# National Educational Programme 2013

Speciality:

**M**echanical **E**ngineering

and

**P**roduction **M**anagement

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# 1 - Course objectives

A graduate from a University Technology Institute's Mechanical and Production Engineering (MAP) department is a mechanical engineer, with a solid background in mechanics.

The course offered by the MAP departments is strongly established in the French educational landscape and the graduates are deeply appreciated by companies from the industrial field.
Many representative surveys done from the perspective of the graduates of the DUT (University Technology Diploma) in Mechanical and Production Engineering and of their employers show that:

- Graduates have entered particularly varied professions in a wide range of activity sectors,
- They have had to adapt quickly and efficiently to their chosen profession,
- They have often evolved to a position of higher responsibilities,
- A significant number of them continued their studies immediately after obtaining their DUT,
- A very large majority of them have attended training courses throughout their career in order to follow technological innovations and changes and to evolve in their career.

Access to the course of the DUT Mechanical and Production Engineering is given to holders of a scientific or technological baccalauréat (high school diploma) or after returning to school during a validation of acquired experience.

His technical, scientific, economic and human sciences education allows him to:

- Exercise his activity in any economic sector (mechanics and machine tools, aeronautics, naval, automobile, environment and energy, nuclear, medical, house appliances, sports and leisure, transports, building and public works and equipment, …),
- Work together with the various company players,
- Contribute to the competitiveness of companies in all of the stages of a product's life by optimising the technical, scientific, economic and human choices and integrating the sustainable development, quality, maintenance and health and safety requirements,
- Pursue his career path based on his Personal and Professional Project.

The holder of a DUT in the speciality of Mechanical and Production Engineering is able to participate in the stages leading from the expression of need to the product itself:

- Analysing,
- Modelling,
- Designing,
- Mechanising,
- Organising and communicating,
- Producing,
- Validating.

His training allows him to conduct technological watch and innovative solution research activities.

The holder of a DUT in Mechanical and Production Engineering can integrate specialised or multi-skilled teams in industrial divisions and departments:

- Tests, R&D (research and development),
- Research and tooling departments,
- Methods and industrialisation,
- Maintenance and supervision,
- Production organisation and management,
- Production,
- Quality assurance and control,
- Purchasing, sales and after-sales...

Based on these findings and forthcoming changes, it has seemed appropriate to structure the course around professions linked to the life cycle of a product and to set up Course Units that each meets a specific general objective.
The contents of these Course Units have been defined according to the teaching evolutions linked to the reform of the baccalauréats. The modules and contents distribution has been designed to ease the admittance and the success of baccalauréat holders, especially holders of the technological baccalauréat STI2D. Indeed, during semester 1, a specific module of methodology and individualized help has been set up.

## 2 - Activities and skills reference documents

A graduate from a University Technology Institute's Mechanical and Production Engineering (MAP) department is a mechanical engineer, with a solid background in mechanics, who can be employed in the following fields:

- Mechanical construction and machine tools,
- Automobile construction and equipment manufacturers,
- Aeronautical, spatial and equipment manufacturers,
- Naval construction and equipment manufacturers,
- Railways construction and equipment manufacturers,
- Environment and energy,
- Nuclear,
- Agri-food industry,
- Agricultural machinery,
- Medical field,
- Household appliances,
- Sport and leisure,
- Building and public works and equipment manufacturers,
- Dismantling and recycling.

In any industrial sectors, the same main steps structure the life cycle of a product, so it seemed appropriate to offer a range of activities and skills reference documents around these main steps, which are the followings:

- Design,
- Industrialisation (Methods: process, product, manufacturing workshop, maintenance and quality),
- Production (Scheduling, Planning, Supply) and workflow management,
- Control, quality, metrology, environmental safety.

The safety (life and property) aspects, the ergonomics and the sustainable development must be integrated into all these fields, according to international directives and standards.

The DUT Mechanical and Production Engineering graduate will be able to:

- Understand the company system and its interactions with its environment,
- Gather and convey information (in French and in English),
- Discuss and argue with different specialists (in French and in English),
- Choose and adapt his/her tools to the different situations,
- Acquire new knowledge and skills,
- Work within a team and to be proactive,
- Work in a transnational or international environment.

**Corresponding ROME codes (profession French codes):**

**H1203 ;** Mechanical product design and drawing.
**H1403 ;** Technical intervention in logistics and industrial management.
**H1403 ;** Technical intervention in method and industrialisation.
**H1403 ;** Technical intervention industrial analysis laboratory.
**H1506 ;** Technical quality intervention in mechanics and metal working.
**H2503 ;** Mechanical production elementary unit management.
**H2504 ;** Team management in processing industry.
**I1310 ;** Industrial mechanics maintenance.

### Identification codes used in the presentation below

| | |
|---|---|
| Design | (a) |
| Industrialisation | (b) |
| Production management | (c) |
| Control / Quality / Metrology / Environmental Security | (d) |
| Cross-curricular competencies | (e) |

| **Activities and core competencies:** | |
|---|---|
| **Activities** | **Competencies** |
| (a)<br><br>Product design | - Participating to the functional specifications writing and to the project management within a multidisciplinary team thanks to his/her technical skills.<br>- Innovation and ecodesign.<br>- Drawing working drawings, part, systems, sub-assemblies and assemblies drawings.<br>- Executing the dimensional measurements of parts, sub-assemblies and assemblies.<br>- Studying and designing parts, sub-assemblies and assemblies.<br>- Defining and calculating the functional, physical, ergonomic, dimensional, structural or geometric constraints of the pieces or products.<br>- Selecting materials.<br>- Defining specifications and dimensioning of parts, sub-assemblies and assemblies.<br>- Checking a product technical feasibility and conformity within the specifications.<br>- Establishing the supplier's specifications.<br>- Selecting and following up suppliers/contractors.<br>- Drafting technical and construction files. |
| (b)<br><br>Product industrialization | - Analysing manufacturing elements and defining processes, means and operating procedures.<br>- Studying the workstations, the ergonomics, the installation or the handling and storage procedures.<br>- Choosing, setting up and making adjustments to automated systems.<br>- Drafting manufacturing documents (routings, procedures, specifications...) and controlling the application compliance.<br>- Assessing and budgeting the costs and manufacturing times and defining the price standards and estimates.<br>- Identifying and analysing malfunctions, defining corrective actions and following their execution.<br>- Realising prototypes or production tools.<br>- Performing the commissioning of new equipments. |
| (b) and (c)<br><br>Production elementary unit management | - Distributing and coordinating activities between teams and assigning staff on workstations.<br>- Selecting appropriate machines and tools.<br>- Following and controlling supply, inventories, production and quality flows.<br>- Assessing the process environmental impact, participating in a product life cycle analysis.<br>- Suggesting organisation and production evolutions (in terms of productivity, quality, safety and environment...) and putting them to practice. |
| (c) and (d)<br>Industrial equipment maintenance | - Controlling working conditions of materials, instrumentation data.<br>- Identifying and planning preventive and curative actions according to the situation (set up, production change...) or maintenance history.<br>- Informing the action follow-up supports and relaying the information to the appropriate department.<br>- Checking the production compliance of suppliers, sub-contractors and contractors. |
| (c)<br><br>Production organisation | - Planning manufacturing according to orders, deadlines, resources and hazards.<br>- Releasing production documents and following the production orders status.<br>- Tracking stock status, identifying supply needs and preparing orders. |
| (d)<br><br>Control, quality and quality management | - Preparing controls to be undertaken from files, production routines, orders and instructions.<br>- Preparing the measuring and analysis products and tools and controlling their operating condition and calibration conformity.<br>- Taking delivery of samples or performing the products and materials sample collections.<br>- Controlling the products, parts, sub-assemblies and assemblies production conformity.<br>- Tracking and analysing product and process data (measures, readings, indicators...).<br>- Identifying the quality and certification stakes and the department operation.<br>- Drafting conformity control, traceability and quality monitoring documents.<br>- Performing destructive and non-destructive tests. |

| **Cross-curricular competencies:** | |
|---|---|
| **Activities** | **Competencies** |
| (e)<br>Modelling / Environments, materials and interactions study. | - Linking a scientific model to a work situation.<br>- Knowing how to set out the system boundaries within which the reasoning must be performed.<br>- Identifying the parameters and the variables of a concrete problem.<br>- Identifying the interactions at play in a system and between the system and the environment in which it is set.<br>- Taking materials (solids, fluids, gases) properties and behaviours into account within a system.<br>- In the field of mechanics, associating observations to measurable, relevant and objective amounts.<br>- Producing experimental designs. |
| (e)<br>Expression/ Communication | - Researching and exploiting documents.<br>- Making oral presentations with current materials.<br>- Producing professional and academic documents.<br>- Actively participating in collaborative work in a company.<br>- Writing a CV and attending a job interview.<br>- Negotiating the customers or suppliers agreement conditions. |
| (e)<br>International communication in English | - Discussing with ease with foreign people, including within an intercultural dimension.<br>- Communicating in English in a professional context in the field of employment (CVs, covering letters, job interview) and in the business world (e-mails, internal memos, summaries, speaking in public).<br>- Mastering technical English in order to integrate an international team. |
| (e)<br>Professional development and knowledge | - Identifying the general organisation and the legal framework of companies.<br>- Being, at any time, able to fit the activities into a professional and skill development perspective, through deepening or enlarging. |

| **Specific activities and competencies:** | |
|---|---|
| **Activities** | **Competencies** |
| (a)<br>Product design | - Negotiating the customers or suppliers agreement conditions. |
| (b)<br>Product industrialization | - Controlling the production tools and machines conformity or making their adjustments.<br>- Defining and performing manufacturing programs (numerical controls, machining centres, automatons...). |
| (b) and (c)<br>Production elementary unit management | - Drafting and developing maintenance and operating procedures, technical data sheets and tracking tools.<br>- Submitting and implementing improvement measures in the pollution treatment field. |
| (c) and (d)<br>Industrial equipment maintenance | - Training operators and technicians to the maintenance, adjustment and service techniques and procedures and assisting them. |
| (d)<br>Control, quality and quality management | Performing analysis in:<br>- Acoustic, vibratory<br>- Metallurgy, metals.<br>- Physical chemistry.<br>- Physics, nuclear physics.<br>- Thermics.<br>Performing a test in the field of:<br>- Structure assembly.<br>- Surface characterization.<br>- Dimensioning, geometry.<br>- Thickness, alloy percentage.<br>- Tightness.<br>- Functional.<br>- Material structure. |

# 3 - General organisation of the course

## a. Course description

The degree course is organised in 4 semesters and includes 1,800 h of supervised training, 300 h of synthesis activities (Projects) and 10 weeks of industrial work placement.

**There are no options available in the Mechanical and Production Engineering specialisation**. A maximum of 20% of the course's total hour requirement (1,800 hours) may be devoted to adaptation to the environment (if necessary), especially in relation to the local industry.

The National Educational Programme is comprised of core competencies representing 85% of the total supervised hour requirement and a range of differentiated modules representing 15% of the total hour requirement that are chosen **according to the student's Personal and Professional Project.**

The course path leading to a DUT consists of a major guaranteeing the DUT core competencies, and complementary modules. These complementary modules are meant to complete the students' education, whether they wish to integrate the professional world (Professional Skills Building (Renforcement des compétences Professionnelles RCP)) or whether they wish to pursue their studies through other courses of higher education.
For students continuing their studies, the complementary modules are aimed at the continuation of studies to certification level 2 (Technological Development (Approfondissements Technologiques: AT)), or for the pursuit of a level 1 qualification (Scientific Open-mindedness (Ouverture Scientifique: OS). Whatever course tracks the student chooses, the complementary abilities needed are fundamental, transversal and disciplinary in nature.

The teaching is gathered in 3 or 4 Course Units (CU), according to the semesters, made of different modules.
Course Unit 1 (CU1) groups the courses linked to the product design.
Course Unit 2 (CU2) groups the courses linked to industrialisation and processes management. It allows the student to understand the industrial field and environment.
Course Unit 3 (CU3) groups the cross-curricular and fundamental courses. Furthermore, they also develop a sense of communication and organisation in the managerial sense.
Course Unit 4 (CU4) is a professional training in the industrial field. All the student's competencies acquired and autonomy will be developed within the company

A module is characterised by:

- A title,
- A number of hours, divided in Lectures (L)/Tutorials (T)/Practicals (P),
- A goal,
- A set of competencies to be acquired,
- Prerequisites,
- A content, which specifies the themes approached,
- Implementation methods,
- Possible continuations,
- Key-words.

The concept of "supplier modules / customer modules" must be the underlying theme of the course: **module transversality and collaborative work between academic staff must guarantee coherence of the Mechanical and Production Engineering course.** Certain courses are therefore common to two modules.

In order to provide more precision and visibility to the reader, a detailed presentation of the fields of discipline can be found at the 4th paragraph of this document.

The module numbering is done for each field of discipline in the following way: M XYZZ
X (number) semester, Y (number) CU number, ZZ (number) module number in the CU and the semester.

## b. Overview table of the modules and CU (Course Units) per semester

Abbreviations used in the tables hereunder:

NC: Numerical Control.
EC: Expression Communication.
IOM: Industrial Organisation and Management.
PPP: Professional Personal Project
MS: Material Sciences.
DS: Dimensioning of Structures.
EEA: Electricity, Electronics and Automation.
FPD: Fundamental Principle of Dynamics.
MR: Material Resistance.

| CU | Module reference | Module name | Module Coef. | Total Coef. | Lecture volume | Tuto volume | PW volume | Student's volume |
|---|---|---|---|---|---|---|---|---|
| Semester 1 | | | | | | | | |
| 11 Design: introduction | M1101 | Mechanical design: study of existing mechanisms | 4 | 10 | 10 | 10 | 40 | 150 |
| | M1102 | DS: MR hypothesis and simple stresses | 2 | | 8 | 18 | 4 | |
| | M1103 | Mechanics: Fundamental principle of statics | 2 | | 6 | 20 | 4 | |
| | M1104 | MS: material properties | 2 | | 9 | 9 | 12 | |
| 12 Industrialise and manage: introduction | M1201 | Production: basis for product manufacturing processes | 3 | 9 | 7 | 10 | 28 | 120 |
| | M1202 | Methods: Introduction to product manufacturing processes | 2,5 | | 6 | 16 | 8 | |
| | M1203 | Metrology: Measurements and control | 1 | | 3 | 4 | 8 | |
| | M1204 | EEA: Fundamental concepts in Electricity | 2,5 | | 6 | 12 | 12 | |
| | M1214 | EEA: Basics of automation | | | | | | |
| 13 Methodology: basics and specifics development | M1301 | Mathematics: mathematical tools | 2,5 | 11 | 14 | 28 | 3 | 185 |
| | M1302 | EC: Fundamental elements of communication | 2 | | 1 | 14 | 15 | |
| | M1303 | PPP: To know oneself better, profession and professional environment discovery | 1 | | 6 | 6 | 8 | |
| | M1304 | Foreign languages: Foreign languages communication: Basic tools | 2,5 | | | 15 | 15 | |
| | M1306 | Methodology and individualised help: To foster student's success | 1 | | 2 | 4 | 24 | |
| | M1307 | Computer science: Spreadsheets and programming languages | 2 | | 5 | 10 | 15 | |
| Total Semester 1 | | | | 30 | 83 | 176 | 196 | 455 |

| CU | Module reference | Module name | Module Coef. | Total Coef. | Lecture volume | Tuto volume | PW volume | Student's volume |
|---|---|---|---|---|---|---|---|---|
| Semester 2 | | | | | | | | |
| 21 Design: Basics | M2101 | Mechanical design: Design study | 3 | 10 | 8 | 12 | 40 | 195 |
| | M2102 | DS: Simple stresses: torsion, flexion | 2 | | 10 | 16 | 4 | |
| | M2103 | Mechanics: Solid dynamics: kinematics, kinetics, FPD | 3 | | 18 | 38 | 4 | |
| | M2104 | MS: Implementation and material behaviour | 2 | | 15 | 14 | 16 | |
| 22 Industrialise and manage: Basics | M2201 | Production: Implementation of production means | 2,5 | 8 | 8 | 12 | 40 | 180 |
| | M2202 | Methods: From product definition to process | 1,5 | | 6 | 12 | 12 | |
| | M2203 | Metrology: Three-dimensional metrology and surface finishes | 1,5 | | 6 | 8 | 16 | |
| | M2204 | EEA: Electric motorization | 2,5 | | 12 | 24 | 24 | |
| | M2214 | EEA: Automation of a workstation, safety | | | | | | |
| 23 Cross-curricular competencies: Tools, methods | M2301 | Mathematics: Integral and matrix calculation | 3 | 12 | 19 | 35 | 6 | 180 |
| | M2302 | EC: communication, information and argumentation | 2 | | 1 | 14 | 15 | |
| | M2303 | PPP: Project building. Professional integration preparation | 1 | | 5 | 4 | 6 | |
| | M2304 | Foreign languages: Technical and professional foreign language: research and convey data | 2 | | | 15 | 15 | |
| | M2305 | IOM: Project management | 2 | | 10 | 15 | 20 | |
| | M2308 | Synthesis work and projects | 2 | | | | | 100 * |
| Total Semester 2 | | | | 30 | 118 | 219 | 218 | 555 |

100*: Student hours

| CU | Module reference | Module name | Module Coef. | Total Coef. | Lecture volume | Tuto volume | PW volume | Student's volume |
|---|---|---|---|---|---|---|---|---|
| Semester 3 | | | | | | | | |
| 31 Design: Implementation | M3101 | Mechanical design: Power transmission design | 3 | 10 | 12 | 23 | 25 | 180 |
| | M3111 | Mechanical design: Study in a digital chain context | 1,5 | | 1 | 4 | 25 | |
| | M3102 | DS: Elasticity – Combined stress | 2 | | 8 | 18 | 4 | |
| | M3103 | Mechanics: Dynamics and energetics | 2,5 | | 9 | 28 | 8 | |
| | M3104C | MS: Material selection | 1 | | 2 | 9 | 4 | |
| 32 Industrialise and manage: Implementation | M3201 | Production: Production preparation on a CNC machine | 2 | 11 | 4 | 6 | 20 | 180 |
| | M3202 | Methods: Phase study and simulation - Cost optimization | 2 | | 6 | 12 | 12 | |
| | M3203C | Metrology: Advanced metrology and control | 1 | | 3 | 6 | 6 | |
| | M3204 | EEA: Information processing | 3 | | 8 | 15 | 22 | |
| | M3214 | EEA: Automated systems integration | | | | | | |
| | M3205 | IOM: Process management | 3 | | 14 | 18 | 28 | |
| 33 Cross-curricular competencies: Implementation | M3301 | Mathematics: Functions of several variables | 2 | 9 | 9 | 18 | 3 | 115 |
| | M3302 | EC: Academic and professional communication | 1 | | 1 | 7 | 7 | |
| | M3303 | PPP: Professional integration preparation (work placement), post-DUT course and international mobility | 1 | | 7 | 8 | 10 | |
| | M3304 | Foreign languages: Technical and professional foreign language: Write and inform in an intercultural context | 2 | | | 15 | 15 | |
| | M3307C | Computer science: Database | 1 | | 3 | 4 | 8 | |
| | M3308 | Synthesis work and projects | 2 | | | | | 100 * |
| Total Semester 3 | | | | 30 | 87 | 191 | 197 | 475 |

MXYZZ C: Complementary module that can be differentiated totally or in part
100*: Student hours

| CU | Module reference | Module name | Module Coef. | Total Coef | Lecture volume | Tuto volume | PW volume | Student's volume |
|---|---|---|---|---|---|---|---|---|
| Semester 4 | | | | | | | | |
| 41 Design: Development | M4101C | Mechanical design: Studies and developments | 2 | 6 | 2 | 10,5 | 40 | 112,5 |
| | M4102C | DS: Energy methods and finite element modelling | 1 | | 8 | 18 | 4 | |
| | M4105C | Mechanical Design and Dimensioning of Structures | 1 | | | 14 | 16 | |
| | M4108 | Synthesis work and projects | 2 | | | | | 50 * |
| 42 Industrialise and manage: Development | M4201C | Production: Production preparation in industrial conditions | 1 | 6 | | 10 | 20 | 97,5 |
| | M4202C | Methods: Multi-process industrialisation | 2 | | 8 | 12,5 | 32 | |
| | M4212C | Methods: Study in a digital chain context | | | | | | |
| | M4204C | EEA: Continuous system automation | 1 | | 2 | 4 | 9 | |
| | M4208 | Synthesis work and projects | 2 | | | | | 50 * |
| 43 Cross-curricular competencies: Development | M4301C | Mathematics: Curves | 1 | 6 | 5 | 10 | | 105 |
| | M4302C | EC: Communication in organisations | 2 | | 1 | 9 | 20 | |
| | M4304C | Foreign languages: General, professional and technical foreign language: Integrate a international professional team | 1,5 | | | 15 | 15 | |
| | M4305C | IOM: Company management | 1,5 | | 10 | 20 | | |
| 44 Professional situation | M4409 | Work placement: professional immersion | 12 | 12 | | | | |
| Total Semester 4 | | | | 30 | 36 | 123 | 156 | 315 |
| Course Total | | | | 108 | 324 | 709 | 767 | 1800 |

MXYZZ C: Complementary module that can be differentiated totally or in part
50*: Student hours

As far as « Learning Differently » is concerned, the article 15 of the provisions precise that « a hourly volume of around 10% of the tutored course must be devoted to it and that it should be taught in every teaching and is part of specific modules. »

### c. Work placement and tutored projects

The work placement in the industrial field will be regulated by an agreement. It should be a perfect opportunity to discover the company, its realities and to immerse in the industrial field. The company chosen by the student for his work placement is checked so that the work placement is also a source of complementary training and improvement. The work placement will be monitored by a teacher: Telephone calls and visit in the company whenever possible. An industrial tutor will monitor the work placement. The assessment will be done jointly by the industrial tutors and the teacher, based on a written report and an oral presentation and thanks to evaluation sheets.

The tutored projects are synthesis activities which are parts of the CU 1, 2 or 3, depending on the semester. It is strongly recommended that the project themes of semesters 3 and 4 are given by the companies, research laboratories, associations, institutions or public authorities. Cross-department challenges or national or international competitions may also serve as basis.
The group of students in charge of a project must apply the analysis, collective organisation and meeting coordination methods to concrete industrial cases. The projects will be tutored and assessed. The choice of projects is of particular importance: the selected projects must not be too ambitious to be completed successfully but must however be a real synthesis of the courses offered.

### d. Personal and Professional Project

It is dispatched on the first three semesters and the totality of the education team is involved in these teachings.
During semester 1, the product serves as a basis to reflection, essentially on the inner knowledge and the motivation update.
During semester 2, the company serves as basis.
During semester 3, the student and his/her project building are at the heart of the reflection.

### e. Teaching orientations, pedagogy through technology

The DUT in Mechanical and Production Engineering welcome students from many courses, having different goals and teachings methods. A balance between the different teaching approaches must then be found:

- From concept to practice,
- From practice to concept.

This allowing a balance between theoretical and practical teachings within the CUs, linked to the product life cycle.

These teachings have been defined according to the teaching evolutions linked to the reform of the baccalauréats. Moreover, a specific methodology and individualised support module is planned. The notion of "Learning differently", which will be defined by each IUT, will place great emphasis on pedagogical innovations.

The course pathway implements an active teaching through different activities, aiming to:

- Guide the student through the building of his/her professional pathway and project,
- Develop independence, a critical judgment, initiative, rigour, ability to fit into operational teams,
- Develop his/her ability to follow the technological evolution of the sector.

The student will work individually, in pairs and in teams. He/she will be provided with real objects, digital models, etc, related to the professional field.

The tutorials are organised in groups of a maximum of 26 students. The size of groups for practical work is half that of tutorial groups. For safety reasons, some teachings related to the handling of different fragile, costly and hazardous materials will be done with fewer students during practical works (8 students) and a Personal Protective Equipment (PPE) will be needed.

The professional and technical skill teaching being one of the major inputs of the course, practical works must rely on materials that should comply with the industrial needs.
The educational approach must spark the curiosity of students, in order to collect useful information and obtain technological innovation and watch.

### f. Consideration of the current economical stakes

One of the qualities of graduates of the Mechanical and Production Engineering department is to be able, in a competitive and changing context, to adapt to many situations thanks to their flexibility. They will possess the ability to evolve through all their professional careers and to potentially become entrepreneurs.
Thus, they must permanently implement project management and continuous improvement processes within their business sector, integrating Management systems of:

- Quality,
- Health and Safety at work,
- Environment.

During all the teachings, reference will be made to the actual standards, their formulation and their applications.

Sustainable development and ecodesign aspects will be necessarily included in the teaching, through product life cycle analysis.

The students must then be introduced to business intelligence, the different industrial production means and the submission of "enveloppe Soleau", patents through project activities must be encouraged.

## 4- Course modules description

For the course main competencies, the modules are codified in the following way: **MXYZZ** with:

- X for the semester considered,
- Y for the CU number within the semester,
- ZZ (number) module number within the CU and the semester.

The C letter at the end of the code (MXYZZ C) is for complementary modules.
The modules with a C correspond to the Professional Competencies Development pathway, allowing the student to fit directly in the labour market.
Depending on the student's professional and personal experience, these complementary modules will be replaced by:

- Technological Development modules, allowing the student to discover specific technologies, fostering short higher education in courses like a Licence Professionnelle,
- Scientific Open-mindedness modules, offering scientific, technological or management tools additions, in order to prepare to long higher education.

The local construction of these courses must respect the balance of hours and coefficients in each course unit.
The non-exhaustive modules list will be annually inventoried by the ACD (Assemblée des chefs de départements (Heads of Department Assembly)) and validated by the CPN (National Education Commission).

### 4.1 Disciplinary fields:

#### a. Mechanical design

**Objectives**
The targeted objectives of modules are to allow a graduate with a DUT in Mechanical and Production Engineering to join an engineering and design department in companies of many different sectors of activity. Thus, the student must be capable of:

- Designing a mechanical system of medium complexity in its entirety from specifications, by integrating requirements related to the industrialisation phase (concurrent engineering) and to the product life cycle,
- Understanding the Computer Aided Design process,
- Drafting every documents and digital models necessary to his/her understanding and to the manufacturing.

## Course steps

- CAD modelling methodology, tool learning and knowledge of representation modes,
- Knowledge of 2D/3D and 3D/2D equivalences,
- Kinematics and architectural schematics definition (recommended in the STI2D programme),
- Knowledge of the different joints for guiding (translation, rotation) and to guarantee a power transmission,
- Knowledge of technical elements and solutions that allow to realise them (technology),
- The selection criteria definition in view of transmissible stresses, speeds, accuracy required, rigidity, cost and life cycle of the product: ecodesign, sustainable development,
- Shape definition in view of materials and part production processes,
- Dimensional definition linked to the functional requirements of the mechanism and of the production process,
- Integration of the requirements related to the different product life cycle phases, including the industrialisation phase (concurrent engineering),
- Opening on some innovation tools or methods.

## Prerequisite

This course is dedicated to a public interested in technology and computer tools, without prior knowledge.

## Teaching approach

- The computer use is essential in all steps,
- The teaching should focus on three elements: Mechanism representation, schematization and real system. Those three elements should also be found in mechanics and dimensioning of structures courses, to familiarise students with the technician communication tools,
- In general, the following aspects will be highlighted on the studied product: Link between specifications and given solutions, chosen operation and architecture analysis (static determinacy, static indeterminacy), assembly, disassembly, possible set-up and life cycle,
- During a product study, we will be able to use an approach through architectural schematization, the definition of a preliminary draft and a 3D software approach to finalise the complex part shape and studied mechanism,
- The solutions study and the research of architectural variations could be undertaken in small groups (giving to everyone a personal problem, in order to support involvement). A final synthesis will allow to give students different technical solutions to broaden their knowledge,
- The selection of study themes will be as large as possible, to cover a maximum of fields and offer to students an important technological knowledge, source of creativity and innovation,
- A study theme could be completely defined in design during S3 and realised by the students in production course during S4,
- The definition aspects of the stresses applied to joints and their dimensioning, on the studied mechanisms, will be based on the Mechanics and Dimensioning of Structure courses, with a possible support from digital tools. In the same way, the material selection and justification, according to the part shapes and the mechanical specifications required will be based on the Materials Science course.

| | Sheet # | MECHANICAL DESIGN | L | T | P |
|---|---|---|---|---|---|
| S1 | M1101 | **Studies of existing mechanisms**<br>Analysing the operation and technology of simple mechanisms.<br>Identifying and modelling the elementary joints in a qualitative perspective.<br>Being able to understand and use the different representation modes of a mechanism. | 10 | 10 | 40 |
| S2 | M2101 | **Design study** | 8 | 12 | 40 |

| | | | | | |
|---|---|---|---|---|---|
| | | Checking a product technical feasibility and conformity within the specifications.<br>Studying and designing parts, sub-assemblies and assemblies.<br>Defining specifications and dimensioning of parts, sub-assemblies and assemblies.<br>Defining and calculating the functional, physical, ergonomic, dimensional, structural or geometric constraints of the pieces or products.<br>Identifying demand and drawing working drawings, part, systems, sub-assemblies and assemblies drawings. | | | |
| **S3** | **M3101** | **Power transmission design**<br>Studying power transmissions from an architecture and energy viewpoint.<br>Choosing and integrating steering and transmission components.<br>Knowing the main types of hydraulic, pneumatic, electrical and mechanical generators and receivers. | **12** | **23** | **25** |
| | **M3111** | **Study in a Digital Chain context**<br>Studying and designing parts, sub-assemblies and assemblies.<br>Checking a product technical feasibility and conformity within the specifications. | **1** | **4** | **25** |
| **S4** | **M4101C** | **Studies and developments**<br>Writing all or part of specifications.<br>Designing mechanical systems in accordance with specifications.<br>Identifying constructive arrangements, selection criteria, and elementary calculations.<br>Determining geometric and dimensional specifications of products: dimensioning and tolerancing.<br>Making a choice of solutions on the design projects, taking the economical aspect into account.<br>Developing and understanding efficient technical and technological solutions at the leading edge of innovation.<br>Offering new or even innovative solutions thanks to continual information and the systematic analysis of new technologies (technological watch). | **2** | **10.5** | **40** |

## b. Dimensioning of Structures

### Objectives

The graduate from a DUT in Mechanical and Production Engineering can work in any industrial sector and, at the end of the course, must be able to:

- Understand and perform dimensioning or rigidity/strength control calculations as well as deformation measurements (linear elasticity problems in statics).
- Perform calculations in a company:
  - In the engineering and research department: they are simple and analytically treated or with the help of computer applications,
  - In the calculations department: static analysis of linear elasticity on classical codes,
  - On a part or a simple structure: use digital and experimental methods for determining stresses with a critical approach to modelling and results.

### General remarks.

Dimensioning of structures is not only based on this discipline and takes account of other factors such as implementation, design technology, the economic aspect of materials, products and technologies, etc.

It is therefore essential that a connection is made between the courses offered in the various supplier modules (materials, etc.) and user modules (design, production, etc.).

### Teaching approach

The course must:

- Lay the foundations for analysing the effects of mechanical stresses: engineering science tools,
- Implement practical methods applicable in a research department, after theoretical study: numerical or other methods,
- Be illustrated by real examples, with a modelling part, in order to introduce stress and deformation calculation methods and favour the analysis of their estimations.

### The use of digital tools is essential and can be covered in tutorials and/or practicals.

The use of software must be studied with a simple theoretical approach in order to allow students to step back from modelling and results.

### Students must be introduced to the 3 phases of a study: modelling, manual or digital calculation and results analysis.

Critical thinking developed in this discipline is important for further studies or professional integration.

| | Sheet # | DIMENSIONING OF STRUCTURES | L | T | P |
|---|---|---|---|---|---|
| S1 | M1102 | **Theories of material strength and simple stresses** | 8 | 18 | 4 |
| | | Introduction to dimensioning tools with method implementation (theories, modelling, calculation, results analysis). | | | |
| S2 | M2102 | **Simple stresses: torsion, flexion** | 10 | 16 | 4 |
| | | Twisting and bending theories applied to beams.<br>Problem solving using analytical and numerical methods. | | | |

| | | | | | |
|---|---|---|---|---|---|
| **S3** | **M3102** | **Elasticity – Combined stresses**<br>Fundamentals of elasticity with applications for multiaxial states of stress.<br>Applications and real case studies using analytical and numerical methods. (Theories, modelling, calculation, results analysis). | **8** | **18** | **4** |
| **S4** | **M4102C** | **Energy methods and finite element modelling**<br>Development of energy methods and introduction to dimensioning calculations using the finite element method.<br>Real case study using analytical and numerical methods (theories, modelling, calculation, results analysis). | **8** | **18** | **4** |

## c. Mechanics

### Objectives

At the end of the course, the graduate from a DUT in Mechanical and Production Engineering must be able to:

- Model simple systems and joints between these systems,
- Understand and perform mechanical calculations in preparation for system verification or dimensioning problems,
- Understand the energy notions in mechanics and apply the appropriate solving methods,
- Understand the parameters that govern a vibration system behaviour.

### Teaching approach

Mechanics is a subject which supports the mechanical design, the dimensioning of structures. Notations must then be standardised with those subjects.

The teaching must allow the student to acquire a structured approach in the solving of the cases studied.

Different solving strategies can be used: graphical, analytical or with the support of computer applications. We will however maintain a structured use of mechanical simulation software.

| | Sheet # | MECHANICS | L | T | P |
|---|---|---|---|---|---|
| **S1** | **M1103** | **Fundamental principle of statics**<br>Model a system and undertake its static study. | **6** | **20** | **4** |
| **S2** | **M2103** | **Solid Dynamics: kinematics, kinetics, Fundamental Principle of Dynamics**<br>Model a system and undertake its kinematical and dynamic study. | **18** | **38** | **4** |
| **S3** | **M3103** | **Dynamics and energetics**<br>Solve a dynamics problem using either the Fundamental Principle of Dynamics or the energetic methods.<br>Application to the vibration system study to some level of liberty. | **9** | **28** | **8** |

## d. Material Sciences

### Objectives

At the end of the course, the student must be able to:

- Know the main properties and characteristics useful for the selection and implementation of materials
- Understand the behaviour of materials, distinguish the various classes and their designations,
- Know the interactions microstructure/behaviour of ferrous and light alloys and know how to adjust their behaviour through different implementation processes modifying the microstructure,
- Master enough knowledge, in terms of implementation processes to broaden the material selection (metallic alloys, plastics, composites, etc) for product design, based on a broad view of materials, and to make a choice based on their technico-economical properties and their shaping processes,
- Define “materials” specifications from which he/she can select adapted materials.

### Teaching approach

The teaching must allow to:

- Select materials and to justify the choice,
- Plan adjustment treatments for their uses, insert them in a bill of materials, in a research department,
- Define the shaping conditions at the manufacturing methods level.

Select the material, taking the different factors into account (implementation, mechanical engineering in product design, ecodesign, costs, etc.). It is essential that an association is made with the different supplier modules (Mechanics, Dimensioning of Structure) and user modules (design, production, etc).

| | Sheet # | MATERIAL SCIENCES | L | T | P |
|---|---|---|---|---|---|
| S1 | M1104 | **Material properties**<br>Performing a simple mechanical test according to standardised procedure.<br>Associating the mechanical properties of materials to corresponding mechanical tests.<br>Associating properties to material composition.<br>Identifying a material by its standardized designation. | 9 | 9 | 12 |
| S2 | M2104 | **Implementation and material behaviour**<br>Using binary diagrams and justifying the microstructure of an alloy.<br>Anticipating the structural state, the mechanical properties and the service behaviour of mechanical parts in relation to the treatment applied.<br>Choosing a relevant treatment for a given application and indicate it in a part manufacturing routing.<br>Justifying the choice of an organic polymer, a ceramic, a metal alloy or a composite in relation to the required properties, the behaviour laws and the implementation possibilities for a given application. | 15 | 14 | 16 |
| S3 | M3104C | **Material selection**<br>Drafting "material" specifications from the functional analysis of a part.<br>Implementing a material selection procedure<br>Taking the method department requirements into account when choosing materials. | 2 | 9 | 4 |

## e. Mechanical Design and Dimensioning of Structures

### Objectives

At the end of the course, the graduate from a DUT in Mechanical and Production Engineering must be able to:

- Model simple systems and joints between these systems,
- Understand and perform mechanical calculations in preparation for system verification or dimensioning problems,
- Use dimensioning tools in mechanical design,
- Use dynamics and/or mechanism validation software,
- Analyse results and their suitability (uncertainties, theories validity, etc),
- Define the interest of a study thanks to dimensioning and mechanics software,
- Conduct analytical, numerical and experimental approaches of the same problem.

The objective of this module is twofold: Implementing the cross-disciplinary knowledge learnt and establishing a critical analysis of the given results.

### Teaching approach

This transversal module uses the acquired knowledge in Mechanics, Dimensioning of Structure, Material Sciences and engineering and research department in order to model real mechanisms for their pre-dimensioning

| | Sheet # | MECHANICAL DESIGN AND DIMENSIONING OF STRUCTURES | L | T | P |
|---|---|---|---|---|---|
| S4 | M4105C | **Mechanical Design and Dimensioning of Structures**<br>This transversal module uses the acquired knowledge in Mechanics, Dimensioning of Structure, Material Sciences and engineering and research department in order to model real mechanisms for their pre-dimensioning. | 0 | 14 | 16 |

## f. Production

### Objectives

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

- Know the fields of use of the various processes for producing metal and non-metal parts,
- Analyse the production coming from the part manufacturing processes and know the production parameters,
- Implement the production means and maximise the influential parameters,
- Write a program in ISO language and implement numerically-controlled machines,
- Use a Computer-Aided Manufacturing software (CAM),
- Implement different machines, taking the obligations linked to the industrial context into account (for example: series production, complex surface machining, use of machines with complex kinematics...).

### General remarks

Except in the case of highly complex machines, graduates with a DUT in Mechanical and Production Engineering are not intended to be operators. Students with a DUT in Mechanical and Production Engineering must know a large range of production means, the physical phenomena they produce, their performances and limits, and their specific constraints.

At the DUT level, production will be considered as:

- A tool for designing and tolerancing assemblies or parts realistically in full knowledge of the technical difficulties caused by the considered production means,
- A discipline for materializing and visualising technical solutions proposed by the research department and the methods department,
- A field of application for organisation methods used in a production workshop.

In parallel, the student is trained in the implementation of complex machines and computer-aided programming techniques.

## Teaching approach

Production allows students to understand a wide range of manufacturing means. The material resources available within the Mechanical and Production Engineering department may prove insufficient; a significant proportion of the courses are then conducted in the form of company visits, conferences, visits to fairs.
Coordination between designers, methods technicians and manufacturers is highlighted in the course modules taught jointly by design, methods and production teaching staff.

| | Sheet # | PRODUCTION | L | T | P |
|---|---|---|---|---|---|
| S1 | M1201 | **Basis for product manufacturing processes**<br>Discovering product manufacturing processes. Preparing and implementing simple production means in a global product development.<br>Simple part manufacturing and critical analysis. | 7 | 10 | 28 |
| S2 | M2201 | **Implementation of production means**<br>Dealing in depth with the main product manufacturing processes: fields of use, physical phenomena at stake and implementation method.<br>Operation, adjustment and programming principles of numerically-controlled machines. | 8 | 12 | 40 |
| S3 | M3201 | **Production preparation on a CNC machine**<br>Implementing and validating a production on a CNC machine thanks to CAM system data.<br>Discovery of the possibilities of machines with complex kinematics. | 4 | 6 | 20 |
| S4 | M4201C | **Production preparation in industrial conditions**<br>Implementing different machines, taking the obligations linked to the industrial context into account.<br>(For example: series production, complex surface machining, use of machines with complex kinematics...). | 0 | 10 | 20 |

## g. Methods

### Objectives

A graduate of a DUT in Mechanical and Production Engineering is able to join a method department in companies operating in various sectors of activity.
In this context, at the end of his studies, the student is able to:

- Know the different production processes, applications fields and environmental impacts,
- Analyse and interpret specifications and constraints derived from product definition in view of performing manufacturing dimensioning,
- Define a production process and draft an industrialisation file,
- Choose the production, mounting and assembly means depending on the product characteristics on the one hand, and on the company's internal or external production means on the other. This choice integrates the quality, cost and deadline constraints,
- Prepare a phase sheet and optimise the manufacturing parameters,
- Propose modifications to the research department,
- Create equipment for improving productivity.

### Teaching approach

The diversity of production processes is addressed and can be based on visits to companies and conferences.
The relation with the research department and production is highlighted. A module taught simultaneously by design, methods and production teaching staff is planned to highlight and implement the necessary coordination between these various departments based on case studies.
The teaching means will extensively be based on computer resources (choice of support).

| | Sheet # | METHODS | L | T | P |
|---|---|---|---|---|---|
| S1 | M1202 | **Introduction to product manufacturing processes**<br>Study of processes other than through chip removal. Processes for the production of blanks.<br>Classifying the various types of production. Identifying and understanding the steps of product transformation.<br>Interpreting the indications in a definition file (quantity, rates...). | 6 | 16 | 8 |
| S2 | M2202 | **>From product definition to the process**<br>Choosing various part production techniques by integrating the nature of the materials, the manufacturing program and the costs. | 6 | 12 | 12 |
| S3 | M3202 | **Phase study and simulation - Cost optimization**<br>Industrialising a product manufactured as a single unit or in volume. | 6 | 12 | 12 |
| S4 | M4202C | **Multi-process industrialisation**<br>Study of a part production process and/or a product which requires a multi-process routing. | 8 | 12.5 | 12 |
| | M4212C | **Study in a Digital Chain context**<br>Participating in the "designing, industrialising, and production" stages that lead to the realization of a product.<br>Simultaneous engineering. | | | 20 |

## h. Metrology

### Objectives

Graduates from a DUT in Mechanical and Production Engineering can join a Control department or a Metrology laboratory.
They thus know how to read various common measuring devices and know their limits. They can identify the stages of production where controls are necessary and can set up an adapted control workstation.
They know how to use complex measuring devices (measuring column, measuring arm, coordinate measuring machine (CMM)), interpret and write a record of measured values.

### Teaching approach

The metrology course is reinforced by the use of measurement and control devices in production practicals.
Statistical control is taught in close collaboration with the lecturer/tutor in charge of that discipline.

| | Sheet # | METROLOGY | L | T | P |
|---|---|---|---|---|---|
| S1 | M1203 | **Measurements and control**<br>Specifications interpretation in the Geometrical Product Specifications (GPS).<br>Use of measuring and simple control tools. | 3 | 4 | 8 |
| S2 | M2203 | **Three-dimensional metrology and surface finishes**<br>The records of measured values.<br>The coordinate measuring machine implementation.<br>Statistical control. | 6 | 8 | 16 |
| S3 | M3203C | **Advanced metrology and control**<br>In depth study of measuring and control methods.<br>Non-Destructive Testing (NDT). | 3 | 6 | 6 |

## i. Electricity, Electronics and Automation

### Objectives

The graduates from the DUT in Mechanical and Production Engineering will have to design, service and operate complete technical systems. They therefore intervene on so-called “mechatronics” systems, mainly in automated production systems, comprised of an association of mechanical, electric, electronic and computerised components. Power and control electronics components are seen as market sub-components: the student does not have to design them as such but he must be able to characterize them and identify the use that he can make of them. He/she is able to configure them, program them and integrate them into a system.
He/she is able to:

- Choose a motorization for a given problem,
- Choose and integrate a standard control or instrumentation component and dialogue with discipline specialists,
- Take environment and safety constraints caused by the presence of electrical equipment into account,
- Select and implement a sensor according to the specifications requirements
- For the automation function, identify the needs, perform implementation in simple cases and collaborate with specialists for more complex cases. He/she must be able to draft specifications,
- For his research and/or methods department activity, be able to organise a production line. He/she must therefore be able to offer an automation solution to be implemented by integrating man/machine dialogue functions for operation and maintenance.

### General remark

Raise awareness of the economic consequences of the choices made.

### Teaching recommendations

Illustrate the different parts of the course by examples taken on real systems (in mechatronics or electrotechnics...).

| | Sheet # | ELECTRICITY - ELECTRONICS - AUTOMATION | L | T | P |
|---|---|---|---|---|---|
| S1 | M1204 | **Fundamental concepts in Electricity** | 3 | 6 | 6 |
| | | Basics of electricity, with a selection of themes and approaches adapted to mechanical engineering. | | | |
| | M1214 | **Basics of automation** | 3 | 6 | 6 |
| | | This is an introduction to the basics of automation (combinatory systems, sequential systems), introduction to sequential function charts and discovery of Programmable Logic Controllers (PLC). | | | |
| S2 | M2204 | **Electrical motorization** | 6 | 12 | 12 |
| | | This course provides the essential knowledge for choosing a motor and a motor control to meet the motorization needs of a mechanical assembly. | | | |
| | M2214 | **Automation of a workstation, safety** | 6 | 12 | 12 |
| | | The aim of this course is to automate an independent workstation and therefore teach the standard automation techniques (combinatory and sequential systems, sequential function charts and programmable logic controllers) and to introduce machine safety rules. | | | |
| S3 | M3204 | **Information processing** | 3 | 5 | 6 |

| | | | | | |
|---|---|---|---|---|---|
| | | This module presents electronics notions that will be used in automation and control engineering. | | | |
| | **M3214** | **Automated systems integration**<br>Concerns the automation of installations consisting of cells that must cooperate, including man/machine dialogue elements. This is an introduction to modes of operation integrating machine safety. | **5** | **10** | **16** |
| **S4** | **M4204C** | **Continuous system automation**<br>Introduction to linear system control. | **2** | **4** | **9** |

## j. Mathematics

### Objectives

Mathematics is an important element of general knowledge. It allows the logical and rigorous reasoning development, as well as the abstraction abilities.

The mathematics programme in Mechanical and Production Engineering implements the necessary tools to master skills required in the users modules.
Its main objective is therefore to provide the student with mastery of mathematical tools useful in his technical and scientific education.

| | **Sheet #** | **Mathematics** | **L** | **T** | **P** |
|---|---|---|---|---|---|
| **S1** | **M1301** | **Mathematical tools**<br>Polynomials, vector calculus.<br>Derivative, trigonometric functions and their reciprocals.<br>Taylor formulas, limited developments.<br>Probabilities, statistics. | **14** | **28** | **3** |
| **S2** | **M2301** | **Integral and matrix calculation**<br>Definition of the integral as the limit of a sum; integration methods (by parts, by change of variable, by breakdown in simple elements).<br>First and second order differential equations.<br>Vector spaces, basis, dimensions.<br>Matrix operations; diagonalization.<br>Applications to equations systems solving. | **19** | **35** | **6** |
| **S3** | **M3301** | **Functions of several variables**<br>Partial derivatives, Differentials, uncertainty calculation.<br>Maxima and minima study, Multiple Integrals. | **9** | **18** | **3** |
| **S4** | **M4301C** | **Curves**<br>Study and drawing of a parametric curve, arc length of the curve, curvature. | **5** | **10** | |

## k. Expression and Communication

### Objectives

Expression and communication is a course unit within the Mechanical and Production Engineering course programme that meets the integration needs of future technicians in professional, social, cultural and human environments. This course guarantees evolution towards senior managerial positions.

It is a transversal module that provides methodologies necessary in all other subjects, more particularly in the Professional and Personal Project (PPP), languages, work placements and projects.

**This course is based on specific contents and trains students to be critical actors in the information research, analysis and production**.

At the end of the four semesters, the student is able to:

- Structure his/her thoughts: Problematize, research and exploit information,
- Develop his/her general knowledge,
- Communicate in an academic environment,
- Communicate in an professional environment,
- Manage efficiently a work placement or employment research.

He/she is trained to collaborative work and is ready to join the working life.

### Teaching approach

The improvement of the French level of students is a continuous concern, as well as the optimisation of communication strategies. Those applications are mainly developed during practicals.

Assessment procedures: oral, written, individual and collective. They will be performed during, tutorials, practicals and supervised exams.

| | Sheet # | EXPRESSION – COMMUNICATION | L | T | P |
|---|---|---|---|---|---|
| **S1** | **M1302** | **Fundamental elements of communication**<br>Understand the stakes of contextual communication. | **1** | **14** | **15** |
| **S2** | **M2302** | **Communication, information and argumentation**<br>Structure a reflection, develop critical thinking and general knowledge. | **1** | **14** | **15** |
| **S3** | **M3302** | **Academic and professional communication**<br>Master the principles of professional communication.<br>Communicate in academic and professional environments. | **1** | **7** | **7** |
| **S4** | **M4302C** | **Communication in organisations**<br>Understanding the communication in organisations.<br>Formalising an experience.<br>Taking the multicultural aspect of communication into account. | **1** | **9** | **20** |

# I. Personal and Professional Project

## Objectives

The student registered in the Mechanical and Production Engineering department must be able to identify the employments to which he/she can apply for:

- After obtaining the DUT in Mechanical and Production Engineering,
- Short post-DUT studies,
- Long post-DUT studies

In each of these cases, they must be able to determine the moral, intellectual, social and economic characteristics of each considered job.

They must master the self-assessment tools and methods to allow them to analyse their personal characteristics and must be able to check their adequacy with the characteristics of the considered job with the help of their tutor.

After this analysis, they must be able to choose their desired career path with the help of their tutor.

## Teaching approach

Firstly, through examination of industrial products the different steps leading to their manufacturing must be listed (design, production, quality, marketing, distribution, maintenance and recycling).

The corresponding jobs will be quickly associated.

The different missions, activities, tools, methodologies and competencies required will then have to be described, through companies visits and meeting with professionals (conferences, interviews, etc).

In the same time, the students must question themselves on their professional career, motivations, representations, competencies and goals.

The students must be capable of building their own personal and professional project and expose it clearly. They must be the main actors of this process. All the teaching staff, from any specialized teaching, will accompany the students during the whole process.

The process could rely on an e-portfolio drafted by the students during their DUT course and reusable afterwards. More generally, the ICT in education tools, the professional social networks, etc. can be used during the different modules implemented in the frame of the PPP.

Those dispositions are materialised through the setting up of three modules, allocated on the first three semesters. During semester, the product serves as reflection support, essentially focused on knowing oneself and the update of motivations. During semester 2, the company serves as a basis and during semester 3, the students and the drafting of their projects are at the heart of reflection.

| | Sheet # | PROFESSIONAL AND PERSONAL PROJECT | L | T | P |
|---|---|---|---|---|---|
| S1 | M1303 | **PPP: To know oneself better, profession and professional environment discovery** | 6 | 6 | 8 |
| | | Identifying the jobs within the frame of Mechanical and Production Engineering.<br>Learning to know oneself.<br>Defining a personal and professional pre-project. | | | |

| | | | | | |
|---|---|---|---|---|---|
| **S2** | **M2303** | **PPP: Project building**<br>**Preparing professional Integration**<br>Discovering and developing knowledge of the world of work and business.<br>Presenting information.<br>Defining and consolidating the student's personal and professional project. | **5** | **4** | **6** |
| **S3** | **M3303** | **PPP - Expression and Communication for professional integration**<br>**Professional integration preparation (work placement), post-DUT course and international mobility**<br>Looking for a job, work placement.<br>Writing a CV and a cover letter.<br>Presenting information.<br>Preparing the post-DUT course. | **7** | **8** | **10** |

## m. Foreign languages

### Objectives

Foreign language teaching at the IUT aims to provide students with an instrument for professional and general communication whose use has become essential due to the internationalisation of relations. The language technical learning will allow the graduate to work on industrial projects. The graduate will also be presented with the cultural differences.
Students with a DUT in Mechanical and Production Engineering are able to:

- Communicate generally and within the context of interpersonal relations,
- Integrate a professional field, within an international team,
- Share information related to the company's communication, master technical language in order to collaborate to industrial missions,
- Take cultural differences into account.

In order to take the heterogeneity of students at the beginning of the course into account, the objective at the en of the DUT is the B2 level, or a progression of one level, according to the Common European Framework of Reference for Languages.

### Teaching approach

The teaching uses different tools thanks to the Information and Communication Technologies for teaching (ICT for teaching) and authentic resources to develop the five language skills: written expression and comprehension, spoken comprehension, continuous spoken expression and spoken expression in interaction. The objectives will be the good grammatical usage, good pronunciation, the good stress usage, etc.
Work in small groups during practicals must favour individual written and spoken expression. It allows role-playing, conversation simulations and, more generally, constructive interactivity. The students must adopt an active approach as the acquisition of knowledge involves speaking in public and producing documents. They must also improve their independence, in the information research and in the learning methods.
In this context, working in coordination with the other subjects allows students to apply, transpose and complete techniques, methods or knowledge common to several subjects. A partnership can thus be formed with the other subjects, especially within the frame of Content and Language Integrated Learning (CLIL): lesson in a foreign language, conferences or interventions done by non french-speaking persons, reports...

| | Sheet # | FOREIGN LANGUAGES | L | T | P |
|---|---|---|---|---|---|
| S1 | M1304 | **Communication in a foreign language: Basic tools**<br>Strengthen the grammatical and phonetic basics.<br>Place oneself in a communication environment.<br>Acquire the basic tools for general, professional and technical communication. | | 15 | 15 |
| S2 | M2304 | **Foreign language (technical and professional): research and deliver data**<br>Acquiring facility in a communication situation.<br>Practicing English in a technical fields. | | 15 | 15 |
| S3 | M3304 | **Foreign language (technical and professional): Write and inform in an intercultural context**<br>Integrating the company's communication and operation with ease and politeness.<br>Describe technical activities and characteristics in English | | 15 | 15 |
| S4 | M4304C | **General, professional and technical foreign language: Integrate a international professional team**<br>Establishing a good relationship with non french-speaking persons in intercultural environment.<br>Integrating the communication and operation of a foreign company.<br>Practicing a professional activity in English in a foreign country. | | 15 | 15 |

## n. Industrial Organisation and Management (IOM)

### Objectives

The graduate from the DUT in Mechanical and Production Engineering will have to participate to the company's projects. He/she will have to understand the dynamics and the interest of those activities, to organise his/her work and to efficiently fit into the different teams.
A rigorous and organised approach of analysis is necessary in these works, within the frame of cooperative work or in personal organisation.
The operation Quality and Safety requirements are to be taken into account during all the work steps.
The student must thus grasp the stakes of all these tools, economic and technical underlying obligations. The company operation is an element that should be mastered.
The management software tool principle and the contemporary company improvement methods are parts of this course.

### Teaching approach

The knowledge of the methods described in these modules is deepened through company visits, simulation games or conferences.
The computer is necessary, and should be given an essential part during practicals and project activities (Spreadsheet, Database, CAMM, CMMS, ERP...). The modules of tutored projects will allow the students to put the tools described in semester 2 into practice. The Method, Production, and Mechanical Engineering modules can be based on the Quality, Maintenance and Safety constraints developed in these modules.
The interaction between these subjects and a systemic approach must be the base of the teaching approaches for these courses.

| | Sheet # | INDUSTRIAL ORGANISATION AND MANAGEMENT | L | T | P |
|---|---|---|---|---|---|
| S2 | M2305 | **Project management**<br>The project management methodology and tools.<br>Functional analysis of a need, specifications.<br>Flow characterization and improvement. | 10 | 15 | 20 |
| S3 | M3205 | **Process management**<br>Production management concepts and tools<br>Concepts and tools for operation quality and safety | 14 | 18 | 28 |
| S4 | M4305C | **Company management**<br>The company's general organisation.<br>Legal aspects.<br>Systemic approach.<br>Industrial tools for ongoing improvement. | 10 | 20 | 0 |

## o. Methodology and individualized follow-up

### Objectives

The goal of this module is to help students succeed in their DUT course, by offering working methods fitting their profiles and the DUT subjects. It also helps students to acquire transversal knowledge basis for the different subjects.

These methods are applied in the subjects in which students have difficulties.

Moreover, it helps them to discover and develop their skills and to develop their independence.

### Teaching approach

These goals are developed in an integrated approach allowing the students to put the methods into practice, directly on subjects chosen by the teaching team.

To define groups, assessments are undertaken during the lectures.

Tests and methodological trainings (see the elements below) are based on exercises or goals related to the chosen subjects and skills. The tutorials will strengthen the knowledge.

For example: reading strategy applied to Practicals subject, course learning applied to English vocabulary, note taking in Mechanics leading to knowledge classifying, understanding and memorization, or the active presence during class.

| | Sheet # | METHODOLOGY AND INDIVIDUALIZED HELP | L | T | P |
|---|---|---|---|---|---|
| S1 | M1306 | **Foster student's success**<br>Answer the pre-professional and academic needs.<br>Learning profiles.<br>Strategies and methods.<br>Student follow-up in his/her acquisitions, competencies and skills. | 2 | 4 | 24 |

## p. Computer science

### Objectives

The goal of the computer science program in Mechanical and Production Engineering is to give students the proficiency in Information Technology tools related to professional life. This teaching must allow them to:

- Organize their computer space,
- Use a spreadsheet,
- Analyse a problem and create a simple application in a structured language,
- Understand the organisation of a database and handle information.

| | Sheet # | COMPUTER SCIENCE | L | T | P |
|---|---|---|---|---|---|
| **S1** | **M1307** | **Spreadsheets and programming languages**<br>Spreadsheets.<br>Programming: Algorithms and programming language | **5** | **10** | **15** |
| **S3** | **M3307C** | **Databases**<br>Organisation, requests, database creation and handling. | **3** | **4** | **8** |

## q. Synthesis work and project

### Objectives

Within the course framework, the tutored projects of a 300-hour duration lead to an organised assessment in view of obtaining the DUT.
The competencies expression in terms of professional skills is:

- The learning and implementation of the project conduct methodology (teamwork, working time management, meeting the deadlines, specifications drafting, written and spoken communication),
- The knowledge and know-how implementation (literature search, solutions recommendations, complete or part of a product or service realization...),
- Independence learning,
- Transdisciplinarity experimentation.

At the end of the course, students master the tools needed to manage a project during the work placement.

### Teaching approach

The objective definition of the tutored project has to be clearly different from the Personal and Professional Project of the students.

The industrial nature of a project is not a goal but a means for pedagogy implementation. However, it is strongly recommended that the project themes of semesters 3 and 4 are given by the companies, research laboratories, associations, institutions or public authorities. Cross-department challenges or national or international competitions may also serve as basis.

The tutored project is conducted in groups (2 students minimum) and is regularly reviewed with the tutor and with the partner if the project comes from a company.

The assessment is based on the work done, the written report and the oral presentation.

This assessment is part of a "grid" which allows assessing the individual and team necessary skills.

| | Sheet # | SYNTHESIS WORK AND PROJECT | | | |
|---|---|---|---|---|---|
| **S2** | **M2308** | **Synthesis work and project** | **100h independently** | | |
| | | Analyse a system independently. | | | |
| **S3** | **M3308** | **Tutored project** | **100h independently** | | |
| | | From specifications to the choice of solutions. | | | |
| **S4** | **M4108** **M4208** | **Tutored project** | **100h independently** | | |
| | | From the choice of solutions to its validation. | | | |

## r. Work placement

### Objectives

Within the course framework, the work placement in a company of a minimum of 10 weeks leads to an assessment in view of obtaining the DUT. The students are brought to:

- Know the company in its social, technical, economic and organisational aspects,
- Apply and enhance the knowledge acquired during face-to-face teaching.

### Teaching recommendations

The whole work placement process must be done in the framework of a quality approach, describing clearly the steps to follow: The work placement research, including the preliminary subject negotiation, the convention signing, the work placement proceedings, the intern follow-up, the activities report (written report and oral presentation, following a professional approach).

A follow-up is conducted by one of the department's lecturers or tutors via regular contacts with the host company and (at least) one on-site visit wherever possible.

The work placement is assessed jointly by the company (tutor) and the department (tutor and jury) on the following elements:

- Work within the company,
- Written report,
- Oral presentation by a professional and teaching jury.

The intern assessment should address the following skills:

- The ability to use the academic knowledge,
- The knowledge gathered from the professional experience,
- The intern ability to integrate the company and the intern interpersonal skills.

The work placement agreements must be signed in compliance with the existing regulation (charter, compensation).

| | Sheet # | WORK PLACEMENT | | | |
|---|---|---|---|---|---|
| **S4** | **M4409** | **Professional immersion** | **10 weeks minimum** | | |

s.

## 4.2 Modules Description

### a. Semester 1

| | | |
|---|---|---|
| UE11 | Design: introduction<br>MECHANICAL DESIGN | Hourly volume:<br>10h Lectures, 10h Tutorials, 40h Practicals |
| M1101 | **Studies of existing mechanisms** | Semester 1 |

Module objectives:
Understanding the Computer Aided Design process.
Learning all the representation modes of a mechanism.
Introduction to joints from real mechanisms.

Competencies covered:
Executing the dimensional measurements of parts, sub-assemblies and assemblies.
Drawing working drawings, part, systems, sub-assemblies and assemblies drawings.
Drafting technical and construction files.

Prerequisite:
None.

Contents:
Manipulating mechanisms and introduction to technology
Drawings reading (overall drawing, part drawings).
Technical vocabulary learning.
Digital 3D model drawing.
On simple examples of parts of mechanisms: Dimension measurement and digital representation.
Learning and practice of representation modes by show of hands (planar, isometric).
Learning of standardised 2D representation.
Generalities on mechanism construction and their schematisations.
Knowledge of simple shapes related to common joints.
Analysis of simple mechanisms operation and technology and introduction to operation conditions.
Ability to understand the different representation modes of a mechanism (drawings, geometric description, plans, CAD...).

Implementation methods:
1 CAD workstation for each student, a real product with electronic documents: digital models and assemblies with bills of materials, layouts and definition files that can be used gradually. Acquire the technological skills necessary for the 3D modelling and from real objects
The studied mechanisms must be diversified and innovating. The sustainable development and ecodesign aspects will have to be integrated through product life cycle analysis.

Possible developments:
M2101: Design study

Keywords:
CAD, mechanism manipulating, representation modes, operation conditions, functional and technological analysis, joints study.

| | | |
|---|---|---|
| UE11 | Design: introduction<br>DIMENSIONING OF STRUCTURES | Hourly volume:<br>8h Lectures, 18h Tutorials, 4h Practicals |
| M1102 | **MR hypothesis and simple stresses** | Semester 1 |

Module objectives:

Understand the MR theories.
Define, for simple isostatic cases, the cohesion torque.
Use the Hooke's law.

Competencies covered:

Selecting materials.
Linking a scientific model to a work situation.

Prerequisite:

Vector calculus.
Statics of solids.

Contents:

Theories of material resistance and elasticity:

- Presentation, based on examples, of the various criteria used for dimensioning an industrial product (technology, stresses, implementation, deformation, costs, resistance to wear-and-tear and ageing...),
- Importance of elastic analysis in dimensioning and connection with the other course modules,
- Uniaxial states of stress, normal and tangential stresses associated to a facet.

Elastic beams behaviour:

- Definition, cohesion torque reduction elements, applications.

Case studies of simple isostatism and hyperstatism in tension/compression and shear:

- Calculation of (normal and tangential) stresses and deformations in cases of simple isostatism in tension/compression and shear (showing the limits of pure shear in real cases),
- Study of some simple cases of hyperstatism not requiring any energy-based tools (with or without temperature influence),
- Peening study,
- Resistance criteria used for tension and shear (stress concentration coefficients and safety coefficients).

Implementation methods:

Rely on real cases in view of studying them,
Use the ISO joints as seen in mechanics.

Possible developments:

M2102: Simple stresses: twisting and bending

Keywords: tension, Hooke, internal stresses.

| | | |
|---|---|---|
| UE11 | Design: introduction<br>MECHANICS | Hourly volume:<br>6h Lectures, 20h Tutorials, 4h Practicals |
| M1103 | **Fundamental principle of statics** | Semester 1 |

Module objectives:
Model a system and undertake its static study.

Competencies covered:
Linking a scientific model to a work situation.
Knowing how to set out the system boundaries within which the reasoning must be performed.
Identifying the parameters and the variables of a concrete problem.
Identifying the interactions at play in a system and between the system and the environment in which it is set.
Knowing materials (solids, fluids, gases) properties and behaviours within a system.
In the field of mechanics, associating observations to measurable, relevant and objective amounts.
Modelling a system.
Knowing the joints.
Applying the Fundamental principle of statics and deducing the mechanical actions of joints.

Prerequisite:
Mathematics from terminale S or STI2D.

Contents:
Vectors and torques in mechanics:
- Direct orthonormal bases and coordinates, components of a vector,
- Vectorial operations (addition, scalar product, vectorial product, projections),
- Torques and their properties.

Mechanical actions modelling (insist on the physical notion of force and of force moment).

Joint modelling:
- Degrees of freedom,
- Associated torques:
  - To perfect classic joints,
  - To real joints: Friction (sliding, adhesion), rolling and pivoting laws with applications.

Fundamental principle of statics:
- Define and isolate a system,
- Apply the fundamental principle of statics (resultant and moment),
- Solve the static balance equations:
  - Basic graphic methods: Symmetry, 2 and 3 forces,
  - Analytical methods,
- Notions of isostatism and hyperstatism.

Implementation methods:
In order to link mechanics to technology, it is advised to start from real mechanisms: Mechanism overall plan, photo, etc.
The modelling can be presented and explained to the students.
Use of digital tools in Tutorials, Practicals or during work on free time.
During Practicals, focus on real systems.

Possible developments:
M2103: Mechanics, solid dynamics, kinematics, kinetics, Fundamental Principle of Dynamics

Keywords: Statics, modelling, torques, isolate, joints, Fundamental Principle of Statics.

| | | |
|---|---|---|
| UE11 | Design: introduction<br>MATERIAL SCIENCES | Hourly volume:<br>9h Lectures, 9h Tutorials, 12h Practicals |
| M1104 | **Material properties** | Semester 1 |

Module objectives:
Performing a simple mechanical test according to standardised procedure.
Associating the mechanical properties of materials to corresponding mechanical tests.
Associating properties to material composition.
Identifying a material by its standardized designation.

Competencies covered:
Selecting materials.
Performing destructive and non-destructive tests.
Linking a scientific model to a work situation.
Identifying the interactions at play in a system and between the system and the environment in which it is set.
Taking materials (solids, fluids, gases) properties and behaviours into account within a system.
Perform analysis in acoustics and vibrations, metallurgy, metals, physico-chemistry...

Prerequisite:
Physics programme for final-year Lycée students specialising in sciences or technology and the associated mathematical tools.

Contents:
Mechanical tests:
- Tension, hardness, creep, impact strength, and fatigue tests
- Behaviour (plastic, elastic, etc).

Types of materials (metals, ceramics, polymers, composites):
- Mechanical and physico-chemical properties and features of materials,
- Order of magnitude of characteristics (relative density, Young module, Poisson factor, elastic limit, etc.),
- Standardized designations of materials.

Structure of matter:
- Basic components and types of linkage,
- Crystalline and amorphous solids, basics of les solides cristallins et amorphes, bases de cristallography,
- Crystal defects (point defects, dislocations, grain boundaries, precipitates).

Implementation methods:
Practicals on mechanical tests on different types of materials

Possible developments: M2104: Implementation and material behaviour, M314C: Material selection.

Keywords: mechanical tests, designation, properties, characteristics, matter organisation, linkage, defects.

| | | |
|---|---|---|
| UE12 | Industrialise and manage:<br>introduction<br>PRODUCTION | Hourly volume:<br>7h Lectures, 10h Tutorials, 28h Practicals |
| M1201 | **Basis for product manufacturing processes** | Semester 1 |

Module objectives:

Producing simple parts on machining machines and with other processes.
Analysing the obtained part to validate the production or propose corrections.
Imagining a machining process for obtaining a simple part
Preparing and implementing simple production means in a global product development.
Explaining the product manufacturing processes.
Understanding the fields of use of the various processes and their characteristics.
Applying the part plotting rules in compliance with the product manufacturing process(es) (from real examples).

Competencies covered:

Analysing manufacturing elements and defining processes, means and operating procedures.
Studying the workstations, the ergonomics, the installation or the handling and storage procedures.
Identifying and analysing malfunctions, defining corrective actions and following their execution.
Assessing the process environmental impact, participating to a product life cycle analysis.
Controlling working conditions of materials, instrumentation data.
Controlling the products, parts, sub-assemblies and assemblies production conformity.
Submitting and implementing improvement measures in the pollution treatment field.
Performing a test in the field of: Structure assembly.
Performing a test in the field of: Dimensioning, geometry.

Prerequisite:

This part will be coordinated with the teachings defined in the sheet M1101: Mechanical design (2D drawings reading), M1203: metrology, M1306: methodology (2D drawings reading), M1104: Material Sciences, M1303: PPP, employments related to the product life cycle.

Contents:

Producing simple parts on machining machines and with other processes.
Analysing the obtained part to validate the production or propose corrections.
Imagining a machining process for obtaining a simple part.
Understanding the fields of use of the various processes and their characteristics.
Explaining the product manufacturing processes.
Applying the part plotting rules in compliance with the product manufacturing process(es) (from real examples).
Health, Safety and environment for the workstation. Consumable recycling principle.
Initiation to production on machine tools (turning, milling, drilling...).
Methods, techniques, and tools implementation (parameters: cutting speed, feed speed...) and use limits (dimensional and geometric tolerances).
Methods, techniques and use limits implementation (dimensional and geometric tolerances) applied to other processes (Foundry, Forging, Metal sheets, Welding, Plastic compounds, composites...).
Students should be provided with a know-how and general knowledge on the production means and methods, by insisting on:

- Organisation: safety, quality, workstations, time, collaborative work,
- Analysis: study of the available means and search for practical solutions, modelling,
- An experimental approach: design of a process, realization, observation of the result and correction procedure,
- Observation and use of technical objects: machine, work holder, tool holder, measurement devices,
- Observation of technical documentation (phase contract, manufacturer's documentation, standards...),
- Observation of physical phenomena (forces, vibrations, strain, thermal phenomena...).

Implementation methods:

As the student should be introduced to several technologies, the practicals should be organised according to the means available.
It is not necessary to provide an exhaustive list of all of the processes. It is preferable to select a limited number and to develop them in order to reinforce the student's knowledge and avoid dispersion.
This course can be taught in the form of lectures and exercises or case studies. The practical work can be conducted on real or teaching material. Coupling with simulation tools can be envisaged to allow for a better understanding of the physical phenomena.
In practicals, the student must be in contact with the material and must handle it independently while respecting the safety rules and good engineering practice. Each plan will be accompanied with a 3D image of the part in question.
It is advisable that part of practicals is kept on conventional machine tools.
The manipulations must be sufficiently guided to oblige the student to analyse the points targeted by the teaching objectives.

**Practical with 8 students (practicals with different, fragile, costly, and hazardous materials)**

Possible developments:

M2201 Production: Implementation of production means

Keywords: machining, foundry, forging, rolling, bending, welding, plastic injection...

| | | |
|---|---|---|
| UE12 | Industrialise and manage: introduction<br>METHODS | Hourly volume:<br>6h Lectures, 16h Tutorials, 8h Practicals |
| M1202 | **Introduction to product manufacturing processes** | Semester 1 |

Module objectives:
Explaining the product manufacturing processes.

Competencies covered:
Analysing manufacturing elements and defining processes, means and operating procedures.
Selecting appropriate machines and tools.
Assessing the process environmental impact, participating to a product life cycle analysis.
Determining product production process(es) (from real examples) and knowing the part plotting rules.
Explaining and classifying the different types of processes according to their application fields and environmental impact.
Understanding the various stages of product transformation.
Interpreting the indications in a definition file (quantity, rate...) in order to understand a manufacturing process.

Prerequisite:
This part will be implemented in relation with the teaching defined in mechanical design, material structure, production and metrology for the means...

Contents:
Analysis of the specifications and constraints resulting from the product definition: morphology, geometric specifications, materials specifications, manufacturing program (quantity, rate...).

Part production:

- Casting (sand, metal mould, lost wax casting...).
- Forging (stamping, extrusion),
- Sheet metals (punching, bending, extrusion, cutting...),
- Welding (arc welding, resistance welding, and electron beam welding...),
- Plastics (thermoplastics and thermosetting plastics),
- Machining (presented in M1201),
- Constraints due to manufacturing means: technology, topology, isostatism,
- Manufacturing process, pilot procedure project, evaluation of means. Introduction to manufacturing dimensioning,
- The sustainable development and ecodesign aspects will also be integrated to the module.

Implementation methods:
Principle of the main means of producing blanks (metal or not), part plotting rules. Implementation according to the means available.

**Practical with 8 students (practicals with different, fragile, costly, and hazardous materials)**

Possible developments:
M2202 Methods: From product definition to process

Keywords: metallic, plastic, foundry, forging, metal sheets, welding, route, manufacturing, machining, production, processes, transformation, industrialisation, isostatism.

| | | |
|---|---|---|
| UE12 | Industrialise and manage: introduction<br>METROLOGY | Hourly volume<br>6h Lectures, 16h Tutorials, 8h Practicals |
| M1203 | **Measurements and control** | Semester 1 |

Module objectives:
Being able to implement simple measurement techniques.

Competencies covered:
Performing a test in the field of: dimensioning, geometry and position.
Identifying and interpreting specifications derived from a definition drawing.
Applying a measurement process.
Choosing and implementing basic measurement techniques.
Estimate the measurement uncertainties.
Being able to identify the shape, orientation and position geometric defects.

Prerequisite:
For synergy to happen, the actors of this teaching must work together with those in charge of the courses defined by the M1101, M1201 and M1301 (statistics).

Contents:
Interpretation of the specifications in the GPS context.
Use of the main control equipment, serial or single units, with the preparation of a report:
- Classical measurement devices: calliper rule, micrometer,
- Surface plate and measurement accessories,
- Special testers: test jigs, limit gauges,
- Measuring machines, column-type gauges.

Device characterization and measuring processes (accuracy, fidelity, repeatability, reproducibility, capability).

Implementation methods:
For this 1st part of the metrology module, the student must have at least followed an introductory course in machining.
The student must use a maximum of different devices to validate all of the measurements.

Possible developments:
M2203 Metrology

Keywords: specifications, uncertainties, surface plate measures, GPS.

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| UE12 | Industrialise and manage: introduction<br>ELECTRICITY, ELECTRONICS AND AUTOMATION | Hourly volume:<br>3h Lectures, 6h Tutorials, 6h Practicals |
| M1204 | **Fundamental concepts in Electricity** | Semester 1 |

Module objectives:
Knowing the basics in electricity.
Reading and understanding user instructions or installation diagrams for electrical appliances.
Integrating the safety rules for goods and individuals.
Implementing the electrical measuring devices, interpret the results.

Competencies covered:
Choosing, setting up and making adjustments to automated systems.

Prerequisite:
Baccalauréat or equivalent.

Contents:
Basic electrical magnitudes (load, electric field, potential, current, energy, capacity...).

Definitions and basic principles in continuous rating:
- Electrical components, resistive sensor, Wheatstone bridge,
- Kirchhoff's laws, association of two-terminal circuits.

Electrical safety.

Implementation methods:
Basic electricity material: electrical components (resistors, capacitances, and coils), DC voltage sources, measuring devices (voltmeter, ammeter, wattmeter).

Possible developments:
M2204 EEA: Electric motorization

Keywords: electricity, measure, safety.

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|---|---|---|
| UE12 | Industrialise and manage: introduction<br>ELECTRICITY, ELECTRONICS AND AUTOMATION | Hourly volume:<br>3h Lectures, 6h Tutorials, 6h Practicals |
| M1214 | **Basics of automation** | Semester 1 |

Module objectives:
Knowing the basics of automation..
Knowing the structure of an automated system and the basic components.
Writing a logic constraint system in the form of Boolean expressions then performing a simplification.
Implementing a set of control equations in the form of hard-wired and/or programmed logic.
Identifying a sequential system.

Competencies covered:
Choosing, setting up and making adjustments to automated systems.

Prerequisite:
Baccalauréat or equivalent.

Contents:
Initial tools for the automation specialist: Boolean algebra, numeration, simplification, combinatory and sequential logic.

Functional structure of an automated system, operative part & control part.

Sensors, actuators and identification systems for automation.

Introduction to the operation principle of a programmable logic controller, programming language elements.

Implementation methods:
Cabling stages for teaching use, automated systems comprised of a programmable controller and a simple operative part.
Privilege the use of various recent industrial products (actuators, sensors, automatons, software).
Illustrate the course with examples from mechanics professions and sectors of industrial production.

Possible developments:
M2214 Automation of a workstation, safety

Keywords:
automated systems, combinatory logic.

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|---|---|---|
| UE13 | Methodology: basics and specifics development<br>MATHEMATICS | Hourly volume:<br>14h Lectures, 28h Tutorials, 3h Practicals |
| M131 | **Mathematical tools** | Semester 1 |

Module objectives:
Standardise the mathematics knowledge of students, whatever their background.
Master the basics of analysis and trigonometry.
Master the basics of probability ands statistics.

Competencies covered:
Manipulating polynomials.
Perform a scalar product, vectorial product, and a vector projection.
Calculate derivatives, specifically of composite functions.
Studying functions,
Applying limited developments to limit calculations.
Studying a random variable following a normal law,
Estimating a mean, a variance, a frequency.
Testing the equality of means and frequencies.

Prerequisite:
Level of a scientific or technological Baccalauréat holder.

Contents:
Polynomials study.
Vectorial calculation (scalar product, vectorial product, projection).
Derivatives.
Trigonometric functions and their reciprocals.
Taylor formulas, limited developments.
Probabilities and Statistics.

Implementation methods:

Possible developments:
This module is a supplier for all the scientific and technological subjects, specifically for the following subjects: Mechanics, Dimensioning of Structure, EEA and Metrology.

Keywords:
polynomials, vectorial calculation, trigonometry, limited developments, statistics.

| | | |
|---|---|---|
| UE13 | Methodology: basics and specifics development<br>EXPRESSION – COMMUNICATION | Hourly volume:<br>1h Lecture, 14h Tutorials, 15h Practicals |
| M1302 | **Fundamental elements of communication** | Semester 1 |

Module objectives:
Understand the stakes of communication.

Competencies covered:
Researching and exploiting documents.
Making oral presentations with current materials.

Knowing and mastering the communication basics and codes.
Understanding contemporary word, develop general knowledge.
Expressing oneself clearly.
Adapting to the communication situation, according to the different contexts (academic, professional, other).
Gaining confidence and asserting oneself in a group.

Prerequisite:
Baccalauréat or equivalent qualification for written and spoken expression skills.

Contents:
Communication concepts (situation, type, language functions...).
Interpersonal communication.
Verbal and non-verbal communication.
Information retrieval tools and techniques.
A strengthening of linguistic competencies.
An awareness raising on cultural and intercultural environment.

Implementation methods:
Written and spoken communication exercises: quick reading, rephrasing, note-taking, mails, E-mails, reports, public speaking (improvised, presentations, self introduction, telephone talk...).
Visual aids: production (posters, advertising brochures...), and oral presentation with presentation software.
Teamwork.
Case study.
Writing workshops, spelling and grammatical help.

Possible developments:
Office softwares, ICT, PPP, tutored projects, company knowledge.

Keywords:
communication, culture, communication ethics, written and spoken, verbal and non-verbal, imageries, document research, writing, individual development, technical writing.

| | | |
|---|---|---|
| UE13 | Methodology: basics and specifics development<br>PERSONAL AND PROFESSIONAL PROJECT | Hourly volume:<br>6h Lectures, 6h Tutorials, 8h Practicals |
| M1303 | **PPP: To know oneself better, profession and professional environment discovery** | Semester 1 |

Module objectives:

From products analysis, the aim is to discover the diversity of professions, of professional environments related to the specialties of Mechanical and Production Engineering and of work conditions.

Apprehend the notion of competencies (knowledge, know-hows, self-management skills of different professions) and to learn to know oneself.

Identify the courses allowing access to these professions.

Competencies covered:

Identify the jobs within the frame of Mechanical and Production Engineering
Learning to know yourself
Research and exploit documents
Perform written and oral presentation

Prerequisite:

Implementation with M1101 and M1302

Contents:

Work from a product: Identification of the different professions associated with a product's life cycle, from the design to industrialisation and end-of.
Performing profession investigations (interview of a professional on his/her working site, of former students who graduated from IUT, of apprentices in course of their education), document research on the same profession and comparison of the information gathered through the two methods.
Event organisation: Alumni Event, thematic conferences, career forums...
Work on knowing yourself: find your own motivations, personality traits, know how to introduce your personal course, with your experiences.

Implementation methods:

In general, the aim is to put the students in an actor position (they thus develop their knowledge and vision) and to help them produce this point of view. The reporting can then be done in front of a group of students in order to broaden their knowledge and to compare their representations.
The students will visit and meet professionals.
This plan can be based on an e-portfolio developed by the students during their course in DUT, which could be reusable, as well as on the ICT for Teaching tools, the professional social networks, ...
The students will be assessed on oral presentations, written reports, as well as on their project development.
This module requires the implementation of **practical work on manipulating mechanisms and an introduction to technology**: the aim is for students to **"tactilely"** understand consumer goods through dismantling, observation, analysis and reassembly activities. The aspects related to sustainable development and product recycling will be presented.

Possible developments:

With the expression-communication teaching, the professional subjects and projects, the work placement.

Keywords:

Professions, employment, skills, profession sheet (ROME), professional activities, professional environment.

| | | |
|---|---|---|
| UE13 | Methodology: basics and specifics development<br>FOREIGN LANGUAGES | Hourly volume:<br>15h Tutorials, 15h Practicals |
| M1304 | **Communication in a foreign language: Basic tools** | Semester 1 |

Module objectives:
Strengthen the grammatical and phonetic basics.
Place oneself in a communication environment.
Acquire the basic tools for general, professional and technical communication.

Competencies covered:
Discussing with ease with foreign people, including within an intercultural dimension.
Mastering technical English in order to integrate an international team speaking in English.

Prerequisite:
Understanding the frequently used expressions and vocabulary. Understanding simple messages. Being able to find a specific piece of information in a document written in everyday English
Being able to communicate and share simple written or spoken information.

Contents:
Phonological strengthening.

General communication tools:
- Make contact, introduce oneself, establish an interpersonal communication,
- Spell a name, an E-mail, an URL, etc,
- Describing a given place and indicating a route.

Professional communication tools:
- Explaining and commentating data with numbers,
- Telephoning: making a first contact, asking for a piece of information, taking or leaving a message,
- Sending a simple E-mail.

Professional communication tools:
- Describing and locating objects, explaining a simple mechanism,
- Writing a short text,
- Performing a short oral presentation.

Implementation methods:
Tutorials, team or pair work, media laboratory, videos, genuine documents.

Possible developments:
Working in common with Expression and Communication, and other subjects within the frame of the CLIL.

Keywords:
Introduce oneself, telephoning, spelling, describing, position, figures.

| | | |
|---|---|---|
| UE13 | Methodology: basics and specifics development<br>METHODOLOGY AND INDIVIDUALISED HELP | Hourly volume:<br>2h Lectures, 4h Tutorials, 24h Practicals |
| M1306 | **Foster student's success** | Semester 1 |

Module objectives:

- Fostering students' success,
- Strengthening knowledge, methods and expertise,
- Preparing professional Integration.

Competencies covered:

- Organising oneself,
- Expressing oneself,
- Understanding the course context,
- Knowing how to use research methods and tools.

Prerequisite:

Baccalauréat or equivalent.

Contents:

- Describing the expectations of the teaching team and the inventory of required skills.
- Describing the different learning processes:
  - Visual, hearing profiles,
  - Deductive, inductive and abductive Reasoning,
  - Global, analytical reasoning.

- Performing knowledge assessments.

- Strengthening the basic knowledge that the assessment detected as insufficient.

Presenting, within the frame of the subjects chosen by the teaching team according to the assessments, concretely and in situation, in a knowledge and skills learning context:

- The reading, note taking, personal and team working strategies,
- The different knowledge understanding, classifying and remembering means,
- Some methods aiming to organise and manage the personal working time.

Implementation methods:

The module assessment will be left to the initiative of the teaching team, depending on the subjects covered.
The evolution of the student will be taken into account.
The assessments are done with all the students together (Lecture).
The methodology aspect will be performed in Tutorials and directly illustrated through a subject approach which will be then strengthened in Tutorials, within the frame of individualised help for each subject or skill.

Possible developments:

ICT for Teaching, Expression-Communication

Keywords:

progression, organisation, methodology, assessment, knowledge, personal work, skills.

| | | |
|---|---|---|
| UE13 | Methodology: basics and specifics development<br>COMPUTER SCIENCE | Hourly volume:<br>5h Lectures, 10h Tutorials, 15h Practicals |
| M1307 | **Spreadsheets and programming languages** | Semester 1 |

Module objectives:
Using a spreadsheet and its main features in a rational way.
Knowing how to process a simple problem in a structured language.

Competencies covered:
Using a spreadsheet and its main features in a rational way.
Knowing how to process a simple problem in a structured language.

Prerequisite:
Computer level of a scientific or technological Baccalauréat holder.

Contents:
Spreadsheet: workbook, spreadsheets, built-in functions, graphics, data processing and consolidation.

Algorithmic analysis of a problem and application in a structured Language, macro-commands.

The word processing and desktop publishing aspects are not part of this module; however, it is important to show the relations between these various applications.

The use of Internet should be addressed in each discipline.

Implementation methods:
Material used: one computer for each student.

Possible developments:
This is a supplier module for the disciplines of:

Keywords:
Spreadsheet, structured language.

## b. Semester 2

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| UE21 | Design: Basics<br>MECHANICAL DESIGN | Hourly volume:<br>8h Lectures, 12h Tutorials, 40h Practicals |
| M2101 | **Design study** | Semester 2 |

Module objectives:
Learning basic joints design.
Introduction to functional dimensioning.

Competencies covered:
Checking a product technical feasibility and conformity within the specifications.
Studying and designing parts, sub-assemblies and assemblies.
Defining specifications and dimensioning of parts, sub-assemblies and assemblies.
Defining and calculating the functional, physical, ergonomic, dimensional, structural or geometric constraints of the pieces or products.
Identifying demand and drawing working drawings, part, systems, sub-assemblies and assemblies drawings.

Prerequisite:
M1101 (Lectures), M1102 (DS), M1103 (Mecha), M1104 (MS), M1201 (Prod), M1203 (Metro).

Contents:
Reading and interpreting specifications in order to design a part of a mechanism.
Joint design study (fitting, rotational and translational guiding...) and definition of solution and dimensioning selection criteria.
Analysing kinematic chain. Identifying a hyperstatic mechanism.
Different parts design in an existing mechanism.
Design methodology with CAD tools.
Lubrication and sealing functions.
Reliability and sustainability notions in a mechanism (wear and tear, service life, fatigue...).
Functional dimensioning and geometric tolerancing (ISO standards): from the function to the dimensioning that allows guaranteeing it.
Production of digital models of system definitions (plans, overall models, definition models and drawings).
Validation of constructive solutions in compliance with specifications.

Implementation methods:
1 CAD workstation for each student, a real product with electronic documents: digital models and assemblies with bills of materials, layouts and definition files that can be used gradually.
Coordination between metrology and design will be necessary.
The studied mechanisms must be diversified and innovating. The sustainable development and ecodesign aspects will have to be integrated through product life cycle analysis.

Possible developments:
Components softwares, Internet sites.

Keywords:
CAD, mechanisms design study, standard components, functional dimensioning, functional specifications exploitation, layout, ecodesign.

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| UE21 | Design: Basics<br>DIMENSIONING OF STRUCTURES | Hourly volume:<br>10h Lectures, 16h Tutorials, 4h Practicals |
| M2102 | **Simple stresses: torsion, flexion** | Semester 2 |

Module objectives:
Introduction to beam's behaviour during flexion or torsion.

Competencies covered:
Selecting materials.
Linking a scientific model to a work situation.
In the field of mechanics, associating observations to measurable, relevant and objective amounts.

Prerequisite:
Statics, materials and stress notions, Material sciences theories, tension-shear, integral.

Contents:
Torsion:

- Definition, reduction elements, characteristics of cross-sections, associated quadratic torques, calculation of stresses and deformations in simple isostatic cases, twisting of circular shafts,
- Introduction to the study of torsion of non-circular beams.

Stress concentration.

Pure and simple bending:

- Definition, reduction elements, characteristics of cross-sections, associated quadratic torques, calculation of stresses (normal and tangential) and deformations in simple isostatic cases,
- Study of some cases of hyperstatism (superposition principle),
- Stress concentration.

Buckling.

Implementation methods:
Relying on real cases in view of studying them: The student must know how to model a bending or torsion problem, define its limit conditions and analyse the results of the (analytical or numerical) solution.
Possibility to rely on software as a tool for Tutorials or Practicals: Digital modelling of problems, results illustration and interpreting.
Possibility to use visual teaching material (foam, photoelasticity...).
Use the ISO joints as seen in mechanics

Possible developments:
M3102 DS: Elasticity – Combined stress

Keywords: bending, torsion

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| UE21 | Design: Basics<br>MECHANICS | Hourly volume:<br>18h Lectures, 38h Tutorials, 4h Practicals |
| M2103 | **Solid Dynamics: kinematics, kinetics, FPD** | Semester 2 |

Module objectives:

Modelling a system and undertaking its kinematical and dynamic study.

Competencies covered:

Linking a scientific model to a work situation.
Knowing how to set out the system boundaries within which the reasoning must be performed.
Identifying the parameters and the variables of a concrete problem.
Identifying the interactions at play in a system and between the system and the environment in which it is set.
Taking materials (solids, fluids, gases) properties and behaviours into account within a system.
In the field of mechanics, associating observations to measurable, relevant and objective amounts.
Choosing a working coordinate and an appropriate solving method.
Analysing the mechanism kinematics.
Determining the position, the speed vector and the acceleration vector of a point in a solid.
Defining for a solid: the mass, the position of the mass centre, the inertia matrix.
Expressing the kinematical and dynamic torques in a well-chosen coordinate and applying the Fundamental Principle of Dynamics.
Deducing the mechanical actions of the joint and/or the movement.

Prerequisite:

Statics of solids, Mathematics

Contents:

Kinematics

- Derivative coordinates, projection coordinates, deriving a vector with respect to time for an observer within derivative coordinates,
- Solid kinematics, Composition of movements,
- Contact kinematics (sliding, rolling and pivoting).

Kinetics

- Characteristics of mass geometry: Mass, position of the centre of inertia, moments and products of inertia,
- Inertia matrix, Huygens theorem, kinetic torques.

Dynamics

- Dynamic torques, Fundamental Principle of Dynamics.

Implementation methods:

The module objective could be directly defined: The Fundamental Principle of Dynamics and the necessary steps to achieve it.
In order to link mechanics to technology, it is advised to start from real mechanisms: overall plans, mechanism picture, supports already studied in design, robotics etc.
The modelling can be presented and explained to the students.
In kinematics, emphasis should be placed on:

- Constructing the joint graph,
- Defining and setting-up the movements in relation to well-chosen coordinates,
- Determining a mechanism's input / output law,
- Determining the speed vector fields for solids and the relations between the movements: Graphically, analytically or using software.

Experimental determination of an inertia centre and a moment of inertia.
For the Fundamental Principle of Dynamics, limiting oneself solids in translation, in rotation around a fixed axis or to systems with two degrees of freedom.
Definition of dynamic balancing conditions.

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| Possible developments:<br>M3103 Mechanics: Dynamics and energetics |
| Keywords:<br>kinematics, speed, acceleration, mass geometry, dynamics. |

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| UE21 | Design: Basics<br>MATERIAL SCIENCES | Hourly volume:<br>15h Lectures, 14h Tutorials, 16h Practicals |
| M2104 | **Implementation and material behaviour** | Semester 2 |

Module objectives:
Using binary diagrams and justifying the microstructure of an alloy.
Anticipating the structural state, the mechanical properties and the service behaviour of mechanical parts in relation to the treatment applied.
Choosing a relevant treatment for a given application and indicate it in a part manufacturing routing.
Justifying the choice of an organic polymer, a ceramic, a metal alloy or a composite in relation to the required properties, the behaviour laws and the implementation possibilities for a given application.

Competencies covered:
Selecting materials.
Performing destructive and non-destructive tests.
Linking a scientific model to a work situation.
Identifying the interactions at play in a system and between the system and the environment in which it is set. Taking materials (solids, fluids, gases) properties and behaviours into account within a system.
Performing a test in the field of: Surface characterization, thickness, alloy percentage, material structure.

Prerequisite:
M1104: Material properties.

Contents:
Phase transformations:
- Equilibrium diagrams, liquid/solid and solid/solid transformations.
- Microstructures,
- Solid state transformations with or without diffusion.

Damaging:
- Plastic deformation mechanisms.
- Service-induced defects: causes and appearance of fractures (ductile / fragile fractures, stress intensity factor, toughness, fatigue fractures and creep fractures)
- Non-destructive testing (NDT) potential.

Adaptation of metal materials to their use:
- Hardening and softening of metal alloys,
- Heat treatments: quenching (TTT and CCT curves, critical quenching speed), tempering,
- Ageing, annealing (applications for steels and light alloys),
- Thermochemical treatments (reinforcement, nitriding) and mechanical treatments (roller-burnishing, shot-blasting)
- Protection against corrosion: basic corrosion mechanisms, coatings.

Polymer material - Ceramics – Composites:
- Specific characteristics in relation with the structure,
- Mechanical behaviour specificities. Implementation processes specificities,
- Subclasses: duroplastics, thermoplastics and elastomers - technical ceramics, glass, etc. Degradation, ageing, sensitivity to solvents.

Implementation methods:
Use of ovens, polishers, optical microscopes, testing machines, NDT.

Possible developments**:**
M3104C MS: Material selection

Keywords: glass, ceramics, polymers, composites, implementation, thermal treatments, thermochemical treatments, NDT.

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| UE22 | Industrialise and manage: Basics<br>PRODUCTION | Hourly volume:<br>8h Lectures, 12h Tutorials, 40h Practicals |
| M2201 | **Implementation of production means** | Semester 2 |

Module objectives:

Understanding the main processes for producing mechanical parts: fields of use, related physical phenomena, influence parameters...
Implementing the processes studied in the module.
Understanding the operation principle of numerically-controlled machines (turning, milling, punching, bending machine, spark-machining...), the kinematical possibilities and the surface generation modes.
Implementing a numerically-controlled machine.
Elaborating the numerically controlled machine programming (ISO language, conversational, CAM...).
Defining an organized operation list allowing manufacturing a simple part.

Competencies covered:

Analysing manufacturing elements and defining processes, means and operating procedures.
Identifying and analysing malfunctions, defining corrective actions and following their implementation.
Selecting appropriate machines and tools.
Assessing the process environmental impact, participating to a product life cycle analysis.
Controlling the products, parts, sub-assemblies and assemblies production conformity.
Defining and performing manufacturing programs (numerical controls, machining centres, automatons).
Performing a test in the field of: Structure assembly, Dimensioning, geometry.

Prerequisite: Semester 1 modules in production, methods, metrology, M1201, M1202, M1203

Contents:

Definition of movement modes and coordinates (standardization) of a numerically-controlled machine.
Motorization, control, measure for numerically-controlled processes.
Vectorial chain notion understanding for a numerically-controlled machine.
Principle, structuring and creation of a numerically-controlled programme.
ISO programme reading and modification.
Preparation and implementation of part manufacturing processes.
Adjustment techniques standardization of production means.
Complete implementation of a process for a well-defined and stabilised production.
Concepts of cost and fields of use.
The processes can be very varied according to the resources available (folding, cutting, electroerosion, rapid prototyping, hydroforming, sintering, gear shaping, grinding, plastics and composites implementation, robotics and assembly...). For implementation, it is preferable to select a limited number of processes and to develop them in order to reinforce the student's knowledge and avoid dispersion, with at least one numerically-controlled process.

Implementation methods:

Each plan will be accompanied with a 3D image of the part in question.
The workstation health, safety and environment concepts and the consumable recycling will be independently put to practice.
The manipulations must be sufficiently guided to oblige the student to analyse the points targeted by the teaching objectives.
As the student should be introduced to several technologies, the practicals should be organised according to the means available. For part manufacturing through a munerically-controlled process: NC Machines, pre-adjustment bench, numerical-control simulators.
**Practical with 8 students (practicals with different, fragile, costly, and hazardous materials)**

Possible developments:

M3201 Production: Production preparation on a CNC machine

Keywords:

numerical control, processes, vectorial chain, programming.

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| UE22 | Industrialise and manage: Basics<br>METHODS | Hourly volume:<br>6h Lectures, 12h Tutorials, 12h Practicals |
| M2202 | **From product definition to the process** | Semester 2 |

Module objectives:
Defining the necessary parameters for a process.

Competencies covered:
Analysing manufacturing elements and defining processes, means and operating procedures.
Drafting manufacturing documents (routings, procedures, specifications...) and controlling the application compliance.
Assessing and budgeting the costs and manufacturing times and defining the price standards and estimates.
Selecting appropriate machines and tools.
Assessing the process environmental impact, participating to a product life cycle analysis.
Suggesting organisation and production evolutions (in terms of productivity, quality, safety and environment...) and putting them to practice.
Defining and performing manufacturing programmes (numerical controls, machining centres, automatons...).

Prerequisite:
Machining basic processes, materials, and methods.

Contents:
Analysis of the product definition drawing and the production program.
Analysis of the constraints and their effects on the progression of the process.
Phase chronology. Choice of processes, tools, equipment and tool holder. Associated parameters Environmental parameters.
Cutting technology: experimental studies, optimisation of cutting conditions, choice of cutting data, evaluation of the forces; applications for turning, milling, drilling, boring, tapping; limits of production means (production tolerances depending on the rates...).

Implementation methods:
Elaboration of the production process, choice of tools and equipment, definition of the production parameters, morphological analysis of the parts, analysis of the specifications, isostatic identification, chronological study of the phases.

Possible developments:
M3202 Methods: Phase study and simulation - Cost optimization

Keywords:
routing, budget, optimisation, manufacturing, production, processes, transformation, methods, means, machine-tool, specifications, definition drawing, materials, phases, equipment, industrialisation.

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| UE22 | Industrialise and manage: Basics<br>METROLOGY | Hourly volume:<br>6h Lectures, 8h Tutorials, 16h Practicals |
| M2203 | **Three-dimensional metrology and surface finishes** | Semester 2 |

Module objectives:
Being able to implement a coordinate measuring machine: specifications analysis, measurement routing, and measurement report.

Competencies covered:
Preparing controls to be undertaken from files, production routines, orders.
Preparing the measuring and analysis products and tools and controlling their operating condition and calibration conformity.
Identifying and interpreting specifications derived from a definition drawing.
Performing a test in the field of: Dimensioning, geometry.
Controlling a mechanical part on a three-dimensional measuring machine.
Writing a measurement process and report.
Controlling the geometry of a machine tool as part of the quality improvement process.

Prerequisite:
Mathematical tools for solving systems of equations.
For synergy to happen, the actors of this teaching must work together with those in charge of the courses defined by the M1201 sheet.

Contents:
Technology of Coordinate Measuring Machines: characteristics, accuracy ranges.
Measurement and calculation principles:
- Method for associating geometrical elements to real surfaces,
- Measure coordinates definition,
- Choosing and interpreting a geometric definition model.

Creation and use of a measurement procedure, use of software or a measuring chain.
Creation and use of a measuring report.
Measurement of surface roughness.
Use of a measuring column, surface plate metrology.
Presentation and/or use of other measuring means (contactless measurement, form measurement, test jigs...).
Remarks:
This sheet allows the teaching staff to address the mathematical treatment of associated surfaces from traced points.
The specifications to a maximum and minimum of subjects can be developed or put off to semester 3.

Implementation methods:
The use of the measuring column and of surface plate metrology will be done to complement the M123 sheet.
Material used: Three-Dimensional Measuring Machine (Numerically-Controlled or not) associated to industrial software, Roughness meter.
Bibliography: Mechanical production books, documents bank, media supports, supplier's documents, book of standards, technical magazines.

Possible developments:
M3203C Metrology: Advanced metrology and control

Keywords:
CMM, GPS, association criteria.

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| UE22 | Industrialise and manage: Basics<br>ELECTRICITY, ELECTRONICS AND AUTOMATION | Hourly volume:<br>6h Lectures, 12h Tutorials, 12h Practicals |
| M2204 | **Electrical motorization** | Semester 2 |

Module objectives:
Choosing an electric motor, its control and its protection, for a given use in simple cases, taking safety into account.
Reading and interpreting the machine rating plates and technical documents.
Communicating with a specialist when choosing complex motorizations (specifications and consideration of remarks).

Competencies covered:
Choosing, setting up and making adjustments to automated systems.

Prerequisite:
Fundamental concepts in Electricity M1204.

Contents:
Sinusoidal mode, resonant circuits, mean and root-mean-square values, measurements with impedance bridges.

Three-phase systems (balanced, star-delta starting....)

Powers (apparent, active and reactive, Joule effect, power factor).

Operation and control principles of motors (single-phase and three-phase asynchronous, DC, stepper, brushless...) and their electromechanical characteristics.

Selection criteria for electric actuators associated to their controls, the safety, and case study.

Implementation methods:
This part of the course is a “resource” for mechanical engineering and automation; coordination with the teaching staff for these disciplines is therefore essential.
Material: Rotating machines, transformers and measuring devices.

Possible developments:
M2204 EEA: Information processing

Keywords:
electric motor, sinusoidal mode, three-phase.

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| UE22 | Industrialise and manage: Basics<br>ELECTRICITY, ELECTRONICS AND AUTOMATION | Hourly volume:<br>6h Lectures, 12h Tutorials, 12h Practicals |
| M2214 | **Automation of a workstation, safety** | Semester 2 |

Module objectives:
Automate a lone workstation according to automation standards.
Model an automated system with discrete events.
Designing the automation of a production workstation, choosing and integrating the common sensors and actuators.
Ensuring the implementation and maintenance of the automation of a simple workstation.
Introducing the rules concerning machine safety.
Identifying the safety problems posed by an automated machine.
Choice of technical solutions for ensuring the safety of a workstation.

Competencies covered:
Choosing, setting up and making adjustments to automated systems.

Prerequisite:
Basics of automation M1214.

Contents:
Description tools for sequential automatons, Sequential function charts, Synthesis of the control, material and software parts.

Structure of a PLC (Programmable Logic Controller), principle of operation, installation of a combinatory and sequential application.

Safety of an automated installation.

Programming and installation of applications on programmable controllers.

Hierarchized sequential function charts.

Implementation methods:
Automated systems made of a programmable controller and imperatively of a simple operative part with a safety management.

Possible developments:
M3214 EEA: Automated systems integration

Keywords:
sequential logic, sequential function chart, PLC, safety.

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| UE23 | Transversal competencies: Tools, methods<br>MATHEMATICS | Hourly volume:<br>19h Lectures, 35h Tutorials, 6h Practicals |
| M2301 | **Integral and matrix calculation** | Semester 2 |

Module objectives:
Developing integral and matrix calculation understanding.

Competencies covered:
Calculate simple integrals.
Solving differential equations of first and second order with constant coefficients.
Diagonalising a matrix.
Solving a system of linear equations.

Prerequisite:
Integral calculation of a level of a scientific or technological Baccalauréat holder.

Contents:
Integral definition as the limit of a sum and of a generalised integral.
Integration methods.
Differential equations of the first order.
Differential equation of the second order with constant coefficients.

Vectorial space in R. Linear applications.
Matrix calculus operations.
Diagonalization of a matrix.
Examples of applications: equation systems, differential systems, geometry...

Assessment and validation of know-how:

- integral calculations (integration by parts, change of variable, by breakdown of rational fractions in simple elements),
- Differential equation solving,
- Showing that a part of a vectorial space is a vectorial sub-space,
- Showing that a part is a base and calculating the dimension of a space,
- Calculating a product of matrices and inversing a matrix, calculating determinant,
- Changing the base,
- Diagonalising a matrix,
- Solving a system of linear equations.

Implementation methods:

Possible developments:
This module is a supplier for all the scientific and technological subjects, specifically for the following subjects: Mechanics, Dimensioning of Structure, EEA and Metrology.

Keywords:
integrals, differential equations, matrix calculation, vectorial space, linear equations.

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| UE23 | Transversal competencies: Tools, methods<br>EXPRESSION – COMMUNICATION | Hourly volume:<br>1h Lecture, 14h Tutorials, 15h Practicals |
| M2302 | **Communication, information and argumentation** | Semester 2 |

Module objectives:
Structure a reflection; develop critical thinking and general knowledge.

Competencies covered:
Researching and exploiting documents.
Producing professional and academic documents.

Knowing and analysing general and specialised media.
Knowing and mastering the argumentation techniques.
Organising and structuring ideas.
Knowing how to summarize.
Developing his/her general knowledge.

Prerequisite:
M1302

Contents:
Information retrieval.
Document writing and structuring: presentation and typographical standards, bibliography and sitography records.
Reporting, summary and/or synthesis technique.
Creativity tools use (brainstorming, mind map...)
Image semiotics.
Written, oral argumentation and argumentation through image.
A strengthening of linguistic competencies.

Implementation methods:
Media analysis (press, web site, advertising, movies).
Case study.
Participation to cultural activities and productions, oral presentations, debates.
Reports, summaries, synthesis, press releases writing.
Writing workshops.

Possible developments:
Office automation, NTI, PPP, tutored projects.

Keywords:
press, media, press release, argument, summarise, ICT, culture.

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| UE23 | Transversal competencies: Tools, methods<br>PERSONAL AND PROFESSIONAL PROJECT | Hourly volume:<br>5h Lectures, 4h Tutorials, 6h Practicals |
| M2303 | **PPP: Project building Preparing professional Integration** | Semester 2 |

Module objectives:

Help the students to define the professional environment and the field of activities in which they want to invest themselves in the future. Facilitate the companies' world understanding as an organisation. First drafting of the professional project in order to look for a work placement.

Competencies covered:

Discovering and developing knowledge of the world of work and business.
Researching and exploiting documents.
Perform oral presentations.
Defining and consolidating the student's personal and professional project.

Prerequisites:

M1303 and M1302

Contents:

Description of companies operations: Information – Research – Documentation (feedback with oral presentations).
Presentation of professions related to the fields of activities and to the employment level (Baccalauréat +2/+3 and +5).
Arrangement of appointments and interviews in a company. (Individual or collective) company visits.
Personal and professional aspects structure.
Expression of the student's personal and professional project:

- Synthesis: written report,
- Presentation: oral presentation of report with supporting material and production of a poster...

Implementation methods:

In general, the aim is to put the students in an actor position (they thus develop their knowledge and vision) and to help them produce this point of view. The reporting can then be done in front of a group of students in order to broaden their knowledge and to compare their representations.
The students will visit and meet professionals.
This plan can be based on an e-portfolio developed by the students during their course in DUT, which could be reusable, as well as on the ICT for Teaching tools, the professional social networks, ...
The students will be assessed on oral presentations, written reports, as well as on their project development.

Possible developments:

With the expression-communication teaching, the professional subjects and projects, the work placement.

Keywords:

professions, employment, skills, profession sheet (ROME), professional activities, professional environment.

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| UE23 | Transversal competencies: Tools, methods<br>FOREIGN LANGUAGES | Hourly volume:<br>15h Tutorials, 15h Practicals |
| M2304 | **Foreign language (technical and professional): research and deliver data** | Semester 2 |

Module objectives:
Acquiring facility in a communication and information situation.
Practicing English in a technical field.

Competencies covered:
Researching and exploiting documents.
Discussing with ease with foreign people, including within an intercultural dimension.
Mastering technical English in order to integrate an international team speaking in English.
Making oral presentations with current digital materials.

Prerequisite: M1304

Contents:
Grammatical strengthening.
Professional communication tools: information retrieval (note taking, Internet).
Professional communication tools:
- Understanding and giving instructions,
- Describing the operation of simple mechanical systems,
- Describing experiences, processes, methods and materials.

Perform a presentation or an oral in English.

Implementation methods:
Tutorials, team or pair work, media laboratory, videos, genuine documents.

Possible developments:
Working in common with Expression and Communication, and other subjects within the frame of the CLIL.

Keywords:
mechanics, experiences, processes, materials, instructions, report, presentation.

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| UE23 | Transversal competencies: Tools, methods<br>INDUSTRIAL ORGANISATION AND MANAGEMENT | Hourly volume:<br>10h Lectures, 15h Tutorials, 20h Practicals |
| M2305 | **Project management** | Semester 2 |

Module objectives:
Being capable of actively participating to an industrial project.
Being able to make flows evolve within a company.

Competencies covered:
Elaborating specifications, managing the project.
Selecting and following up suppliers/contractors.
Suggesting organisation and production evolutions (in terms of productivity, quality, safety and environment...) and putting them to practice.
Distributing and coordinating activities between teams and assigning staff on workstations.
Assessing the process environmental impact, participating to a product life cycle analysis.
Knowing how to set out the system boundaries within which the reasoning must be performed.
Actively participating in collaborative work in a company.
Studying the workstations, the ergonomics, the installation or the handling and storage procedures.

Prerequisite:
Mechanical design, Professional and Personal Project, Methods from semester 1.

Contents:
The project management methodology.
Project management tools: PERT, GANTT, milestones...
Project tracking tools.
Resources and activities management (cost, deadline, quality).
Functional analysis and specifications.
Methods and tools for flow organization and improvement.

Implementation methods:
The sustainable development and ecodesign aspects will necessarily be highlighted during the various teaching applications.
Case study (goods and service) of project management.
Group work.
Project management software use and simulation games.

Possible developments:
Compulsory use in tutored project and in industrial work placement.

Keywords:
project, PERT, GANTT, simulation, flow, team, follow-up, planning.

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| UE23 | Transversal competencies: Tools, methods<br>SYNTHESIS WORK AND PROJECTS | Hourly volume:<br>100h independently |
| M2308 | **Tutored project** | Semester 2 |

Module objectives:
Analysing an industrial product independently.
Preparing the S3 and S4 project.

Competencies covered:
Elaborating specifications and managing the project.

Prerequisite:

Contents:
Analysing an existing system by studying:

- Its global function,
- Its main functions,
- The technological solutions chosen,
- The shaping modes, the materials.

Preparing the S3 and S4 project:

- Establishing a provisional scheduling
- Information retrieval
- …

Implementation methods:
Project conducted by groups of 2 or 3 students.
The analysis will be integrated in a written report and an oral presentation.

Possible developments:
Project of S3 and S4.

Keywords:
project management.

## c. Semester 3

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| UE31 | Design: Implementation<br>MECHANICAL DESIGN | Hourly volume:<br>12h Lectures, 23h Tutorials, 25h Practicals |
| M3101 | **Power transmission design** | Semester 3 |

Module objectives:
Study of mechanical, hydraulic, pneumatic and electromechanical power transmissions.

Competencies covered:
Studying and designing parts, sub-assemblies and assemblies.
Defining and calculating the functional, physical, ergonomic, dimensional, structural or geometric constraints of the pieces or products.
Defining specifications and dimensioning of parts, sub-assemblies and assemblies.
Checking a product technical feasibility and conformity within the specifications.

Prerequisite:
M1101, M2101 (MD), M1102, M2102 (DS), M1103, M2103 (Mecha), M1104, M2104 (MS), M1201, M2201 (Prod), M1203, M2203 (Metro) , M1240, M2240 (EEA).

Contents:
Rotational guiding through angular contact ball bearings: Dimensioning, fundamental of pre-stressing, mounting rules.
Architectures and dimensioning of gear drives.
Applications in relation to gear trains: study of some constructive arrangements and calculations**.** Planetary gears: basic relations.
Elastic couplings and belt and chain drives: Components' characteristics and selection from manufacturer's documentation.
Energy aspects and efficiency of power transmissions: screw-nut system, worm and wheel gears...
Main types of hydraulic, pneumatic and electrical components.
Fundamental principles of fluid mechanics applied to industrial hydraulics.
Hydraulic systems: Simple system design and complex system understanding.
Calculation and selection of an electric motor. Equivalent inertia.
Introduction to vibratory insulation of a power transmission.
Calculation softwares use.

Implementation methods:
Material used: 1 CAD workstation for each student, a real product with electronic documents: digital models and assemblies with bills of materials, layouts and definition files that can be used gradually.
The studied mechanisms must be diversified and innovating. The sustainable development and ecodesign aspects will have to be integrated through product life cycle analysis.

Possible developments: Semester 4 module preparation

Keywords:
design, dimensioning, power transmission, bearings, gears, hydraulic

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| UE31 | Design: Implementation<br>MECHANICAL DESIGN | Hourly volume:<br>1h Lecture, 4h Tutorials, 25h Practicals |
| M3111 | **Study in a digital chain context** | Semester 3 |

Module objectives:
Showing the integrated and inseparable nature of the design phase for a product that is part of the company's production activity.

Competencies covered:
Studying and designing parts, sub-assemblies and assemblies.
Checking a product technical feasibility and conformity within the specifications.
Analysing manufacturing elements and defining processes, means and operating procedures.
Drafting manufacturing documents (routings, procedures, specifications...) and controlling the application compliance.
Selecting appropriate machines and tools.
Suggesting organisation and production evolutions (in terms of productivity, quality, safety and environment...) and putting them to practice.
Defining and performing manufacturing programmes (numerical controls, machining centres, automatons...).
Defining and realising check and reception plans of procedure.

Prerequisite:
Activities dealing with the whole content of the former semesters sheets in design, production, method, metrology, mechanics, dimensioning of structures, material sciences.

Contents:
Design of a part or mechanical assembly by parametric and associative digital modelling: search for solutions, design ready for assembly, parameterisation of the part based on the functional conditions and the surrounding standard elements.
Dimensioning of the components in the designed product. Integration of the results of dimensioning and geometric tolerancing into the digital model.
Deepening the issues around digital model defining a component: design-manufacturing interactions, digital chain (PLM), other digitization modes (surface, laser, scanner...), pre-industrialisation approach.
The sustainable development and ecodesign aspects will be largely integrated to the module.

Implementation methods:
It is desirable to highlight this approach with the production of definition drawings for the part, as a phase contract for collaborative work between design and production teaching staff. **It is necessary that the same teachers be in charge of this "digital chain" module during semesters S3 and S4).** The project can serve as support for digital chain.
It is **essential** that the design and industrialisation study deal with the same part and the same mechanical assembly in order to highlight any possible design feedback.
**It is also important to stress that the M4212 will work as a development of this module.**
If a single CAD/CAM software application is used, it is possible to highlight the influence of the choice of the design functions used (drilling, spot facing, boring, pockets) on the machining: hole recognition, pocket-emptying, automatic selection of tool type...
If separate CAD and CAM software applications are used, it is possible to highlight the interfacing difficulties between the software applications and data transmission from the CAD software to the CAM software and vice-versa.
The sustainable development and ecodesign aspects will have to be integrated through product life cycle analysis.

Possible developments:
Continue up to the manufacturing and checking steps**.**

<table>
<tr><td colspan="3">Keywords:<br>CAD, CAM, CAD/CAM, industrialisation, methods, simultaneous engineering, collaborative engineering, digital model, digital mock-up, prototype, prototyping, specifications, development, digital chain, built-in design, technological watch, teamwork, data transfer.</td></tr>
<tr><td rowspan="2">UE31</td><td>Design: Implementation</td><td rowspan="2">Hourly volume<br>8h Lectures, 18h Tutorials, 4h Practicals</td></tr>
<tr><td>DIMENSIONING OF STRUCTURES</td></tr>
<tr><td>M3102</td><td>Elasticity – Combined stresses</td><td>Semester 3</td></tr>
<tr><td colspan="3">Module objectives:<br>Introduce the concept of linear elasticity.<br>Introduce the notion of elastic limit criteria.</td></tr>
<tr><td colspan="3">Competencies covered:<br>Selecting materials.<br>Linking a scientific model to a work situation.<br>Taking materials (solids, fluids, gases) properties and behaviours into account within a system.</td></tr>
<tr><td colspan="3">Prerequisite:<br>Matrix M2301</td></tr>
<tr><td colspan="3">Contents:<br>Elasticity stresses and strains:<br>- Plane stresses: Concepts of facets and associated stress, main stresses and directions, analytical, graphical and digital problem solving (Mohr stress circle),<br>- Generalized Hooke’s law, main directions in two or three dimensions,<br>- Mohr's circle of strain: for strain measurement application in practicals,<br>- Strength criteria,<br>- Applications for multiaxial states of stress (combined stresses)<br><br>Using a finite element calculation tool:<br>- Modelling steps by finite elements (meshing, limit conditions, interpretation)<br>- Capacities and limits.</td></tr>
<tr><td colspan="3">Implementation methods:<br>Relying on real cases in view of studying them: The student must know how to model a problem, define its limit conditions and analyse the results of the (analytical, graphical or digital) solution.<br>Possibility to use a software as a support for Tutorials or Practicals: Digital modelling of problems, results illustration and interpreting.<br>Possibility to use visual teaching material.</td></tr>
<tr><td colspan="3">Possible developments:<br>M4102C Dimensioning of structures: Energy methods and finite element modelling</td></tr>
<tr><td colspan="3">Keywords:<br>elasticity, strength criteria, finite elements.</td></tr>
</table>

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|---|---|---|
| UE31 | Design: Implementation<br>MECHANICS | Hourly volume:<br>9h Lectures, 28h Tutorials, 8h Practicals |
| M3103 | **Dynamics and energetics** | Semester 3 |

Module objectives:
Solving a dynamics problem using either the Fundamental Principle of Dynamics or the energetic methods.
Application to the vibration system study to some level of liberty.

Competencies covered:
Linking a scientific model to a work situation.
Knowing how to set out the system boundaries within which the reasoning must be performed.
Identifying the parameters and the variables of a concrete problem.
Identifying the interactions at play in a system and between the system and the environment in which it is set. Taking materials (solids, fluids, gases) properties and behaviours into account within a system.
In the field of mechanics, associating observations to measurable, relevant and objective amounts.
Applying the fundamental principle of dynamics on mechanical systems.
Evaluating Work and Power.
Evaluating potential and kinematical energies present in a system.
Knowing how to apply the Kinetic energy theorem.
Knowing the influence of vibration on a system with 1 degree of freedom.

Prerequisite:
Solid statics, kinematics, kinetics, dynamics, mathematics.

Contents:
Dynamics:
- Reminder of the fundamental principle of dynamics,
- Dynamics problem solving method,
- Dynamics balancing,
- Applications (from real cases) stresses and/or movements search.

Energetics:
- Work, potential energy, kinetic energy, power,
- Kinetic energy theorem (in its two forms: power and work),
- Fundamentals of efficiency (internal mechanical actions power).

Vibrations:
- Systems with 1 degree of freedom, free or forced, damped or not damped vibrations.

Implementation methods:
In order to link mechanics to technology, it is advised to start from real mechanisms: overall plans, mechanism picture, supports already studied in design, robotics etc.
The modelling can be presented and explained to the students.
The vibratory systems balancing study is a good subject for practicals.

Possible developments:
M4105C Mechanical Design and Dimensioning of Structures

Keywords:
Fundamental Principle of Dynamics, energy, efficiency, kinetic energy theorem, balancing, vibratory systems.

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| UE31 | Design: Implementation<br>MATERIAL SCIENCES | Hourly volume:<br>2h Lectures, 9h Tutorials, 4h Practicals |
| M3104C | **Material selection** | Semester 3 |

Module objectives:
Drafting "material" specifications from the functional analysis of a part.
Implementing a material selection procedure
Taking the method department requirements into account when choosing materials.

Competencies covered:
Selecting materials.
Elaborating specifications, managing the project.
Studying and designing parts, sub-assemblies and assemblies.
Innovation and ecodesign.
Identifying the parameters and the variables of a concrete problem.

Prerequisite:
Parts of the design, production and technical project management modules studied in semesters 1 and 2.
M1104: Material properties.
M2104: Implementation and material behaviour.

Contents:
Summary of the physical and mechanical characteristics.
Material characteristics search in a material data source (database, supplier's data, bibliography).
Drafting "material" specifications from the functional analysis of a part: Requirements, related properties and characteristics, required levels, performance indexes.
Selection criteria depending on the costs, availability, conditions of use and production.
Awareness of the existence of tools for helping with the selection of materials, case studies.

Implementation methods:
The case studies can be processed thanks to material selection softwares.

Possible developments:
M4101C: Mechanical design: Studies and developments

Keywords: material selection, specifications.

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| UE32 | Industrialise and manage:<br>Implementation<br>PRODUCTION | Hourly volume:<br>4h Lectures, 6h Tutorials, 20h Practicals |
| M3201 | **Production preparation on a CNC machine** | Semester 3 |

Module objectives:

Implementing a CAM system (manufacturing documents, machining strategies...).
Implementing a production on a CNC machine thanks to CAM system data.
Discovering the possibilities of machines with complex kinematics.
Evaluating the conformity of the obtained parts, analysing the causes of the defects observed and proposing improvements or corrections.

Competencies covered:

Drafting manufacturing documents (routings, procedures, specifications...) and controlling the application compliance.
Identifying and analysing malfunctions, defining corrective actions and following their implementation.
Realising prototypes or production tools.
Performing the commissioning of new equipments.
Selecting appropriate machines and tools.
Controlling the products, parts, sub-assemblies and assemblies production conformity.
Defining and performing manufacturing programs (numerical controls, machining centres, automatons...).
Performing a test in the field of:

- Structure assembly,
- Dimensioning, geometry.
-

Prerequisite: M2201, M2101, M2202

Production techniques for numerically-controlled machines.
Use of a CAD system. Production procedure.

Contents:

Definition of the part production process (machining order, choice of positioning, equipment definition...).
Programming.
Machine implementation, part production and manufacturing specifications checking.
Production of associated documents.

Training in production on multi-axis numerically-controlled machines:
The aim is to provide students with in-depth knowledge on numerically-controlled machines by sufficiently generalising the methodology to allow for adaptation to any type of material:

- Kinematics analysis and coordinate transformation,
- Machine and part behaviour forecast,
- Observation of defects and correction,
- CAM working method, understanding the post-processor's influence,
- Data sharing formats (CAD-CAM).

For reasons of safety and means, production must be conducted with pre-defined program and tools.
The study of complex multi-axial machines can be conducted by simulators in virtual reality.
Certain practicals can be coupled with those in the courses defined in summaries M322 (Phase study and simulation - Cost optimization)

Implementation methods:

Numerically-Controlled Machines. CAM software. Pre-adjustment bench.
**Practical with 8 students (practicals with different, fragile, costly, and hazardous materials)**

Possible developments:

M4201C Production: Production preparation in industrial conditions

Keywords: CAM, Numerically controlled multi-axis machines, post-processor, digital chain.

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| UE32 | Industrialise and manage:<br>Implementation<br>METHODS | Hourly volume:<br>6h Lectures, 12h Tutorials, 12h Practicals |
| M3202 | **Phase study and simulation - Cost optimization** | Semester 3 |

Module objectives:
Understanding a process optimisation phase.

Competencies covered:
Analysing manufacturing elements and defining processes, means and operating procedures.
Studying the workstations, the ergonomics, the installation or the handling and storage procedures.
Drafting manufacturing documents (routings, procedures, specifications...) and controlling the application compliance.
Assessing and budgeting the costs and manufacturing times and defining the price standards and estimates.
Selecting appropriate machines and tools.
Assessing the process environmental impact, participating to a product life cycle analysis.
Defining and performing manufacturing programs (numerical controls, machining centres, automatons...).

Prerequisite:
Product manufacturing process, materials, metrology, methods.

Contents:
Phase analysis, Optimisation of the manufacturing parameters.
Assessment and optimisation of economical and environmental impacts.
Manufacturing dimensioning.
Study of tools, workstation study.

The sustainable development and ecodesign aspects will also be integrated to the module.

Implementation methods:
From the first draft of the manufacturing study, the students must present the phase contracts for a large series production. The production processes studied should be diversified (sintering, folding, cutting, injection...). This study should lead to determining the functions of positioning and maintaining the parts on a tool-holder unit (for machining, welding, assembly...)., the definition of the manufacturing dimensioning, the tools selection and the cutting conditions.

Possible developments:
M4202C Methods: Multi-process industrialisation
M4212C Methods: Study in a Digital Chain context

Keywords:
routing, simulation, manufactured dimensioning, process, methods, planning department, definition drawing, phase drawing, phases, phase contract, cost, optimisation, toolings, tools, positioning, maintaining the part, workstation, cutting conditions, tool holder.

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| UE32 | Industrialise and manage:<br>Implementation<br>METROLOGY | Hourly volume:<br>3h Lectures, 6h Tutorials, 6h Practicals |
| M3203C | **Advanced metrology and control** | Semester 3 |

Module objectives:
Depending on the local industrial environment, developing the different metrology or checking teachings corresponding to the wanted skills.

Competencies covered:
Preparing controls to be undertaken from files, production routines, orders and instructions.
Controlling the products, parts, sub-assemblies and assemblies production conformity.
Performing destructive and non-destructive tests.
Deepening the primitive surfaces control and measuring methods and applying them to complex surfaces.
Knowing the principles of other dimensioning technologies and participating to their implementation.
Performing the production means metrology.

Prerequisite:
Mathematical tools for solving systems of equations.

Contents:
Implementation of control procedures.
Specifications of primitive and complex surfaces analysis (development). Dimensioning process implementation (with or without contact).
Implementing non-destructive check techniques.
Selection ands use of a method of investigation according to the defect to look for.
Production means geometrical defect measure assessment of their influence on the part.

Implementation methods:
This module complete the sheet M2203. The Practicals are organised according to the local means and needs.
The specifications to the maximum material condition and the least material condition should be treated in this module if they haven't been tackled during semester 2.

Possible developments:
Digital chain operation.

Keywords: NDT, complex surfaces, process check, production means, non-contact and contact measurement.

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| UE32 | Industrialise and manage:<br>Implementation<br>ELECTRICITY, ELECTRONICS AND AUTOMATION | Hourly volume:<br>3h Lectures, 5h Tutorials, 6h Practicals |
| M3204 | **Information processing** | Semester 3 |

Module objectives:
Knowing the basic functions of an information chain.
Recognizing and choosing the components of an information chain.
Identifying a faulty function within an information chain.

Competencies covered:
Controlling working conditions of materials, instrumentation data.
Choosing, setting up and making adjustments to automated systems.

Prerequisite:
M1204, M2214, M1214, M2214.

Contents:
Information chain components: from the sensor to the analogue-to-digital converter.

Sensor: Transduction general principles (resistive, capacitive, inductive sensor...) and main features (transfer function).

Signal shaping: Filtering, amplification, D/A and A/D conversion.

Implementation methods:
Practical reusable in M428 bloc identification within the closed-loop control chain, microcontroller use.

Possible developments:
M4204C EEA: Continuous system automation

Keywords:
Bandwidth, transfer function, sampling, acquisition card.

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| UE32 | Industrialise and manage:<br>Implementation<br>ELECTRICITY, ELECTRONICS AND AUTOMATION | Hourly volume:<br>5h Lectures, 10h Tutorials, 16h Practicals |
| M3214 | **Automated systems integration** | Semester 3 |

Module objectives:
Concerns the automation of installations consisting of cells that must cooperate, including man/machine dialogue elements.
Modelling a hierarchized or distributed automated system with discrete events.
Participating in the design and automation of a workstation by integrating the modes of operation and the safety rules.
Understanding, organising and managing a technological line comprised of coordinated heterogeneous machines (man/machine interface, contribution of network, communication and control technologies).
Choosing, programming and integrating a robot into an automated cell.

Competencies covered:
Choosing, setting up and making adjustments to automated systems.

Prerequisite:
M1204, M1214, M2204, M2214, M2103.

Contents:
Operation modes of an automated installation (Gemma) and hierarchized control part.
Fieldbus, industrial programmable logic controller networks.
Programming and installation of applications on programmable machines (industrial programmable logic controllers, microcontrollers...) requiring text processing..
Robotics: features, coordinates system, movements and path following.
Robot implementation within a cell (structure, inputs/outputs, communication). Safety rules.
Integrating the supervision and man/machine dialogue principles into a hierarchized and distributed automated installation.

Implementation methods:
The student is able to explain the functional structure of a complex automated system or one with multiple workstations, in particular when the control part is hierarchized.
He/she is able to participate in the design and integration of an automated application requiring digital processing and machine-machine communication. The concepts of start and stop mode as well as safeguards are well understood.
Use an automated installation with programmable controller(s) in a network and robot(s) with a man/machine dialogue system.
Privilege the use of various recent industrial products.

Possible developments:
M4204C EEA: Continuous system automation

Keywords:
Production cell, Gemma, robot, supervision, MMI, industrial network.

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| UE32 | Industrialise and manage: Implementation | Hourly volume<br>14h Lectures, 18h Tutorials, 28h Practicals |
| | Industrial Organisation and Management | |
| M3205 | **Process management** | Semester 3 |

Module objectives:
Being able to understand the production management methods.
Being able to understand the operation quality and safety concepts and tools.

Competencies covered:
Identifying and analysing malfunctions, defining corrective actions and following their implementation.
Selecting appropriate machines and tools.
Following and controlling supply, inventories, production and quality flows.
Suggesting organisation and production evolutions (in terms of productivity, quality, safety and environment...) and putting them to practice.
All the skills associated to the industrial equipment maintenance and production organisation activities.
Linking a scientific model to a work situation.
Identifying the parameters and the variables of a concrete problem.
Tracking and analysing product and process data (measures, readings, indicators...).

Prerequisite:
Mechanical design, Methods, Production, Industrial organisation and management of the former semesters.

Contents:
Production system organisation – technical data processing (bills of material, routings...).
Supply chain: supply – production – distribution.
Physical flows, information flows, financial flows – flow mapping.
Push, pull and tight flows.
Supply and stock management: simple supply, order point, replenishment, FIFO, LIFO, safety stocks.
Production management methods: MRP2, Kanban, OPT.
Management through workload, priority management and CAPM.
Workshop scheduling, queuing.
Management chart and indicators.
Standards and quality stakes – customer's satisfaction – spirit of the ISO 9001, 9004 and 14001 standards.
Process management – customers / suppliers relationships.
Problem solving methods – quality classic tools: PDCA – Pareto - Ishikawa - Five Ws - Brainstorming – 5 Whys.
Reliability, maintainability, availability, safety, risk analysis, FMECA.

Implementation methods:
The sustainable development and ecodesign aspects will necessarily be highlighted during the various teaching applications.
Case study, teamwork.
CAMM softwares, software tools creation on spreadsheets or databases.

Possible developments:
Companies visits, industrial work placement.
Production activities, Methods.

Keywords:
Management, production, quality, maintenance, standards.

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| UE33 | Transversal competencies:<br>Implementation<br>MATHEMATICS | Hourly volume:<br>9h Lectures, 18h Tutorials, 3h Practicals |
| M3301 | **Functions of several variables** | Semester 3 |

Module objectives:
Developing the knowledge of partial derivatives and of multiple integrations.

Competencies covered:
Calculating the functions partial derivatives.
Integrating exact differential forms.
Looking for a function's extrema.
Using the double or triple integrals to calculate areas, volumes, centres of gravity.

Prerequisite:
M2301 module mathematics.

Contents:
Functions of several variables: definitions and graphical representation.
Partial derivatives, differentials and applications for uncertainties.
Looking for a function's extrema.
Multiple integrals.
Areas, volumes and centres of gravity calculations (by possibly converting to polar, cylindrical or spherical coordinates).

Implementation methods:

Possible developments:
This module is a supplier for all the scientific and technological subjects, specifically for the following subjects: Mechanics, Dimensioning of Structure, EEA.

Keywords:
Multiple variable functions, partial derivatives, multiple integrals.

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| UE33 | Transversal competencies:<br>Implementation<br>EXPRESSION – COMMUNICATION | Hourly volume:<br>1h Lecture, 7h Tutorials, 7h Practicals |
| M3302 | **Academic and professional communication** | Semester 3 |

Module objectives:
Master the principles of professional communication.
Communicate in academic and professional environments.

Competencies covered:
Producing professional and academic documents.
Performing a job interview.

Understanding the stakes of communication.
Reporting a professional experience in oral or written form.
Mastering the necessary processes for professional integration.
Managing digital identity.

Prerequisite:
M1302, M2302, M2303.

Contents:
Job search techniques: Hiring tests and interviews.
Professional social networks' role.
Professional orals and writings.
Work placement report methodology.

Implementation methods:
Individual and group interview preparation, tests, role-plays, case studies.
Mail, memorandum, executive summaries, press releases, reports.
Preparation to the work placement and activity report writing.
Writing workshops.
Internet site analysis (companies' sites and job search specialised sites) and specific tools analysis (CV and cover letter), which were studied in the first part of the PPP module (M 3330).

Possible developments:
Bureautics, ICT, PPP, tutored projects, work placement, event communication actions (forums, shows...).

Keywords:
Professional integration, Job Search Techniques, interviews, test, report, oral presentation, social networks.

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| UE33 | Transversal competencies:<br>Implementation<br>PERSONAL AND PROFESSIONAL PROJECT | Hourly volume:<br>7h Lectures, 8h Tutorials, 10h Practicals |
| M3303 | **PPP - Expression and Communication for professional integration**<br>**Professional integration preparation (work placement), post-DUT course and international mobility** | Semester 3 |

Module objectives:

Helping the students to build appropriate, methodological and efficient tools for their work placement and job search.
Allowing the students to transform their background into useful experiences, on which they should know how to express themselves (in a CV for example) and that they can mobilize in their thinking, and in the actions to come (interview, project after the DUT...).
Allowing the students to build their post-DUT course in France or abroad. They should acquire knowledge on complementary courses of the DUT: pursuit for higher education or all through the life (VAP, VAE, continued training). They must also know how to understand a course offer, a job offer (in French and in English).
The students must build and formalise a professional network.

Competencies covered:

Looking for a job, work placement.
Writing a CV and a cover letter.
Researching and exploiting documents.
Perform oral presentations.
Communicating in a professional context, in the employment field.
Preparing the post-DUT course.

Prerequisite: M2303, M2302 and M2308.

Contents:

Part I (60% of the hourly volume): This part will be done or managed par the Expression-Communication staff.

- Work placement and job offers decoding,
- Work placement and job search techniques (CV, cover letters), site analysis (companies' sites, job search sites).

Part II (40% of the hourly volume)

- Work on the work placement (and sandwich course) reports of the previous years,
- Presentation of the possible higher education (in France and abroad) and of the continuous training through all the life (VAP, VAE, FC).

Expression of the post DUT project of the student.

Implementation methods:

All the part I (CV, cover letter, job search techniques) will be done or managed by the Expression-Communication teaching staff. The language teaching staff can be associated to this module.
In general, the aim is to put the students in an actor position (they thus develop their knowledge and vision) and to help them produce this point of view. The reporting can then be done in front of a group of students in order to broaden their knowledge and to compare their representations. The students will visit and meet professionals.
This plan can be based on an e-portfolio developed by the students during their course in DUT, which could be reusable, as well as on the ICT for Teaching tools, the professional social networks, ...
The students will be assessed on oral presentations, written reports, as well as on their project development.

Possible developments: The professional subjects, the project, the work placement and the pursuit of higher education.

Keywords: professions, employment, skills, profession sheet (ROME), professional activities, professional environment.

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| UE33 | Transversal competencies:<br>Implementation<br>FOREIGN LANGUAGES | Hourly volume:<br>15h Tutorials, 15h Practicals |
| M3304 | **Foreign language (technical and professional): Write and inform in an intercultural context** | Semester 3 |

Module objectives:
Integrating the company's communication and operation with ease and politeness.
Describing technical activities and characteristics in English.

Competencies covered:
Discussing with ease with foreign people, including within an intercultural dimension.
Communicating in English in a professional context in the field of employment (CVs, covering letters, job interview) and in the business world (e-mails, internal memos, summaries, speaking in public).
Mastering technical English in order to integrate an international team speaking in English.

Prerequisite: M2304.

Contents:
Complex sentence formulation and speech logical structure. Argumentation.

Professional communication tools:
- Presenting your curriculum and your projects: Writing a CV, a cover letter, preparing a job interview,
- Presenting a company,
- Telephoning and writing e-mails: Taking an appointment, asking for confirmation, rectifying errors, organising meetings.

Professional communication tools:
- Writing, presenting, explaining complex processes related to one of the themes of S3,
- Writing an experience report.

Implementation methods:
Tutorials, team or pair work, media laboratory, videos, genuine documents.

Possible developments:
PPP, work in common with Expression and Communication, and other subjects within the frame of the CLIL.

Keywords:
Setting out your arguments, organising, company, professional integration, complex processes.

<table>
<tr><td>UE33</td><td>Transversal competencies:<br>Implementation<br>COMPUTER SCIENCE</td><td>Hourly volume:<br>6h Lectures, 16h Tutorials, 8h Practicals</td></tr>
<tr><td>M3307C</td><td>Databases</td><td>Semester 3</td></tr>
<tr><td colspan="3">Module objectives:<br>Using a database and its main features in a rational way.</td></tr>
<tr><td colspan="3">Competencies covered:<br>Using a spreadsheet and its main features in a rational way.<br>Knowing how to process a simple problem in a structured language.</td></tr>
<tr><td colspan="3">Prerequisite:<br>Level of a scientific or technological Baccalauréat holder.</td></tr>
<tr><td colspan="3">Contents:<br>Databases: general organisation, tables, requests, forms, status.<br>Databases creation and handling.<br><br>The use of Internet should be addressed in each discipline.</td></tr>
<tr><td colspan="3">Implementation methods:<br>One computer per student during practicals.</td></tr>
<tr><td colspan="3">Possible developments:<br>This is a supplier module for the disciplines of:</td></tr>
<tr><td colspan="3">Keywords:<br>Databases.</td></tr>
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| UE33 | Transversal competencies: Implementation<br>SYNTHESIS WORK AND PROJECTS | Hourly volume:<br>100h independently |
| M3308 | **Tutored project** | Semester 3 |

Module objectives:
Developing a project from specifications to the choice of solutions.

Competencies covered:
Elaborating specifications and managing the project.

Prerequisite:
All the competencies from S1 and S2.

Contents:
Establishing the specifications.
Organising the project in terms of planning, team work, management, etc. (project management methods implementation).
Perform a project through development of the following phases:
- Definition,
- Solution search and selection.

Remarks:
The project theme will be preferably technical.
The project could be led in collaboration with a company.
It is advised that the students integrate the ecodesign and sustainability concepts in their design process.

Implementation methods:
Project conducted in at least 2 persons groups.

An assessment should be made at the end of the semester.

Possible developments:
Semester 4 project.
Work placement: professional immersion

Keywords:
Project management, independent work, transdisciplinarity.

## b. Semester 4

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| UE41 | Design: Development<br>MECHANICAL DESIGN | Hourly volume:<br>2h Lecture, 10,5h Tutorials, 40h Practicals |
| M4101C | **Studies and developments** | Semester 4 |

Module objectives:
Team work from functional specifications to the production of a complete technical folder
Developping innovation tools

Competencies covered:
Elaborating specifications, managing the project.
Innovation and ecodesign.
Identifying demand and drawing working drawings, part, systems, sub-assemblies and assemblies drawings.
Studying and designing parts, sub-assemblies and assemblies
Defining specifications and dimensioning of parts, sub-assemblies and assemblies
Drafting technical and construction files
Checking a product technical feasibility and conformity within the specifications
Assessing and budgeting the costs and manufacturing times and defining the price standards and estimates

Prerequisite:
Activities dealing with the whole content of the former semesters sheets in design, production, method, metrology, mechanics, dimensioning of structures, material sciences, EEA

Contents:
Writing of all or part of the functional specifications: the changeover from Service Functions to Technical Functions
Studies based on current industrial solutions in relation to objectives chosen from fields privileging technological diversity and essentially covering:

- Various sectors of activity,
- Various series of parts,
- Various powers,
- Various part production technologies,
- Various assembly technologies.

Constitution of a complete technical folder in compliance with specifications for industrialisation.
Introduction to the "costs – delivery time - quality" optimisation through synthesis activities, team activities (simultaneous engineering).
Proposing new or even innovative solutions thanks to continual information (technological watch, innovation management) and the systematic analysis of technological novelties.

Implementation methods:
Practicals in teams (4 or 5 students) ; individual working time: The time required for technological solution research, the creation of diagrams and sketches, and dimensioning before and during each study should not represent less than 30% of the total time devoted to each study.
Material used: 1 CAD workstation for each student, a real product with electronic documents: digital models and assemblies with bills of materials, layouts and definition files that can be used gradually.
The studied mechanisms must be diversified and innovating. The sustainable development and ecodesign aspects will have to be integrated through product life cycle analysis.

Possible developments:
Work placement: professional immersion

Keywords:
CAD, design, specifications, functional specifications, architectures selection, deliverable technical folder, built-in design, technological watch, team work, synthesis, development

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| UE41 | Design: Development<br>DIMENSIONING OF STRUCTURES | Hourly volume:<br>8h Lectures, 18h Tutorials, 4h Practicals |
| M4102C | **Energy methods and finite element modelling** | Semester 4 |

Module objectives:

Presenting the various energetic approaches.
Knowing how to use a finite element calculation software for simple cases.

Competencies covered:

Selecting materials.
Checking a product technical feasibility and conformity within the specifications.
Linking a scientific model to a work situation.
Identifying the parameters and the variables of a concrete problem.
Knowing how to set out the system boundaries within which the reasoning must be performed.

Prerequisite:

Matrix, circle equation.

Contents:

Energetic methods:

- Deformation energy expression,
- Relations between deformation energy and the work of external forces.

theoretical introduction to the finite element method:

- Theoretical notions, limited to beams and frames, in relation to energy methods (notions of nodes, elements, stiffness and softness matrices, loading vectors, movement vectors, etc.),
- Modelling: consideration of the limit conditions.

Application to isostatic and hyperstatic problems (rods, beams):

- Use of the Castigliano theorem et/or of the finite element method.

Using a calculation tool by finite elements on simple cases (standalone parts):

- Modelling steps,
- Model's validity (showing the influence of modelling by concrete examples),
- Critical analysis of the results,
- Insisting on the “Real object – Model – Calculation – Results – Analysis” relation,
- Part optimisation.

Implementation methods:

Presentation of studies conducted in industry with analysis of the model and results,
Relying on real cases from mechanical design and project in order to study them: The student must know how to model a problem, define its limit conditions and analyse the results of the (analytical, graphical or digital) solution.
Encourage the use of finite elements software in Tutorials.

Possible developments:

Work placement: professional immersion

Keywords:

modelling, finite elements, deformation energy.

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| UE41 | Design: Development<br>MECHANICAL DESIGN AND DIMENSIONING OF STRUCTURES | Hourly volume:<br>0h Lecture, 14h Tutorials, 16h Practicals |
| M4105C | **Mechanical Design and Dimensioning of Structures** | Semester 4 |

Module objectives:
This transversal module uses the acquired knowledge in Mechanics, Dimensioning of Structure, Material Sciences and engineering and research department in order to model real mechanisms for their pre-dimensioning.

Competencies covered:
Linking a scientific model to a work situation.
Knowing how to set out the system boundaries within which the reasoning must be performed.
Identifying the parameters and the variables of a concrete problem.
Identifying the interactions at play in a system and between the system and the environment in which it is set. Taking materials (solids, fluids, gases) properties and behaviours into account within a system.
In the field of mechanics, associating observations to measurable, relevant and objective amounts.
Modelling the mechanisms in order to design them.
Use the dimensioning tools in mechanical design.
Use dynamics and/or mechanism validation softwares
Analysing the results and their relevance.
Determine the interest of a study thanks to a mechanical software.

Prerequisite:
Statics, dynamics, materials, Dimensioning of structures, stresses, energetics methods, research departement, methods, production.

Contents:
Modelling, calculation and results analysis with possible readjustment.
Application to case studies with the main aim of drawing conclusions on modelling, validation, modification or improvement of the studied case.
Check the studied cases for convergence or divergence of results between the use of models analysed and processed manually and the use of a digital tool (that sometimes requires simplification of the model).
Developments regarding the use of specific tools.

Implementation methods:
All the teaching staff, particularly in BE, mechanics and Dimensioning of structures can participate to the module.
The students can work on a study independently or in pairs: Work on folders.
The studies can tackle modelling, calculation, results analysis and their consequences on design.
Theoretical/analytical, digital and experimental approaches of a same problem can be considered. Student objective: Identify the advantages of the various approaches.
Possible development Perform a study in a limited time.
Use of simulation software in practicals.

Possible developments:
Work placement: professional immersion

Keywords:
Project, research department, dimensioning.

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| UE41 | Design: Development<br>SYNTHESIS WORK AND PROJECTS | Hourly volume:<br>50h independently |
| M4108 | **Tutored project** | Semester 4 |
| Module objectives:<br>Realising a project, from the choice of solutions to its validation. | | |
| Competencies covered:<br>Elaborating specifications and managing the project. | | |
| Prerequisite:<br>All competencies of semesters 1, 2 and 3. | | |
| Contents:<br>Defining solutions.<br>Tests and validation on digital model.<br>Written report and oral presentation (presentation of the methods, results and constructive critical analysis). | | |
| Implementation methods:<br><br>Project conducted in at least 2 persons groups.<br><br>The project will be integrated in a written report and an oral presentation. | | |
| Possible developments:<br>Work placement: professional immersion | | |
| Keywords:<br>Project, project management, independent work, transdisciplinarity. | | |

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| UE42 | Industrialise and manage: Development<br>PRODUCTION | 0h Lectures, 10h Tutorials, 20h Practicals |
| M4201C | **Production preparation in industrial conditions** | Semester 4 |

Module objectives:

Implementing different machines, taking the obligations linked to the industrial context into account.

For example: series production, complex surface machining, use of machines with complex kinematics,...

Competencies covered:

Identifying and analysing malfunctions, defining corrective actions and following their implementation.
Realising prototypes or production tools.
Selecting appropriate machines and tools.
Suggesting organisation and production evolutions (in terms of productivity, quality, safety and environment...) and putting them to practice.
Releasing production documents and following the production orders status.
Controlling the products, parts, sub-assemblies and assemblies production conformity.
Tracking and analysing product and process data (measures, readings, indicators...).
Controlling the production tools and machines conformity or making their adjustments.
Defining and performing manufacturing programs (numerical controls, machining centres, automatons).
Performing a test in the field of:

- Structure assembly,
- Dimensioning, geometry.

Prerequisite: M3201

Production procedure. Production techniques for numerically-controlled machines.
Use of a CAD system.

Contents:

Acquiring specific knowledge by tackling themes related to local context:

- Methodology for machining and controlling a complex shape,
- CAM work development,
- Launch and validation of production with control charts (SPC),
- Series production.

This course leaves you much freedom with regard to the process (machining, shaping...) and the teaching objectives. The project or the theme of digital chain can be used as a tool.
Examples of themes:

- Measurement of times for installation and production, for changing tools in the magazine and for changing a tip,
- Implementation of a control chart, measurement of the dispersions,
- Methodology for using a palletized machining centre for simultaneous production of two batches of different parts on the two pallets with independent programs,
- Processing of families of parts with parameterized programming,
- Methodology for machining and controlling a complex shape (mould),
- Production parameter monitoring (forces, vibrations, temperature...),
- Production launch procedure,
- Obtaining the geometrical or structural quality for the parts,
- Production parameter monitoring,
- Study of the production change,
- System assembly.

This module is an occasion to strengthen and validate the knowledge acquired during the first two semesters, while dealing with themes specific to the local context.

Implementation methods:

**Practical with 8 students (practicals with different, fragiles, costly, and hazardous materials)**

Possible developments: Work placement: professional immersion

Keywords: complex shape machining, series production, production follow-up, complex kinematics, industrial context.

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| UE42 | Industrialise and manage:<br>Development<br>METHODS | Hourly volume:<br>8h Lectures, 12,5h Tutorials, 12h Practicals |
| M4202C | **Multi-process industrialisation** | Semester 4 |

Module objectives:
Developing the knowledge in the industrialisation field.

Competencies covered:
Analysing manufacturing elements and defining processes, means and operating procedures.
Drafting manufacturing documents (routings, procedures, specifications...) and controlling the application compliance.
Selecting appropriate machines and tools.
Suggesting organisation and production evolutions (in terms of productivity, quality, safety and environment...) and putting them to practice.
Defining and performing manufacturing programs (numerical controls, machining centres, automatons).
Defining the production process for a part and/or a product that requires a multi-process routing.
Analysing the different production and assembly constraints.
For each process, determining the chronology of operations according to the specificities of the product to be manufactured

Prerequisite:
Final part of the module requiring knowledge of the entire contents of the production, methods and metrology courses in semesters S1 to S4.

Contents:
Processes influence on the procedure, according to the product to manufacture specifications.
For example:

- Blank production processes (forging, punching, moulding of various materials, welding...),
- Other machining processes (transfer machines, broaching, shaping, electroerosion...),
- Assembly process (with screws, clipsage, interlocking, bonding...),
- Heat treatments and surface treatments on processes,
- Other finishing (grinding, hard turning, shaving, induction heat treatment...).

The sustainable development and ecodesign aspects will also be integrated to the module.

Implementation methods:
This course can be taught:

- In academic lectures and tutorials,
- Through case studies from industrial files, through real parts analysis.

Possible developments:
Work placement: professional immersion

Keywords: metallic, plastic, foundry, forging, metal sheets, welding, process, route, manufacturing, production, procedures, processes, transformation, industrialisation, constraints, methods, definition drawing, specifications, productivity, specifications, assembly, operations, steps, particularities, scheduling, machining, grinding, finishing, superfinishing, heat treatment, surface treatment.

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| UE42 | Industrialise and manage:<br>Development<br>METHODS | Hourly volume:<br>20h Practicals |
| M4212C | **Study in a Digital Chain context** | Semester 4 |

Module objectives:
Showing the integrated and inseparable nature of the design phase for a product that is part of the company's production activity.

Competencies covered:
Studying and designing parts, sub-assemblies and assemblies.
Checking a product technical feasibility and conformity within the specifications.
Analysing manufacturing elements and defining processes, means and operating procedures.
Drafting manufacturing documents (routings, procedures, specifications...) and controlling the application compliance.
Selecting appropriate machines and tools.
Suggesting organisation and production evolutions (in terms of productivity, quality, safety and environment...) and putting them to practice.
Defining and performing manufacturing programs (numerical controls, machining centres, automatons...).
Knowing how to implement the necessary tools for defining a shared digital model.
Mastering the digital models for mechanical engineering activities.
Advanced modes of digital definition in 3D CAD (parameters management, surface mode, laser digitalisation...).
Using the parametric and associative nature of the digital model to integrate all of the possible product modifications resulting from the design and industrialisation study.
Showing the integrated and indissociable nature of the design phase for a product that is part of the company's production activity.
Raising awareness on an organisation where all the actors work simultaneously (simultaneous, concurrent or integrated engineering).

Prerequisite: **M3111**
Activities dealing with the whole content of the former semesters sheets in design, production, method, metrology, mechanics, dimensioning of structures, material sciences.

Contents:
Study of the various software tools required (CAM, post-processors, simulation tools, file transfer...)
Transformation process with integration of industrial constraints into dedicated computers.
Generation of the various phases (procedures) conditioned by the chosen process(es) (initial, intermediate, final states).
Process simulation (validation of the scheduling choices, the product/process interactions, the technological parameters...).
Edition of the industrialisation and production documents.
Production and check with means integrated in the digital chain.

The sustainable development and ecodesign aspects will be largely integrated to the module.

Implementation methods:
It is desirable to highlight this approach with the production of definition drawings for the part, as a phase contract for collaborative work between design and production teaching staff. **It is necessary that the same teachers are in charge of this "digital chain" module during semesters S3 and S4).** The project can serve as support for digital chain.
It is **essential** that the design and industrialisation study deals with the same part and the same mechanical assembly in order to highlight any possible design feedback.
**It is also important to highlight that this module is a perfect development from module M3111**
If a single CAD/CAM software application is used, it is possible to highlight the influence of the choice of the

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| design functions used (drilling, spot facing, boring, pockets) on the machining: hole recognition, pocket-emptying, automatic selection of tool type...<br>If separate CAD and CAM software applications are used, it is possible to highlight the interfacing difficulties between the software applications and data transmission from the CAD software to the CAM software and vice-versa.<br>The sustainable development and ecodesign aspects will have to be integrated through product life cycle analysis.<br><br>**Practical with 8 students (practicals with different, fragile, costly, and hazardous materials)** |
| Possible developments:<br>The work should reach the production and check steps.<br>Work placement: Professional immersion |
| Keywords:<br>CAD, CAM, CAD/CAM, industrialisation, methods, simultaneous engineering, collaborative engineering, digital model, digital mock-up, prototype, prototyping, specifications, development, digital chain, built-in design, technological watch, teamwork, data transfer. |

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| UE42 | Industrialise and manage:<br>Development<br>ELECTRICITY, ELECTRONICS AND AUTOMATION | Hourly volume:<br>2h Lectures, 4h Tutorials, 9h Practicals |
| M4242C | **Continuous system automation** | Semester 4 |

Module objectives:
Introduction to linear system control.
Understanding the concept of feedback loops, modelling a system, choosing and integrating an equalizer into a loop.
Identifying the contributions / limits of a closed-loop control system, effects on the mechanisms and processes.

Competencies covered:
Choosing, setting up and making adjustments to automated systems.

Prerequisite:
M1204, M1214, M2204, M2214, M3204, M3103.

Contents:
Servocontrols: modelling of physical systems, open loops and closed loops.

Time and frequency responses of first-order and second-order systems.

Correction (P: Proportional, PI: integral, PID: differential): role, effects, use in a feedback loop.

Implementation methods:
Focus should be made on the behavioural aspects rather than on the concept.
Use preferably closed-loop control systems, industrial robot or digital axis as support.

Possible developments:
Work placement: professional immersion

Keywords:
closed-loop control, continuous system, regulation, equalizer.

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| UE42 | Industrialise and manage: Development<br>SYNTHESIS WORK AND PROJECTS | Hourly volume:<br>50h independently |
| M4208 | **Tutored project** | Semester 4 |

Module objectives:
Realising a project, from the choice of solutions to its validation.

Competencies covered:
Elaborating specifications and managing the project.

Prerequisite:
All competencies of semesters 1, 2 and 3.

Contents:
Implementation processes and means definition.
Implementation.
Written report and oral presentation (presentation of the methods, results and constructive critical analysis).

Implementation methods:

Project conducted in at least 2 persons groups.

The project will be integrated in a written report and an oral presentation.

Possible developments:
Work placement: professional immersion

Keywords:
Project, project management, independent work, transdisciplinarity.

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| UE43 | Transversal competencies:<br>Development<br>MATHEMATICS | Hourly volume:<br>5h Lectures, 10h Tutorials |
| M4301C | **Curves** | Semester 4 |

Module objectives:
Developing parametric curve proficiency.

Competencies covered:
Studying a parametric curve.
Calculating the length, the centre and the curvature radius of a curve.

Prerequisite:
M3301 module mathematics.

Contents:
Plane curves: parametric equations, polar equation.
Arc length of the curve.
Curvature.
Assessment and validation of know-how:

- Studying a parameterized curve with its symmetries, its singular points and its infinite branches,
- Studying a curve given by its polar equation,
- Calculating the length of a curve,
- Calculating the center and curvature radius.

Implementation methods:

Possible developments:
This module is a supplier for all the scientific and technological subjects, specifically for the following subjects: Mechanics, Dimensioning of Structure, EEA.

Keywords:
Parametric curves, singular points, centre and curvature radius.

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| UE43 | Transversal competencies: Development<br>EXPRESSION – COMMUNICATION | Hourly volume:<br>1h Lecture, 9h Tutorials, 20h Practicals |
| M4302C | **Communication in organisations** | Semester 4 |

Module objectives:
Understanding the communication in organisations.
Formalising an experience.
Taking the multicultural aspect of communication into account.

Competencies covered:
Elaborating specifications, managing the project.
Drafting technical and construction files.

Presenting efficient communication tools in an academic and professional context.
Working in teams and cooperating.
Leading a meeting.

Prerequisite:
M1302, M2302, M2303, M3302, M3303.

Contents:
Internal and external communication.
Drafting technical and scientific writings.
Conducting a meeting: preparation, animation, reporting.
Teamwork and interpersonal relationship management.
Socio-cultural differences approach.
Preparation to the oral presentation of the DUT work placement.

Implementation methods:
Role playing, case study, presentations, folders, video and written documents study, synthesis.

Possible developments:
Work placement: professional immersion

Keywords:
Interpersonal relationship management, meetings, professional writings, oral presentation, intercultural communication, communication ethics.

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| UE43 | Transversal competencies:<br>Development<br>FOREIGN LANGUAGES | Hourly volume:<br>15h Tutorials, 15h Practicals |
| M4304C | **General, professional and technical foreign language: Integrate a international professional team** | Semester 4 |

Module objectives:
Establishing a good relationship with non french-speaking persons in intercultural environment.
Integrating the communication and operation of a foreign company.
Integrating a international professional team.
Practicing a professional activity in English in a foreign country.

Competencies covered:
Discussing with ease with foreign people, including within an intercultural dimension.
Communicating in English in a professional context in the field of employment (CVs, covering letters, job interview) and in the business world (e-mails, internal memos, summaries, speaking in public).
Mastering technical English in order to integrate an international team speaking in English.

Prerequisite: M3304.

Contents:
Preparation to intercultural activities.
General communication tools.
Preparing for a travel abroad: transport, hotel, restaurant...
Mastering different levels of language.
Professional communication tools.
Leading a conversation with colleagues, giving an opinion in meetings.
Technical communication tools.
Explaining clearly and accurately a "process".
Present a technical project, a report, and an oral.

Implementation methods:
Tutorials, team or pair work, media laboratory, videos, genuine documents.

Possible developments:
Working in common with Expression and Communication, and other subjects within the frame of the CLIL.
International work placement

Keywords:
Intercultural, work placement abroad, professional communication, technical communication.

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| UE43 | Transversal competencies:<br>Development<br>INDUSTRIAL ORGANISATION AND MANAGEMENT | Hourly volume:<br>10h Lectures, 20h Tutorials, 0h Practicals |
| M4305C | **Company management** | Semester 4 |

Module objectives:
Being able to understand the company and your role within it.
Being able to modifiy the company's operation through improvement projects.

Competencies covered:
Identifying and analysing malfunctions, defining corrective actions and following their implementation.
Suggesting organisation and production evolutions (in terms of productivity, quality, safety and environment...) and putting them to practice.
Knowing how to set out the system boundaries within which the reasoning must be performed.
Identifying the parameters and the variables of a concrete problem.
Being, at any time, able to fit the activities into a professional and skill development perspective, through deepening or enlarging.
Identifying the general organisation and the legal framework of companies.

Prerequisite:
Mechanical design, Methods, Production, Industrial organisation and management of the former semesters.

Contents:
Systemic approach – comprehensive vision.
Company strategies – business forecast – sales forecast.
ERP integrated management software packages offers.
Continuous improvement: LEAN, TPM, "6 Sigma" approach.

Legislation - labour code – health and safety.
Employment contracts.
Collective agreements.
Social partners.

Implementation methods:
The sustainable development and ecodesign aspects will necessarily be highlighted during the various teaching applications.
Conferences.
Industrial practice studies.
Stepping back on the company operation.

Possible developments:
Company visits.
Work placement: professional immersion
Professional integration.

Keywords:
ERP, continuous improvement, collective agreement, labour law.

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| UE44 | Vocational training<br>WORK PLACEMENT | Hourly volume:<br>A minimum of 10 weeks |
| M4409 | **Professional immersion** | Semester 4 |
| Module objectives:<br>Professional immersion. | | |
| Competencies covered:<br>Knowing the company in its social, technical, economic and organisational aspects.<br>Applying and enhancing the knowledge acquired during face-to-face teaching. | | |
| Prerequisite:<br>All competencies of semesters 1, 2, 3 and 4. | | |
| Contents:<br>Work on studies and/or on company achievements related to the course.<br>Activities report presentation (oral and written presentation following a professional method). | | |
| Implementation methods:<br>The students must invest themselves in a work placement search. | | |
| Possible developments:<br>Professional integration, pursuit for higher education in sandwich course. | | |
| Keywords:<br>Company, professionalisation, work placement. | | |

## Glossary

**2D**: Two Dimensions.
**3D**: Three Dimensions.
**A/D**: Analog/ Digital
**FMECA**: Failure Mode, Effects, and Criticality Analysis.
**PLC**: Programmable Logic Controller.
**CAD**: Computer-Aided Design.
**CAD/CAM**: Computer-Aided Design and Computer-Aided Manufacturing.
**MD**: Mechanical design.
**NC**: Numerical Control.
**NDT**: Non-Destructive Test.
**R**: Report.
**CV**: Curriculum Vitae.
**DS**: Dimensioning of Structures.
**DUT**: Diplôme Universitaire de Technologie (Technological University Degree).
**EC**: Expression and Communication.
**EEA**: Electricity, Electronics and Automation.
**CLIL**: Content and Language Integrated Learning.
**ERP**: Entreprise Ressource Planning
**CAM**: Computer-Aided Manufacturing.
**CE**: Continuing Education.
**FIFO**: First In, First Out.
**GEMMA**: Guide d'Etude des Modes de Marche et d'Arrêt (run/stop modes guide).
**CMMS**: Computerized Maintenance Management System.
**GMP**: Génie Mécanique et Productique (Mechanical and Production Engineering).
**CAMM**: Computer-Aided Management and Manufacturing.
**GPS**: Geometrical Product Specifications.
**SFC**: Sequential Function Chart.
**MMI**: Man Machine Interface.
**ISO**: International Standard Organisation.
**IUT**: Institut Universitaire de Technologie (Technological University Institute).
**LIFO**: Last In, First Out.
**MRP2**: Manufacturing Resources Planning.
**SPC**: Statistical Process Control.
**D/A**: Digital / Analog.
**IOM**: Industrial Organisation and Management.
**OPT**: Optimized Production Technology.
**PDCA**: Plan, Do, Check, Act.
**FPD**: Fundamental Principle of Dynamics.
**FPS**: Fundamental Principle of Statics.
**PLM**: Product Lifecycle Management.
**PPP**: Professional Personal Project.
**Five Ws**: Who, What, Where, When, Why.
**MR**: Material Resistance.
**MS**: Material Sciences.
**SMED**: Single Minute Exchange of Die.
**STI2D**: Sciences et Technologies de l'Industrie et du Développement Durable (Industry and sustainable development sciences and technologies).
**ICT**: Information and Communication Technology.
**ICT for Teaching**: Information and Communication Technology for Teaching.
**TPM**: Total Productive Maintenance
**CCT**: Continuous Cooling Transformation.
**JST**: Job search techniques.
**TTT**: Time-Temperature-Transformation
**VAE**: Validation des Acquis de l'Expérience (experience validation).
**VAP**: Validation des Acquis Professionnels (Professional experience validation).