00 |

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| | | **Cad 2** | CAD is a digital tool which assists the mechanical designer in his daily work. The mechanical designer:<br>• Designs mechanical systems,<br>• Projects (draws),<br>• Sizes the mechanical components,<br>• Defines the technological characteristics,<br>• Specifies the technical features,<br>• Guides the production department.<br><br>Each session includes a theoretical part and a practical part.<br><br>The theoretical part allows the student to improve his knowledge in the following areas:<br>• Use of CAD software: brings together the computer tools that make it possible to carry out a geometric modeling of an object in order to be able to simulate tests with a view to manufacturing,<br>• Use of PLM software: corresponds to all the processes, technologies, software and methods put in place to properly manage the life cycle of a product.<br><br>The practical part allows the student to apply his knowledge through a team project comprising the following phases:<br>• Discovery of the main functions of the CAD tool and configuration of the 3D model,<br>• Complete modeling of the project proposed by the teacher,<br>• Integration of CAD data into the PLM,<br>• Creation of definition plans for each part, and overall drawings,<br>• Writing of a complete mechanical design report. | TP : 8h00<br>Travail personnel : 12h00<br>Durée totale: 20h00 |
| | | **Industrial Organization 2** | | TD : 8h00<br>Cours : 8h00<br>Durée totale: 16h00 |
| | | **Heath, Safety And Environment** | Definitions and content of OHS-QVT policies<br>o Focus on prevention<br>o Health insurance figures (occupational accidents, occupational diseases and causes)<br>o Focus on MSDs<br>o What cost for the company<br>Identify the economic and competitive challenges of eco-design<br>o The regulatory and normative context<br>o Customer requests, eco-responsible purchases<br>o Other incentives: financial institutions, competitors, NGOs<br>Assimilate the fundamentals of eco-design<br>o Global consideration of the environment: multi-criteria<br>o "Life cycle" approach<br>o Ecological quality of products<br>o Innovation and eco-design<br>o Transversality of the approach: mobilize stakeholders in the company and beyond<br>o Identify the environmental assessment tools adapted to the company<br>o Relevance and field of validity of the different tools: Life Cycle Analysis (LCA), derived methods, energy content, etc.<br>o Simplified practice of an LCA tool<br>o Practice of eco-innovation oriented creativity tools<br>Films, videos and quizzes for dynamic and fun animation to interest students and give meaning to the subject matter which is truly essential for everyone. | TD : 6h00<br>Cours : 2h00<br>Travail personnel : 2h00<br>Durée totale: 10h00 |
| **Energy 2** | 4 | **Applied Ther modynamics** | The application of thermodynamic principles to the study of thermal machinery is taught in masterclasses. Class exercises are performed in the following areas: | TD : 10h00<br>TP : 8h00<br>Cours : 10h00 |

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| | | | - Review of fluids and fluids transformations, concept of work and heat, and finally the first and second principle.<br>- Positive displacement compressors, turbo-compressors: description of the main types of machines, the thermodynamic cycle and powers at stake.<br>- Vapor-compression refrigerating units: technology, refrigerants, operating cycle.<br>- Internal combustion engines: Otto and Diesel cycles, efficiency and practical aspects (engine components, combustion, polluting gas emissions)<br>- Gas turbines and turbojet engines Brayton cycle, influence of irreversibility on thermal efficiency. | Travail personnel : 20h00<br>Durée totale: 48h00 |
| | | **Electrical Machines** | Lectures :<br>- L1 : Introduction to rotating machines: definition of an electromechanical converter, illustration, general description of machines, reminder of electromagnetic laws (Laplace, Lenz-Faraday) demonstration of the creation of an electromotive force and a torque in a simplified structure.<br>- L2 : The direct current machine: description, particularity of design of the electrical contacts by brush-collectors. Reversibility of the machine. Separate excitation, shunt and series modes: description of the circuit model and plot of torque and speed characteristics as a function of armature voltage and current.<br>L3 : Rotating field (Ferrarris theorem demonstration)<br>- L4 : The synchronous machine: description, comparison of a wound rotor machine with permanent magnets. Demonstration of obtaining the circuit model. Description of different models of the synchrone machine: linear, Behn-Eschenburg and Potier. Implementation of synchronous machines: connection to the network.<br>- L5 : The Induction machine: description, Demonstration of obtaining the circuit model. Plot of the torque-slip and speed torque characteristic.<br>-L6 : Openness to the use of electric machines in energy production. Conference on the adequacy of primary energy - type of turbine - type of electrical machine<br><br>Tutorials :<br>- Study of direct current and asynchronous motors in railway traction, the case of TGV<br>- Comparison of linear and Behn-Eschenburg models for the calculation of an operating point of a synchronous alternator.<br><br>Practical work:<br>- Coupled system of a DC motor and a synchronous alternator<br>- Study of the MAS characteristics | TD : 4h00<br>TP : 8h00<br>Cours : 16h00<br>Travail personnel : 15h00<br>Durée totale: 43h00 |
| **Student Life Commitment 2** | 3 | **Student Life Commitment** | | Durée totale: 0h00 |
| **Student Life Investment 2** | 2 | **Student Life Involvement** | | Durée totale: 0h00 |
| **Foreign Language 2** | 3 | **English 2** | Expanded vocabulary and tests<br>Revision of grammar points<br>Strategies, techniques and practice papers to prepare for the TOEIC (lower-level groups)<br>Assigned presentations (individual and in pairs) on technical subjects<br>Task-based practice of language appropriate for professional and social settings.<br>Be able to ask and field questions related to scientific and technical subjects<br>Written assignment related to engineering themes (scientific poster for higher-level groups) | TD : 24h00<br>Travail personnel : 6h00<br>Durée totale: 30h00 |

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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | **Second Foreign Language** | 2 hour lessons every week.<br>Expanded vocabulary<br>Revision of grammar points<br>Improvement of phonological control<br>Language skills according to different CEFR level groups:<br>A1<br>Can establish basic social contact by using the simplest everyday polite forms of: greetings and farewells; introductions; saying please, thank you, sorry etc.<br>A2/B1<br>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.<br>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.<br>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.<br>Has a limited repertoire of short memorised phrases covering predictable survival situations; frequent breakdowns and misunderstandings occur in non-routine situations.<br>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.<br>B2<br>Can express him/herself clearly and without much sign of having to restrict what he/she wants to say.<br>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.<br>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.<br>C1<br>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. | TD : 18h00<br>Travail personnel : 10h00<br>Durée totale: 28h00 |
| | | **Second Foreign Language** | 2 hour lessons every week.<br>Expanded vocabulary<br>Revision of grammar points<br>Improvement of phonological control<br>Language skills according to different CEFR level groups:<br>A1<br>Can establish basic social contact by using the simplest everyday polite forms of: greetings and farewells; introductions; saying please, thank you, sorry etc.<br>A2/B1<br>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.<br>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.<br>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.<br>Has a limited repertoire of short memorised phrases covering predictable survival situations; frequent breakdowns and misunderstandings occur in non-routine situations.<br>Has enough language to get by, with sufficient vocabulary to express | TD : 18h00<br>Travail personnel : 10h00<br>Durée totale: 28h00 |

| Semester 6 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | 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.<br>B2<br>Can express him/herself clearly and without much sign of having to restrict what he/she wants to say.<br>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.<br>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.<br>C1<br>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. | |
| | | **Lv3** | 2 hour lessons every week.<br>Expanded vocabulary<br>Revision of grammar points<br>Improvement of phonological control<br>Language skills according to different CEFR level groups:<br>A1<br>Can establish basic social contact by using the simplest everyday polite forms of: greetings and farewells; introductions; saying please, thank you, sorry etc.<br>A2/B1<br>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.<br>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.<br>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.<br>Has a limited repertoire of short memorised phrases covering predictable survival situations; frequent breakdowns and misunderstandings occur in non-routine situations.<br>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.<br>B2<br>Can express him/herself clearly and without much sign of having to restrict what he/she wants to say.<br>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.<br>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.<br>C1<br>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. | TD : 18h00<br>Travail personnel : 10h00<br>Durée totale: 28h00 |
| | | **A&M-Eeng Lv2-Ec1** | | |
| **Advanced Materials And** | 4 | **Metallic Materials** | "Different means to give a metallic material specific properties and knowing how to explain the mechanisms / parameters controlling these | TP : 16h00<br>Cours : 14h00 |

| Semester 6 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| **Structures 1** | | | properties.<br>Processes that allow their properties to change both in the mass and on the surface.<br>Mechanical resistance, modification of surface conditions, resistance to wear, etc.<br>Laboratory work :<br>- Heat treatment of aluminum alloys (4h)<br>- Hardenability of different steel grades - Jominy test. (4h)<br>- Design and realization of a low pressure carburizing cycle (4h).<br>- Control of nitrided parts (4h). | Travail personnel : 10h00<br>Durée totale: 40h00 |
| | | **Polymer Materials** | Courses (14h):<br>The learning will be complementary compared to the learning provided in the common core.<br>We will deal with the different means to give a polymer material specific properties, while knowing how to explain the mechanisms/parameters controlling these properties. In particular, we will be able to control the influences of the formulation and the conditions of elaboration on the final properties of the material, while being able to control and follow the modification of the materials.<br>We will focus, for example, on ways to provide a conduction property to this class of intrinsically nonconductor materials, or to understand and improve the biodegradation or recycling of plastic materials.<br><br>Practical work (16h) : Two main parts:<br><br>Polymer materials (2*4h): the two main classes of polymer materials will be studied :<br>- thermoplastics<br>- thermosets (including the mechanical properties of composite materials)<br>The influence of formulations and processing conditions will be compared with the final properties of the material.<br><br>Project (2*4h):<br>A two-session project should make it possible to:<br>- Exercise faculties of increase in competence on a little-known subject<br>- Propose a study compatible with the imperatives of time and feasibility with the available equipment<br>- Design and carry out the necessary samples<br>- Carry out the planned tests, use the results<br>- Present the study in the form of a report. | TP : 16h00<br>Cours : 14h00<br>Travail personnel : 10h00<br>Durée totale: 40h00 |
| **Materials And Structures : Applications** | 7 | **Structural Analysis** | The course is divided into two parts.<br><br>A section "Strength of Materials" which exposes through courses and exercises, the physical parameters which influence the behavior of a structure.<br>This part contains the following chapters:<br>- calculations of displacements in beam structures,<br>- study of the particularities of hyperstatic structures compared to isostatic structures,<br>- introduction to plastic calculation, notions of plastic adaptation and plastic ruin,<br>- introduction to elastic instabilities and geometric nonlinearities, example of buckling of compressed beams.<br><br>A "Finite Element analysis" section which explains, through lectures and comparisons of simulation results, the analysis parameters whose choices must be reasoned.<br>This part contains the following chapters<br>- Finite Element Method - theoretical approach: notion of approximation and influence of the mesh, | TP : 16h00<br>Cours : 20h00<br>Travail personnel : 28h00<br>Durée totale: 64h00 |

| Semester 6 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | - Finite Element Method - practical aspect: types of elements, boundary conditions, analysis options.<br>- geometrical non-linearity<br>material non-linearity: elastoplastic calculation<br><br>Practical work is associated with each of these parts.<br><br>The practical work associated with the "Strength of Materials" part includes experimental verifications, in addition to finite element simulations. These pratical works are:<br>- equations of a nonlinear problem (flexible elastic loaded transversely), resolution of the equations, experimental verification of the results, use of finite element calculation software in order to reproduce the observed phenomena,<br>- experimental study of the buckling of a compressed beam in different loading cases, use of finite element calculation software in order to reproduce the observed phenomena.<br><br>The practical work associated with the "Finite Element Analysis" part aims to enable students to use calculation software recognized in the industry (ANSYS) by themselves, to make them discover the extent of the possibilities of this software and to make them aware of the risks of modeling errors. These TPs are:<br>- discovery of the finite element method: principle of approximation and influence of the mesh<br>- synthesis on the activity calculation of structures: dimensioning of a structure (comparison RDM -EF in the areas comparable to beams, study of influence of the mesh in the zones of stress concentrations, interpretation of the results, elastoplastic analysis . | |
| | | **Materials For Engineering Office** | The course is based on the analysis of concrete applications to provide the necessary concepts for the understanding, definition and use of technical, functional, economic and / or environmental criteria for the choice of materials and processes<br><br>Course content :<br><br>- Materials (and processes) choice : main principles and methodology<br>- Metallic materials for highly stressed mechanical parts, adaptation of mechanical properties by heat treatment processes, influence of parts size<br>- Light structural parts: use of low density metallic materials, engineering polymers or composite materials<br>- Materials for very high temperature parts<br>- Durability of materials (corrosion, polymers aging)<br>- Parts end of life (recycling, ...)<br><br>Practice<br>The practical work will highlight and observe the effects of corrosion and aging on metals and polymers. The choice of materials will be implemented through case studies through the use of a software for materials choice | TD : 6h00<br>TP : 12h00<br>Cours : 32h00<br>Travail personnel : 43h00<br>Durée totale: 93h00 |
| **Programming And Databases** | 2 | **Software Development** | Concepts of software development project management, study of each regular stage in the process: analysis of needs, functional specifications, UML, architecture, modeling, test, acceptance test, operating systems. Study of a few models in development cycles with critical insight (V, W, Spiral, Agile methodology).<br>Project: Development of a Java application in groups of 4 to 5 persons, using a project management methodology, within a timeframe of five 4-hour sessions.<br>The project is divided into stages: | TP : 20h00<br>Cours : 3h00<br>Durée totale: 23h00 |

| Semester 6 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | - Drafting specifications<br>- Modelization, UML class diagram<br>- Development<br>- Use of GIT<br>- Defense | |
| | | **Database** | The CDM (conceptual data model) will be approached using the UML class diagram and the MLD (logical data model) with the relational model.<br>Labwork involves using databases with the SQL language. | TD : 2h00<br>TP : 4h00<br>Cours : 2h00<br>Travail personnel : 8h00<br>Durée totale: 16h00 |
| | | **Introduction Of Ai** | | TP : 4h00<br>Cours : 8h00<br>Durée totale: 12h00 |
| **Automatic Systems And Data Processing** | 3 | **Automatics 1** | "<br>Boolean Algebra, Combinatorial and Sequential Logic<br>- Numeration, and Coding<br>- Digital functions<br>- Le Grafcet<br>" | TD : 4h00<br>TP : 8h00<br>Cours : 8h00<br>Durée totale: 20h00 |
| | | **Statistics** | - The use of statistics and probabilities in the industry.<br>- Different graphic representation modes (Pareto, box plot, histogram, etc)<br>- Concept of population and sampling<br>- Data characterization: average, median, quartiles, standard deviation, variance<br>- Probability calculations (Bayes formula)<br>- Statistical laws:<br>Discrete laws (binomial law, hypergeometric law, Poisson)<br>Continuous laws (Normal law, Student)<br>- Confidence intervals<br>- Type 1 risk, type 2 risk<br>- Variance analysis | TP : 8h00<br>Cours : 14h00<br>Durée totale: 22h00 |
| **Energy Transition 1** | 4 | **Fundamentals Of Energy** | "Fossil energy / easy energy: Back to Basics, Basics of energy in the 21st century, what is energy? Order of magnitude change in consumption and demography, primary energy or final energy what are we talking about? the question of returns.<br>- Fossil energy / easy energy 2: The French energy mix, the different uses, the issue of travel, housing, consumption, price formation, the message of the Club of Rome, Oil, gas and coal, what is the situation? What climate for tomorrow? the question of stocks.<br>- Some possible solutions: Energy savings and the issue of social acceptability, factor 4, what would sustainable development require? Respect the Kyoto protocol: easy or not easy? Renewables, what are they? exactly? Carbon has its accounting plan: the Bilan Carbone. Carbon offsetting, the Negawatt scenario, from Kyoto to Copenhagen, what's new?, The political toolbox,<br>- Prospective: What challenges for renewable energy in France, what scenarios for the future?<br>- What impacts for the professions of tomorrow? based on Kaya's equation, which profession for sustainable development, analysis by function, analysis by sector, analysis from classified ads from different files." | Cours : 12h00<br>Travail personnel : 10h00<br>Durée totale: 22h00 |
| | | **Advanced Th** | 1. Changes and coexistence of phases | TD : 10h00 |

| Semester 6 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | **ermodynamics** | 2. Steam engine cycles<br>2.1. Operating principle and energy balances.<br>2.2. Use of usual thermodynamic diagrams.<br>2.3. Practical case study<br>3. Refrigerating machines with mechanical vapor compression.<br>3.1. Refrigeration overview<br>3.2. Importance of the nature of the refrigerant.<br>3.3. Operation and performance of refrigeration machines.<br>3.4. Practical case study<br>4. Heat pumps.<br>4.1. The different uses of heat pumps.<br>4.2. Operation and performance of heat pumps.<br>4.3. Practical case study<br>5. Humid air and air conditioning<br>5.1. General information on humid air<br>5.2. Importance on the energy consumption of buildings<br>5.3. Using the humid air diagram<br>5.4. Practical case study | TP : 12h00<br>Cours : 12h00<br>Durée totale: 34h00 |
| | | **Design Of Electrical Machines** | - Identification games for the different types of machines with a participatory restitution to describe each of the rotating electrical machines.<br>- Description of the technical vocabulary of synchronous electric machines with permanent magnets, using real open and dismantled machines as support.<br>- Reminders of the physical phenomena in place in electrical machines (Maxwell's laws) and details on the numerical calculation methods that can be envisaged in electromagnetism to solve these complex equations. Comparison of numerical calculation methods and justification of the choice of finite elements.<br>- Description of single and double layer winding techniques and their influence on the induction harmonics present in the electrical machine.<br>- Apprehension of the techniques for calculating the winding coefficient via the distribution and shortening coefficient.<br>- Description of the analytical sizing method with the progress of a complete example<br>- Description of the modeling approach: analytical pre-dimensioning with the method seen previously, description of the geometry in MATLAB, piloting of the FEMM4.2 finite element CAD software by MATLAB.<br>- Realization of a 12-hour project on the design of a synchronous machine with permanent magnets based on industrial specifications. | TD : 2h00<br>TP : 12h00<br>Cours : 4h00<br>Travail personnel : 4h00<br>Durée totale: 22h00 |
| **Factory 4.0 - 1** | 4 | **Methods 3** | "<br>Definition and configuration of MOCN resources: tools, chuck, turret, machining assembly, etc.<br>- Configuration of MOCN workspace: machine origins, machining assembly and part.<br>- Simulation of the CNC program from the ISO code.<br>- Detection of MOCN collisions, assembly, machining and workpiece.<br>- Validation of the CNC program for mass production.<br>" | TD : 12h00<br>Durée totale: 12h00 |
| | | **Cad 3** | This course allows students to improve their use of advanced digital CAD tools. The mechanical designer:<br>• Designs mechanical systems,<br>• Projects (draws),<br>• Sizes the mechanical components,<br>• Defines the technological characteristics,<br>• Specifies the technical features,<br>• Guides the production department.<br><br>Each session includes a theoretical part and a practical part. | TP : 32h00<br>Travail personnel : 12h00<br>Durée totale: 44h00 |

| Semester 6 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | The theoretical part allows the student to improve his knowledge in the following areas:<br>• Advanced use of CAD software: brings together the computer tools that make it possible to carry out a geometric modeling of an object in order to be able to simulate tests with a view to manufacturing,<br>• Advanced use of simulation tools (kinematics, dynamics, digital),<br>• Advanced use of augmented reality tools,<br>• Advanced use of topological optimization tools,<br>• Advanced use of PLM software: corresponds to all the processes, technologies, software and methods put in place to properly manage the lifecycle of a product.<br><br>The practical part allows the student to apply his knowledge through a team project comprising the following phases:<br>• Complete modeling of the project proposed by the teacher,<br>• Complete production of a prototype using the tools available in the FabLab,<br>• Writing of a complete mechanical design report,<br>• Presentation of a communication medium and promotion of the work carried out over the year. | |
| | | **Statistical Process Control And Big DATA** | | TD : 14h00<br>Travail personnel : 8h00<br>Durée totale: 22h00 |

## A&M - Year 4

### Semester 7

| Unité d'Enseignement | ECTS | Unité de Cours | Contenu | Nb d'Heures |
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| **Applied Internships** | 3 | **Applied Engineering Internship** | During this applied engineering internship (13 to 16 weeks, starting at the end of year 3), the engineering student joins a company or a university laboratory with the objective of taking on a variety of tasks and assignments that correspond to his/her level of studies. | Stage : 455h00<br>Durée totale: 455h00 |

### Semester 8

| Unité d'Enseignement | ECTS | Unité de Cours | Contenu | Nb d'Heures |
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| **ITC** | 2 | **Business Game** | | Projet : 12h00<br>Durée totale: 12h00 |
| | | **Research Exposure** | | Projet : 6h00<br>Durée totale: 6h00 |
| **Advanced Dimensioning And Optimization** | 5 | **Damage And Failure** | Courses (14h)<br>Failure under static stresses:<br>The brittle and ductile fracture mechanisms are studied for the different families of materials as well as the various influencing parameters. The brittle ductile transition, the toughness, as well as the fracture statistics, complete this part to refine the choices of materials and their dimensioning for the strenght to sudden fracture by crack propagation.<br>Failure under dynamic stresses<br>The mechanisms of fatigue failure in materials, and the bases of pre-dimensioning of parts for dynamic stresses are studied.<br>The course is illustrated with numerous examples and exercises from expertises treated in the laboratory.<br>Practical work (6x4h)<br>In the form of mini projects allowing for a global consideration of the design, choice of materials, analytical and numerical calculations and expertise of parts subjected to dynamic or statics constraints. | TP : 24h00<br>Cours : 14h00<br>Travail personnel : 20h00<br>Durée totale: 58h00 |
| | | **Vibratory Expertise** | The chapters of the course, grouped according to the general objectives, are as follows:<br><br>Characterization of the vibrations of a system:<br>- analytical study: sub-structuring of a complex system,<br>- experimental study: means of measurement and software for experimental modal analysis.<br><br>Vibration reduction methodology:<br>- actions on the source of the vibrations,<br>- actions on the transmission of vibrations,<br>- actions on the system's own response.<br><br>Conditional and provisional maintenance of rotating machinery:<br>- types of defects in rotating machinery,<br>- choice and limitations of monitoring indicators and diagnostic tools.<br><br>These chapters are complemented by the presentation of frequency analysis tools: Fourier series and digital Fourier transform, used in the experimental characterization of systems and diagnosis of defects in rotating machines.<br><br>The theoretical knowledge on the characterization of the vibrations of a system is implemented during three sessions of practical work, relating respectively to the use:<br>- means of measurement,<br>- a modal analysis software,<br>- finite element calculations software. | TP : 12h00<br>Cours : 14h00<br>Travail personnel : 8h00<br>Durée totale: 34h00 |

| Semester 8 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | These three sessions make it possible to compare, on the same system, the vibratory characteristics extracted from measurements with those calculated from a modeling of the system. | |
| | | **Mechanical Topology Optimization** | Optimization methods are increasingly used today. In the field of structural design, they make it possible in particular to reduce the mass of a mechanical system and therefore to reduce its production cost (less material), and possibly its cost of use (reduction in energy consumption). ). Among the different methods, topological optimization is currently experiencing strong development because of the interest it represents if it is associated with 3D printing. The objective of this course is to make students aware of this method.<br>The following 3 sessions will be devoted to carrying out a project in a group and independently. This project will consist of the following stages:<br>Mechanical characterization of the material used: creation and 3D printing of test specimens which will be subjected to a tensile test. The anisotropy of the material can be highlighted and characterized.<br>Topological optimization: search for an optimized solution for a given load case. The influence of parameters such as mesh size, boundary conditions or optimization methods should be evaluated.<br>Numerical validation of the optimized structure (simulation on the optimized structure)<br>3D printing of the optimized structure and mechanical test on this part. The experimental results will be compared with the numerical results; we will then try to explain any differences. | TD : 4h00<br>Projet : 12h00<br>Travail personnel : 10h00<br>Durée totale: 26h00 |
| **Structural Dynamics** | 2 | **Structural Dynamics** | The course resumes the basics of rigid body mechanic before introducing less common notions such as shocks theory and vibration analysis.<br>The movement is studied independently of its causes first. The kinematic and the associated torsor are introduced. The course focus and the point before extrapolating the results to generic solids.<br>Mechanical actions and their modelling is presented in order to apply the dynamic notions.<br>Newton's laws are introduced et allow to link the movement to it cause.<br>Energy is approached as well as the basics of shock theory, which is at the limit of the rigid body hypothesis.<br>Finally, the vibration analysis and it matrix formalism is presented and applied at two degress of freedom systems.<br>Exercises are done after each notion to put into practice formula and method introduced in the course. | TD : 6h00<br>TP : 8h00<br>Cours : 22h00<br>Travail personnel : 20h00<br>Durée totale: 56h00 |
| **Industry Of The Future** | 3 | **Supply Chain : Fresh Connection** | The Fresh Connection "is an online simulation exercise game of the management of the supply chain of a company in difficulty. The Fresh Connection is therefore a real simulator in which the Board of a company is faced with a difficult situation and must do so. remedy A real challenge!<br>Organized as a management committee, the team members develop a strategy to maximize the profitability of their business and satisfy their customers.<br>The game is organized in 6 rounds spread over 3 sessions of 4 hours. The difficulty is growing with more and more parameters to integrate and an increasingly constrained environment.<br>Management of supplies and stocks (Safety stocks, batch sizes, ...)<br>Production and operations management (Loads & Capacity, Launch, Scheduling, machine investments, Lean Manufacturing, ...)<br>Customer management (Sales) Service level delivery times, Product quality service level.<br>Supplier management (Purchasing) | TD : 12h00<br>Cours : 4h00<br>Durée totale: 16h00 |
| | | **Maintenance 1** | - Introduction & definition of the RMA system: Reliability, Maintainability and Availability of production equipment,<br>- Study of repairable FMD systems: indicators, characterization methods, reliability laws: study of models | TD : 6h00<br>Cours : 4h00<br>Travail personnel : 4h00 |

| Semester 8 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | Exponential & Weibull,<br>- Application to the management of spare parts,<br>- Case study. | Durée totale: 14h00 |
| | | **Discovering And Project Of Robotization** | • Kinematics/movement<br>• Learning points on a dedicated software<br>• Handling of ECAM's virtual and physical robots | TD : 2h00<br>TP : 12h00<br>Cours : 2h00<br>Durée totale: 16h00 |
| **Energetic 3** | 4 | **Control Of Electrical Machine** | Lectures :<br>-L1 : Presentation of the physical phenomena involved in semiconductors (PN junction and MOS effect). Description of the basic components of power electronics (Diode, Thyristor, MOSFET, IGBT). Study of the basic circuits of power electronics: Choppers (Buck, Boost, Buck-Boost), Single-phase and three-phase rectifiers and inverters. Presentation of the pulse width method via a visual analogy.<br>-L2 : Reminder of the DC machine models and their characteristics (Torque-current and Speed-voltage). Presentation of power converters according to the type of network (choppers from DC and rectifiers from AC) and the operating quadrant (bidirectional voltage and / or current converter).<br>- L3 : Reminders on the induction machine. Presentation of the two types of control allowed by a frequency converter (scalar and field oriented). Demonstration of maintaining the performance of the machine at variable speed in both modes with explanations of the limits at high and very low frequencies.<br><br>Tutorials :<br>- Complete study of a synchronous machine autopiloted by a thyristor inverter<br>- Complete study of an asynchronous machine controlled by scalar control<br>- Sizing of an autonomous electricity installation containing a generator (synchronous generator) and photovoltaic panels. | TD : 4h00<br>TP : 4h00<br>Cours : 8h00<br>Travail personnel : 15h00<br>Durée totale: 31h00 |
| | | **Heat Transfer** | The approach on theory is made in masterclasses and with class exercises on the following points:<br>- Conduction: Fourier law, general three-dimensional heat conduction equation for steady state and unsteady conditions, introduction to the concept of thermal resistance.<br>- Convection: Newton law, dimensionless numbers and used correlations in convective transfer situations.<br>- Radiation: study of black bodies and gray bodies, Stefan-Boltzmann law, equivalent thermal network to treat radiation problems.<br>- Application to insulation problems, study of combined transfers (example with fins).<br>- Heat exchangers: description of the main types, study of associated calculation methods. | TD : 10h00<br>TP : 8h00<br>Cours : 24h00<br>Travail personnel : 12h00<br>Durée totale: 54h00 |
| **Student Life Commitment 3** | 3 | **Student Life Commitment** | | |
| **Energy Transition 2** | 6 | **Biomass Valorization As An Energy Source** | - Definitions and Issues<br>a. What are we talking about?<br>b. Biomass issues and constraints (including regulations)<br>c. Incentive policies<br>d. The actors in the sector<br>II- Characterization of a biomass project<br>a. Technical component: boiler room design<br>b. Energy Component: Procurement Assessment<br>c. Economic component: cost-effectiveness<br>d. Operational Component: Operations | TD : 20h00<br>Cours : 20h00<br>Projet : 12h00<br>Travail personnel : 10h00<br>Durée totale: 62h00 |

| Semester 8 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | e. Policy: Actors<br>III- Sizing a facility<br>a. Choice of thermal production and its supply: power, coverage ratio, type of fuel transfer<br>b. Heating plant layout and design: storage design, building design, hydraulics<br>c. Case of heat networks<br>IV- Consider legal and other constraints<br>a. Assessment of environmental impacts (ash, fumes, CO2, dust, etc.)<br>b. Regulatory constraints based on boiler size and fuel type<br>c. Elements of Timber Supply Contract Development<br>d. Operating costs and ROI calculation<br>V- Improve the operation of an existing facility<br>a. Analysis of an existing facility,<br>b. Monitoring its performance<br>c. Identify possible causes of malfunction<br>d. Proposed solutions | |
| | | **Economic Analysis Of The Renewable Energy Project** | Economic and geopolitical context / Political and regulatory framework, national objectives / Support mechanisms for renewable energies / Key players in project financing /fundamentals and strategic vision Knowing how to understand the costs of renewable energy production sectors / Understanding the levers of demand and the competitive environment / "Route to Market": Auctions, "Purchasing Power Agreements", the typical contracts of a renewable energy project / Partnerships / Risk management / Stakeholder management - measuring the socio-economic impacts of renewable energy projects / Costing of revenues, costs and investments / Establishment of cash flows taking into account tax effects and inflation./ Cost of capital and Discount calculation method / | TD : 8h00<br>Cours : 8h00<br>Projet : 12h00<br>Durée totale: 28h00 |
| **Commitment & Responsibilities 3** | 0 | **Commitment And Responsabilities** | | Cours : 2h00<br>Durée totale: 2h00 |
| **Student Life Involvement 3** | 2 | **Student Life Involvement** | | |
| **Digital 3** | 4 | **Digital Systems** | Digital concepts: Digital and analog signals, logic functions, programmable logic, FPGA, integrated circuits, process control system<br><br>numeration systems and operations: microprocessor vs. Microcontroller, binary system, conversion systems, digital codes, error detection and correction codes, rules of Boolean algebra and DeMorgan theorems, application examples<br><br>Memory and storage: basic concepts of solid-state memories, different types of memories, memory expansion, magnetic and optical storage, memory hierarchy, cloud storage<br><br>Introduction to digital signal processing: filtering and sampling, analog-to-digital conversion, analog-to-digital and digital-to-analog conversion methods, converter errors, digital signal processing, digital signal processor DSP<br><br>Data transmission: modulation of analog signals with digital data, modulation of digital signals with analog data, digital data systems, bus basics, PCI parallel bus, USB Universal Serial Bus, other serial buses<br>Data processing and control: computer system, special processor operations, microcontrollers and embedded systems, system on chip (SoC), integrated circuit technologies<br><br>ARM “mbed” development environment: Main technical characteristics, NXP LPC1768 microcontroller, LPC1768 mbed board, Development environment (Keil online) | TD : 2h00<br>TP : 4h00<br>Cours : 16h00<br>Travail personnel : 10h00<br>Durée totale: 32h00 |

| Semester 8 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | Application: temperature and humidity sensor, LCD screen, Bluetooth module for data transfer | |
| | | **Operational Research** | Course outline:<br>- Graphs: definitions<br>- Connectivity<br>- Shortpath problem<br>- Hamitonians paths and heuristic<br>- Minimum spanning tree<br>- Graphs coloration<br>- Maximum flow<br>- Assignment Problem<br>- Binpacking | TD : 4h00<br>Cours : 12h00<br>Travail personnel : 8h00<br>Durée totale: 24h00 |
| | | **Fundamentals Of Digital Network And Information Systems** | 1 - Understand the fundamentals of computer networks, including their historical context and various use cases.<br><br>2 - Learn about the client/server model of communication, network components, and infrastructure.<br><br>3 - Understand what a communication protocol is and what are their specifications, as well as TCP/IP and OSI models for communication.<br><br>4 - Understand addressing schemes at layer 2 (MAC Address) and layer 3 (IP Address), frames and packet processing, and the role of end devices and intermediary devices in network communication.<br><br>5 - Gain an in-depth understanding of IP communication on local and remote networks, including the Address Resolution Protocol (ARP).<br><br>6 - Understand the critical aspect of information system security and learn about internal and external threats to information systems.<br><br>7 - Learn about cryptographic schemes to encrypt and decrypt data, as well as the Information Systems Security Policy (ISSP).<br><br>8 - Gain knowledge of the General Data Protection Regulation (GDPR) and its impact on data protection and privacy for individuals in the EU and EEA. | TD : 6h00<br>TP : 8h00<br>Cours : 20h00<br>Travail personnel : 26h00<br>Durée totale: 60h00 |
| | | **Information Systems** | - Introduction (objectives, stakes for the engineer)<br>- History of information systems (IS)<br>- The information system:<br>- Urbanization and interoperability (principles of urbanization, criteria of interoperability)<br>- Governance (different organizations, strategic issues, maturity of the IS)<br>- IS modeling (cartography, BPMN)<br>- Technological components<br>- application components (HTTP, XML, HTML, LDAP / Directories, Databases)<br>- Hardware Architecture (processors, storage, system rooms)<br>- Software Architecture (operating system, process management, memory management)<br>- Backup and Archiving (issues, current technologies)<br>- Virtualization and cloud computing (general principle)<br>- Standard software offer (software families, selection criteria, publishers' economic models)<br>- Information system security<br>- Security Policy (document, methods, WSIS)<br>- Actors of the IS and the ISP (CIO, ISSO, DPO, professions, external organizations, geopolitics)<br>- Risk Management (general principle, identification, risk management | TD : 2h00<br>TP : 4h00<br>Cours : 15h00<br>Travail personnel : 6h00<br>Durée totale: 27h00 |

| Semester 8 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | methods, countermeasures) | |
| | | **Introduction To Data Science** | The course plan is as follows:<br>- Linear regression and Gradient Descent<br>- Logistic regression<br>- Data: learning base vs test base<br>- Over and under learning<br>- Meta parameters<br>- Perceptron<br>- Neural networks<br>The course will be enhanced with many exercises.<br><br>The second part of the course is carried out in the form of a project whose objective is to implement the concepts seen in the first part. It is about carrying out a machine learning process on a real basis and studying the avenues for improvement. | Cours : 8h00<br>Projet : 8h00<br>Travail personnel : 8h00<br>Durée totale: 24h00 |
| **Innovation Project** | 4 | **Innovation Engineering Project** | - Each team will independently organize their work corresponding to an overall schedule. They are expected to develop their project over different rush periods/<br>- Mission statement: Clearly present the conditions and requirements for the mission. Beforehand, they must isolate project features (mission objectives, scope, timeframe, requirements, confirmation, etc.)<br>- Marketing Specifications: Identify future client needs, main elements for market positioning. Information related to project timeframe from the demand until market launch. Analysis of competition.<br>- Creativity: Allowing for innovative solutions and response to current problems. Techincal Protudct Architecture makes up the transition between the creativity phase and the planning phase to go from ideas to solution principals.<br>- Technical Development: Application of technical knowledge acquired during the program.<br>- Defense: Oral defense of the project and the applied methodology. Requirement and functional analyses are offered aas well as analyzing the team dynamic over the semester.<br>- Pitch: Pitching to potential investors (played by fellow ECAM Students) to support their engineering project. Maximum length of 2 minutes.<br>- Communication: Apply a communication strategy (posters, videos, articles, etc.) to convince potential investors (played by fellow ECAM students) to support their engineering project. Communication may be displayed at the institution. | TD : 6h00<br>TP : 4h00<br>Cours : 8h00<br>Projet : 80h00<br>Durée totale: 98h00 |
| **Humanities, Entrepreneurial** | 3 | **English 3** | Consolidation of grammar and expanded vocabulary.<br>Strategies, techniques and practice papers to prepare for the TOEIC (lower-level groups)<br>Assigned presentations (individual and in groups) on a variety of themes, including international current affairs and cross-cultural elements<br>Students animate masterclasses where interactive elements, debates and active participation are encouraged.<br>Task-based practice of language appropriate for professional and social settings.<br>Assignments will be related to engineering or cultural themes. | TD : 20h00<br>Travail personnel : 4h00<br>Durée totale: 24h00 |
| | | **Second Foreign Language 3** | 1.5 hour lessons every week.<br>Expanded vocabulary<br>Revision of grammar points<br>Improvement of phonological control | TD : 18h00<br>Travail personnel : 10h00<br>Durée totale: 28h00 |
| | | **Entrepreneurship 2** | "Introduction to marketing concepts.<br>Marketing a product for prospects, customers, managers, investors.<br>Realization of a marketing study and a marketing CDC.<br>Establishment of a business development plan via the establishment of the Canvas business model and a business plan (establishment of the | Projet : 12h00<br>Travail personnel : 4h00<br>Durée totale: 16h00 |

| Semester 8 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | map of actors / customers / suppliers / distribution channels)." | |
| | | **Humanities** | Know yourself better to better leverage your strengths<br>1. Better understand your personality with the MBTI<br>2. Build on your strengths and master your drivers<br>Better understand others to strengthen your ability to interact effectively<br>3. Key principles of team communication<br>4. Interact more effectively with others using the DISC tool<br>5. Resolve conflicts with kindness using NVC<br>Better understand the role of the manager and their contribution to a team's ecosystem<br>6. Dimensions of team functioning<br>7. Specificities of the managerial stance<br>8. Manage performance and know how to set SMART objectives | TD : 16h00 |
| **Applied Internships** | 3 | **Applied Engineering Internship** | During this applied engineering internship (13 to 16 weeks, starting at the end of year 3), the engineering student joins a company or a university laboratory with the objective of taking on a variety of tasks and assignments that correspond to his/her level of studies. | Stage : 455h00<br>Durée totale: 455h00 |
| **Energy Transition 2** | 5 | **Industrial Hydraulics** | - Hydraulic networks (friction and minor losses, altitude rise, pipes in parallel and / or in series),<br>- Operating principle of rotodynamic pumps (generality, constitution, pump curves, pump coupling, operating point, specific speed, similarity, cavitation, adaptation of the operating point) ;<br>- Control valve (types of valves, valve coefficients);<br>- Transient phenomena in pipes (generalized equations of transient flows, waterhammers, means of protection). | TD : 6h00<br>Cours : 24h00<br>Travail personnel : 20h00<br>Durée totale: 50h00 |
| | | **Acoustics** | - Acoustic waves (linear acoustic equations, propagation equations, acoustic intensity and power, plane and spherical waves),<br>- Sound levels ;<br>- Elementary acoustic sources (monopole and dipole) and extended acoustic sources;<br>- Cavities and waveguides, tubes, resonators and filters, ;<br>- Acoustic metrology (sound levels, acoustic spectra, microphones, laboratory and in-situ measurements, measurements of intensity and acoustic power). | TD : 4h00<br>Cours : 16h00<br>Travail personnel : 15h00<br>Durée totale: 35h00 |
| | | **Electricity Production And Network** | The electrical network:<br>- From the production of electricity to its distribution<br>- The substation HV/LV<br>- The design of a substation HV/LV<br>- The reactive power compensation<br>The low voltage installation:<br>- LV connections<br>- The protection against electrical shocks<br>- The establishment of grounding systems<br>- The protection of circuits<br>- The electrical equipment<br>- The design of an electrical installation<br>Power system perturbations<br>- Identify the failures in a network | TP : 8h00<br>Cours : 6h00<br>Durée totale: 14h00 |
| | | **Energetic Issues** | " History of major innovations in the energy field.<br>- Influence of regulatory contexts on the development of innovations.<br>- Prospective on future changes in energy consumption.<br>- Influence of the constraints posed by global warming." | Cours : 16h00<br>Travail personnel : 10h00<br>Durée totale: 26h00 |
| **Advanced Software & Hardware 2** | 5 | **API Language And Robotic Systems** | | TP : 16h00<br>Cours : 6h00<br>Durée totale: 22h00 |
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| Semester 8 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | **Digital Servo** | "Modeling of the sampled signals, the Z transform, recurrence equation<br>- Servo-controls of the sampled linear systems.<br>- The digital equivalent of an analog PID corrector<br>- RST correctors<br>- Control with internal model (predictive control)<br>- Analysis of robustness and performance<br>- Temperature regulation of a unit heater<br>" | TD : 6h00<br>TP : 4h00<br>Cours : 14h00<br>Travail personnel : 10h00<br>Durée totale: 34h00 |
| | | **Embedded Software** | - Lectures:<br>- Programmable Logic<br>- VHDL<br><br>- 4 labs (4 hours):<br><br>- The first two sessions are dedicated to the development of one or more applications on C:<br>- Using a Nintendo Nunchuck grip<br>- ERDF remote information and energy metering<br>- Reading RFID tags<br>- Scan of a CAN network and site manipulators<br><br>- The other two sessions are dedicated to development on the Bays 3 FPGA board using VHDL:<br>- Full adder<br>- Multiplier<br>- Counter<br>- Shift register<br>- LED chain<br>- Temperature sensor | TP : 16h00<br>Cours : 4h00<br>Travail personnel : 8h00<br>Durée totale: 28h00 |
| | | **Introduction To Data Science** | The course plan is as follows:<br>- Linear regression and Gradient Descent<br>- Logistic regression<br>- Data: learning base vs test base<br>- Over and under learning<br>- Meta parameters<br>- Perceptron<br>- Neural networks<br>The course will be enhanced with many exercises.<br><br>The second part of the course is carried out in the form of a project whose objective is to implement the concepts seen in the first part. It is about carrying out a machine learning process on a real basis and studying the avenues for improvement. | Cours : 8h00<br>Projet : 10h00<br>Travail personnel : 8h00<br>Durée totale: 26h00 |
| **Industry Of The Future 2 (Factory 4.0)** | 5 | **Industrial Organization 3** | "• Application of an ECAM workstation analysis methodology & workstation robotization elements.<br>• Failure Modes and Criticality Analysis (FMECA) method applied to design & maintenance<br>• Total Productive Maintenance (TPM) method<br>• 7 principles of Quality Management. The ISO9001 standard and the “8DO” and QRQC (Quick Respond Quality Control) methods applied to a concrete case.<br>• Global vision of the industrial company in order to implement and monitor overall performance in teams via Key Indicators (KPI).<br>" | TD : 8h00<br>Cours : 22h00<br>Projet : 38h00<br>Durée totale: 68h00 |
| | | **Maintenance 2** | "Introduction & definition of the FMD system: Reliability, Maintainability and Availability of production equipment,<br>- Study of repairable FMD systems: indicators, characterization methods, reliability laws: study of Exponential & Weibull models,<br>- Application to the management of spare parts,<br>- Case study. | TD : 8h00<br>Durée totale: 8h00 |

| Semester 8 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
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| | | **Production Simulation** | "Introduction & definition of the FMD system: Reliability, Maintainability and Availability of production equipment,<br>- Study of repairable FMD systems: indicators, characterization methods, reliability laws: study of Exponential & Weibull models,<br>- Application to the management of spare parts,<br>- Case study.<br>" | TP : 4h00<br>Durée totale: 4h00 |
| Extra Semester | | | | |
| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |

## A&M - Year 5

Semester 9/10 - Double Degree

| Unité d'Enseignement | ECTS | Unité de Cours | Contenu | Nb d'Heures |
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| Semester 9 | | | | |
| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| **ATS ENR** | 6 | **Methanization** | | Cours : 24h00<br>Durée totale: 24h00 |
| | | **Industrial And Territorial Ecology** | | Cours : 16h00<br>Durée totale: 16h00 |
| | | **Solar Thermal Energy** | | Cours : 20h00<br>Durée totale: 20h00 |
| **Scientific And Technical Specialization** | 6 | **Energy** | 1. This course comprises a number of lecture classes and lab work which cover the following points:<br>- Why should we be concerned with energy efficiency?<br>- What is energy efficiency?<br>- Measuring energy efficiency<br>- Global and local methods<br>2. This project is structured around various sessions of group work with access to the necessary computer resources. Students have the possibility to meet with a professor at different steps of the project in order to verify that their project is on the right tracks. | Cours : 30h00<br>Projet : 30h00<br>Travail personnel : 5h00<br>Durée totale: 65h00 |
| | | **Materials & Structures** | Students work on a project involving the design of an automotive suspension system.<br>They are required to reuse a significant portion of the concepts studied in previous years, including:<br><br>- Strength of materials<br>- Materials selection<br>- Computer-Aided Design (CAD)<br>- Finite Element Analysis (FEA)<br><br>To reinforce and complement their knowledge, lectures are provided throughout the project on the following topics:<br><br>-Fundamentals of suspension systems<br>-Review of strength of materials<br>-Management of assemblies using finite element methods<br>-Review of CAD<br>-Review of material selection<br>-Assemblies using threaded fasteners<br><br>A written exam assesses the theoretical components.<br><br>At the end of the project, students must present their parts in English and submit a technical report. | Cours : 30h00<br>Projet : 30h00<br>Travail personnel : 20h00<br>Durée totale: 80h00 |
| | | **Factory 4.0** | 1.LD:<br>- challenges of new products + dynamics of development<br>- different management methods<br>- fundamental principles of Lean Product Development<br>2. Discover production management tools<br>3.Improvement with the SCRUM method<br>4.Project<br>Simulation and operation of a small business (students are assigned operational and functional roles). Various projects are conducted with the | Cours : 30h00<br>Projet : 30h00 |

| Semester 9 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | original organization, which is also inefficient. Implementation of Lean processes in development phase. | |
| | | **Automation & It** | 1. During teaching modules lasting 2 to 8 hours each, the new material will cover:<br>- Data bases<br>- Measurement chains, sample and signal treatment<br>- Business Intelligence reporting tools<br>- Regulation using predictive Controller<br>- Network Security<br>2. The design and application of an M2M control and monitoring tool of a fleet of machines/systems located worldwide: from local monitoring of a machine to reporting its operational parameters.<br>The fleet of machines consists of a CTA air treatment and heat exchanger connected to the school's intranet.<br>The tools used to monitor, sensor, record data, and report are programmed using industrial software and are implemented in realistic conditions. | Cours : 30h00<br>Projet : 30h00<br>Durée totale: 60h00 |
| **Student Life Commitment 4** | 3 | **Student Life Commitment 4** | | |
| **Student Life Involvement 4** | 2 | **Student Life Involvement 4** | | |
| **English 5** | 3 | **English 5** | TOEIC preparation:<br>Close study of practice papers.<br>Revision of grammar and vocabulary.<br>Strategies and techniques for the TOEIC<br><br>Advanced English:<br><br>First part is a student-led discussion based on a variety of sources provided at the beginning of the module. Sources originate from newspapers, podcasts, websites etc. Students are encouraged to choose unfamiliar subjects and themes in order to expand vocabulary and lexical range. Teachers provide feedback and grammar corrections at the end of every session.<br><br>Second part is a workshop. Groups of 2 or 3 students lead a workshop they have previously prepared on a subject appropriate for final year engineering students. Interactive elements, debates and active participation are encouraged. Teachers and peers provide feedback after each session.<br><br>Following their workshop, students complete a 750-word report evaluating their performance and reflecting on its success. | TD : 22h00<br>Cours : 4h00<br>Travail personnel : 8h00<br>Durée totale: 34h00 |
| **Electives Courses** | 2 | **Sustainable Energy** | | TD : 20h00<br>Travail personnel : 10h00<br>Durée totale: 30h00 |
| | | **Civil Engineering Module** | Students choose 2 of the following modules:<br>1. Becoming an entrepreneur: from idea to action<br>2. Micro and Nano Technologies<br>3. Corporate Social Responsibility<br>4. Civil Engineering<br>5. Energy Challenges of the 21st Century<br>6. Managing Health and Safety in the Workplace<br>7. Supply Chain Management | TD : 20h00<br>Travail personnel : 10h00<br>Durée totale: 30h00 |

| Semester 9 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | 8. Supply Chain Management 2 | |
| | | **Micro And Nanotechnology Module** | Here we rely on general skills in physics and chemistry as well as on several aspects discussed in the semiconductor technology chapter of the electronics course (semester 5).<br>* Introduction to micro and nano technologies<br>* Micro fabrication, toolbox available, engraving techniques<br>* Description of micro mechanical sensors (pressure, micromotor ...)<br>* Analysis of the design of an electrochemical micro-sensor (ISFET structure),<br>* Nano FET, nano mechanism, current design limits, manufacturing tools, test tools ...<br>* Ethical aspects around nanotechnologies | TD : 20h00<br>Travail personnel : 30h00<br>Durée totale: 50h00 |
| | | **Corporate Social Responsibility Module** | Students choose 2 of the following modules:<br>1. Becoming an entrepreneur: from idea to action<br>2. Micro and Nano Technologies<br>3. Corporate Social Responsibility<br>4. Civil Engineering<br>5. Energy Challenges of the 21st Century<br>6. Managing Health and Safety in the Workplace<br>7. Supply Chain Management<br>8. Supply Chain Management 2 | TD : 20h00<br>Travail personnel : 10h00<br>Durée totale: 30h00 |
| | | **Supply Chain Management Module** | This module aims to obtain the internation certification : Certified Supply Chain Analyst (CSCA). This certification from ISCEA (International Supply Chain Education Alliance) is distributed by Fapics (Association Française de Supply Chain Management). This french and international recognition offers a sharp advantage on your curiculum for the jobs in Supply Chain, manufacturing management, logistics, engineering process and planning. You will learn international vocabulary and a culture about the managemet of physical, financial and informatoin flows. | TD : 20h00<br>Travail personnel : 20h00<br>Durée totale: 40h00 |
| | | **Supply Chain Module : Blue Connection** | Business simulation THE BLUE CONNECTION (publisher INCHAINGE) which students will play via a web interface (in English).<br>ECAM La Salle is a forerunner in the deployment of this game (we work in parallel with professors from HEC).<br>The game takes place in 6 to 8 rounds, the students work in teams of 3 or 4 and each plays the role of a manager within the fictitious company The Blue Connection:<br>- Sales management<br>- Purchasing/design department<br>- Supply chain management<br>- Finance department<br>The company sells bicycles (only one model) to 3 different customers and is in great financial difficulty. The goal of this game is to make the company profitable while developing a circular economy.<br>In each round, the students test and deploy a circularity or life extension strategy (maintenance/warranty, refurbishment, remanufacturing, recycling).<br>In the final rounds, they must choose their own strategy, implement it and explain it in an individual report. | TD : 20h00<br>Travail personnel : 10h00<br>Durée totale: 30h00 |
| | | **Managing Health And Safety In The Workplace Module** | | TD : 20h00<br>Travail personnel : 12h00<br>Durée totale: 32h00 |
| | | **Quality Module** | "• Quality Management Systems in companies and Company Strategy - The Global Vision of Quality Management<br>o The Quality Management System according to ISO9001 - detailed decryption, the heart of the standard<br>o Other examples with aeronautical and automotive sector standards<br>o The linking of Quality Management Systems with other Organizational Management Systems: OHSAS18001 (ISO45001), ISO14001, | TD : 20h00<br>Durée totale: 20h00 |

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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | ISO26000, ISO50001<br><br>• Quality Management Systems and Operational Steering<br>o Operational Risk Analysis tools<br>o Continuous Improvement tools<br>o Internal audit<br>o Monitoring tools, measuring efficiency<br>o Putting into perspective with the economic approach of Quality, analysis of CNQs, the notion of efficiency<br>o Links with benchmarks of excellence, Good Practices<br><br>• Continuous Improvement as the common thread of Performance Management Systems<br>o Business cases on the production side<br>o Case of non-production companies" | |
| **Professional Skills** | 2 | **Continuous Improvement** | Introduction to the Lean and continuous improvement<br>Simulation of an entreprise to be improved by using the tools from the Lean<br>The side effects of the Lean and the management situation | TD : 20h00<br>Durée totale: 20h00 |
| | | **Management** | Understand the role of the manager in the entreprises<br>Know how to deal with decision situation referring to management<br>Manage the relationships, simple or complex ones<br>Analyse the dynamics of the motivations of the collaborators<br>Know the fundamentals in job psychodynamics<br>Analyse the situations at risks with psychosocial risks | TD : 20h00<br>Durée totale: 20h00 |
| | | **Debriefing** | | Cours : 3h00<br>Projet : 3h00<br>Travail personnel : 12h00<br>Durée totale: 18h00 |
| **Program Management Of Organizational Excellence Systems** | 10 | **Industrial Excellence Systems** | Mapping tools to observe the sources of waste in value chains<br>Lead Time measurement in relation to customer satisfaction and time to market<br>The Value Stream Design approach guided by the key principles of Lean Thinking<br>The concept of A3 mother and the variation in A3 daughters according to the strategic transformation objectives<br>The priorities of different projects and planning in time and space (SWOT & Gain / Effort Matrices) | Projet : 250h00<br>Durée totale: 250h00 |
| | | **Mechanical Design** | Methodology<br>Conduct of several multidisciplinary projects alone and/or in a team highlighting the skills developed during the ecam training<br>Educational content<br>Students must know how to solve problems such as:<br>- technical project: Creation of a vegetable garden with intelligent programming of watering with recovered water and electricity generated by solar panels + big data (digitalization of the vegetable garden)<br>- Moodle project: integration of an existing project at ECAM into an educational platform: integration of grade management, groups, multiple choice questions, communications, announcements, scheduling, ... take advantage of the educational advantages of the platform on an already existing project | Projet : 250h00<br>Durée totale: 250h00 |
| **R&D Project** | 10 | **R&D Project** | The Research and Development projects are, for the most part, conducted in partnership with companies.<br><br>At the beginning of the semester, the various project areas (Digital, Industrial Management, Materials & Structures, Energy) are presented as well as the number of students that can be accepted. Each student | Projet : 250h00<br>Durée totale: 250h00 |

| Semester 9 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | needs to choose a project area and a corresponding project.<br><br>The R&D projects are generally completed in groups of two people.<br>The R&D projects include in varying proportions depending upon the subject matter:<br>- Rewriting the specifications, project organization and client relations management<br>- Structuring communication with the head teacher<br><br>- Literature review<br>- Study of theory<br>- Experimental study<br>- Result formatting and presentation of progression during technical meetings<br><br>-Compiling final case study (files, computer programs), detailed documentation<br><br>-Final presentation (defense examination) for validation | |
| **Professional Course** | 10 | **Professionalisation Project** | The Research and Development projects are, for the most part, conducted in partnership with companies.<br><br>At the beginning of the semester, the various project areas (Digital, Industrial Management, Materials & Structures, Energy) are presented as well as the number of students that can be accepted. Each student needs to choose a project area and a corresponding project.<br><br>The R&D projects are generally completed in groups of two people.<br>The R&D projects include in varying proportions depending upon the subject matter:<br>- Rewriting the specifications, project organization and client relations management<br>- Structuring communication with the head teacher<br><br>- Literature review<br>- Study of theory<br>- Experimental study<br>- Result formatting and presentation of progression during technical meetings<br><br>-Compiling final case study (files, computer programs), detailed documentation<br><br>-Final presentation (defense examination) for validation | Projet : 250h00<br>Durée totale: 250h00 |
| **Soft Skills** | 7 | **Finance** | Theoretical Contributions • General Accounting<br>• Profitability: value chain, income statement, cost theory<br>• Cash flow: balance sheet, working capital, working capital requirement<br>• Imbalance: “cash is king!”, cessation of payments, receivership/liquidation<br>• Cash flow for profitability: “time is money”<br>Deliverables during the course: Characterize the company's economic activity<br>• Understand the main business(es), the economic model; define needs (expenses, fixed assets) and opportunities (revenues, markets)<br>• Identify some listed competitors<br>• Find recent news about the group (last 3 years) and/or its primary market<br>Theoretical Contributions • General accounting plan<br>• Tax return<br>• Income statement: interim management balances, income accounts (7), expense accounts (6); Focus on the payroll ??<br>• Balance sheet: capital and long-term debt, fixed assets, inventories, | Projet : 12h00<br>Durée totale: 12h00 |

| Semester 9 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | third-party accounts, and VAT<br>• Financial analysis: why? Operating ratios and financial structure<br>Deliverables during the Financial Analysis course<br>• Locate the financial statements and the company report<br>• Conduct an initial analysis of the company's situation and its evolution over the past few years, based on the identified significant events<br>• Compare with identified competitors and any information on the broader market<br>Theoretical contributions • Finance and financial markets<br>• Financial instruments: shares, bank loans<br>• Speakers: equity investors (private investors and public markets (stock market)), banks, and public and parapublic organizations<br>Deliverables during the course: The company in its market<br>• Complete the initial analysis with a vision of the company's environment: does it need funds, what type, and from whom? Is it better equipped than the competition? • Conclusion: should we buy? | |
| | | **Sales & Marketing** | 1 - Marketing<br>* Marketing challenges<br>* Responding to challenges<br>* The different types of marketing<br>* Marketing studies<br>* Segmentation<br>* The 4 Ps<br>* Building an image<br>* Case studies: Apple, Nespresso and Easyjet data management<br><br>2 - Sales<br>* The importance of sales<br>* The different types of sales<br>* A salesperson's qualities<br>* The sales cycle<br>* Benefits, advantages, functionalities<br>* Case study: Dyson<br>* Objection management<br>* Negotiation<br>* Role playing: practical exercises | TD : 12h00<br>Durée totale: 12h00 |
| | | **Job-Hunting Techniques** | STAGE 1:<br>Make a self-assessment and define a career objective<br>* Make a self-assessment<br>* Build a professional project<br>* Confirm your professional project<br><br>STAGE 2:<br>Updating your documents<br>* Resume<br>* Cover letter<br><br>STAGE 3: Prospecting<br>* Apply to posted job offers<br>* Unsolicited application<br>* Prospect small to medium sized companies and at trade shows<br>* Telephone prospecting<br>* Network prospecting<br><br>STAGE 4: Preparing for different recruitment methods<br>* The interview<br>* Tests<br>* Other methods | Cours : 1h30<br>Projet : 4h00<br>Durée totale: 5h00 |
| | | **Ethics** | 1/ Theoretical Contributions to Ethics in the Context of Philosophy<br>2/ Ethics in Society<br>• The Notion of Progress | TD : 10h00<br>Cours : 2h00<br>Durée totale: 12h00 |

| Semester 9 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | • Working Conditions<br>• Gender Equality<br>• Sustainable Development Goals<br>3/ Ethics and the Environment<br>• Planetary Boundaries and Resource Depletion<br>• Biomimicry<br>• Carbon Footprint<br>4/ Ethics in Business<br>• The History of Business Ethics<br>• Indirect Carbon Emissions (Scopes 1, 2, and 3)<br>• Greenwashing<br>• Regulations<br>• Charters and Codes of Ethics<br>5/ Ethics and the Individual<br>• The Pillars of Manipulation<br>• Biases and Stereotypes<br>• Industrial Espionage<br>6/ Legal Obligations<br>• GDPR<br>• Civil and Criminal Liability<br>• The Right to Disconnect | |
| | | **Business Simulation** | Marketplace est un serious game immersif, intense et rapide. Pendant trois jours, vous serez plongé dans l'univers de la prise de décision stratégique. Vous travaillerez avec vos équipes pendant la pause déjeuner et le soir. Vous serez également amené à travailler de manière autonome pendant les sessions.<br><br>Pour être compétitif sur Marketplace, vous devez prendre un large éventail de décisions. Ces décisions s'inspirent de décisions réelles prises par de jeunes entreprises. Chaque décision a été limitée à ses dimensions les plus importantes afin de garantir la maîtrise du jeu. Néanmoins, la complexité et le réalisme sont suffisants pour vous mettre au défi.<br><br>Le véritable défi du jeu, comme dans les nouvelles entreprises réelles, réside dans la nécessité de prendre continuellement un grand nombre de décisions stratégiques et tactiques concurrentes. La décision publicitaire ou de développement de marché est constante pendant la prise de décision tarifaire.<br><br>Vous devez non seulement vous soucier des compromis au sein de chaque domaine de décision, mais aussi évaluer les compromis entre les domaines de décision. L'un des atouts de Marketplace réside dans l'apprentissage de la gestion d'un univers dynamique et complexe.<br>La Marketplace vous permettra également de vous entraîner à la prise de décisions stratégiques et tactiques. Après avoir identifié vos options et pesé le pour et le contre de chacune, vous devrez vous engager dans une démarche. L'issue de cette action sera toujours incertaine, mais vous constaterez que vous pouvez formuler des hypothèses éclairées et en tirer des enseignements au cours du trimestre suivant. Vous pourrez ensuite procéder à des ajustements afin de gérer même les décisions les plus douteuses (notre recul est bien plus judicieux que notre anticipation).<br><br>Le contenu, le contexte et l'objectif pédagogique de chaque décision à prendre dans la simulation sont présentés dans les chapitres accessibles sous l'icône Aide. Ce fichier d'aide contient une discussion conceptuelle des décisions à prendre. Les informations fournies ici vous aideront à vous familiariser avec chaque étape du processus décisionnel. Les décisions sont présentées approximativement dans l'ordre dans lequel elles seraient exécutées en situation réelle, de la formation de l'équipe de direction à l'analyse de marché, en passant par la conception de la marque, la publicité, les ressources humaines, la distribution, la fabrication et le financement. Ce processus étape par étape vous aidera à organiser votre prise de décision pendant le jeu. | Projet : 20h00<br>Durée totale: 20h00 |

| Semester 9 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | Il est recommandé de revoir d'abord l'intégralité du contenu de chaque chapitre afin de bien appréhender le contexte décisionnel. Ensuite, installez-vous à votre ordinateur et analysez chaque décision à prendre. Il est important de saisir physiquement les décisions et d'analyser les effets des décisions alternatives. Cette expérience pratique vous permettra de vous familiariser avec les conséquences de vos décisions.<br><br>Enfin, la section « Décisions à prendre par trimestre » vous aidera à organiser votre travail tout au long de l'exercice de simulation. | |
| | 10 | **Innovation Mangement And Strategy** | Students work in teams on three real projects proposed by partner companies. The course alternates between creativity sessions, ideation workshops, and time spent confronting the needs of companies. Supervised by external speakers (experts in innovation strategy, experts in digital communication, experts in HMI (Human Machine Interface) and Page Langing (internet domain for communication and online business), students learn to explore original avenues, structure their ideas and build an innovation strategy. The emphasis is placed on the approach, more than on the technical solution chosen: students do not develop the technical aspects (mechanical design, computer design, materials, energies, etc.) but focus on proposing a strategic and inspiring vision for the company. The alternation between business project and expert interventions allows students to progress in a measured and supervised manner. | Projet : 250h00<br>Durée totale: 250h00 |
| Semester 10 | | | | |
| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| **Professional Course** | 30 | **Engineer Internship** | The final engineering internship will be conducted either:<br>- Within a company or laboratory in France<br>- In a company abroad or in a university laboratory working in partnership with companies<br>It will be based on an industrial theme; scientific, technical or organizational.<br>It must take place under the supervision of an engineer. A clearly defined assignment must be proposed by the company. Success or failure will be evaluated according to the student's performance and ability to fulfill the requirements set forth by the company.<br>The assessment of this training session will be performed by the trainee's supervisor and a supervising professor designated by the Director of studies.<br>Assessment charts are used to measure the trainee's quality of work, as well as the quality of the written report and oral defense.<br><br>The internship must last a minimum of 21 weeks. | Stage : 770h00<br>Durée totale: 770h00 |
| | | **Debriefing** | | Cours : 4h00<br>Projet : 2h00<br>Travail personnel : 12h00<br>Durée totale: 18h00 |
| **Engineer Internship** | 30 | **Engineer Internship** | The final engineering internship will be conducted either:<br>- Within a company or laboratory in France<br>- In a company abroad or in a university laboratory working in partnership with companies<br>It will be based on an industrial theme; scientific, technical or organizational.<br>It must take place under the supervision of an engineer. A clearly defined assignment must be proposed by the company. Success or failure will be evaluated according to the student's performance and ability to fulfill the requirements set forth by the company. | Stage : 770h00<br>Durée totale: 770h00 |

| Semester 10 | | | | |
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| **Unité d'Enseignement** | **ECTS** | **Unité de Cours** | **Contenu** | **Nb d'Heures** |
| | | | The assessment of this training session will be performed by the trainee's supervisor and a supervising professor designated by the Director of studies.<br>Assessment charts are used to measure the trainee's quality of work, as well as the quality of the written report and oral defense.<br><br>The internship must last a minimum of 21 weeks. | |