CENTRALE NANTES

INGÉNIEUR, SPÉCIALITÉ MÉCANIQUE

2021-2022

Year 1

PROGRAMME SUPERVISOR

Pascal COSSON

Year 1

Course unit	ECTS Credits	Course type	Course code	Title
UE100	10			
		Core course	MECA1_ENTRE	Business Skills
UE101	3			
		Core course	MECA1_SSAT	Social Sciences Applied to the Workplace
UE102	7			
		Core course	MECA1_ANGL	English
		Core course	MECA1_ANPRA	Analysis of Professional Practices
		Core course	MECA1_ESE	Social challenges for the companies
		Core course	MECA1_PSI	International experience
UE103	8			
		Core course	MECA1_GI	Industrial Engineering
UE104	7			
		Core course	MECA1_MATHS	Mathematics
UE105	4			
		Core course	MECA1_MATER	Materials
UE106	7			
		Core course	MECA1_DSOLI	Rigid Multibody Dynamics
UE107	4			
		Core course	MECA1_COFAB	Mechanical Design and Manufacturing
UE108	6			
		Core course	MECA1_ELEC	Electricity
UE109	4			
		Core course	MECA1_ALGO	Algorithmics

Business Skills [MECA1_ENTRE]

LEAD PROFESSOR(S): Marie GOUGEON / Pascal COSSON

Objectives

The UV Entreprise, which is not an academic course, is dedicated to the learner's journey in the company during his or her apprenticeship training and to the analysis he or she makes of this course. It therefore focuses on the learner's development during his or her periods in the company, on the skills acquired and on his or her ability to take a step back and analyze his or her career path. It is therefore an opportunity for the learner to reflect on his or her career path in the company, describing and analysing the situations encountered, identifying strengths, weaknesses and areas for improvement. The first year is more particularly devoted to the discovery of the company, to integration in the world of work, to the first tasks entrusted.

The evaluation is conducted using the following four elements:
- the maintenance of the Electronic Monitoring Book,
- the drafting of the deliverable "Missions and discovery of alternance",
- the drafting of the deliverable "Feedback on my first year of alternance",
- the evaluation grid completed by the Industrial Tutor.

Course contents

The deliverable "Missions et découverte de l'alternance" is a document of about three pages, written at the end of the first semester of the first year of the Formation Ingénieur which states:
- assignments assigned to the learner during the first semester in a company; - the actions that the learner has had to take to cope with the daily life of alternance (moving, commuting, living independently, discovering the world of work, etc.); - a personal balance sheet for the preceding half-year.

The deliverable "feedback on my first year of alternance" is a document of about five pages. It is an opportunity for the learner (s) to establish, at the end of the first year of Engineering Training, a review of his first year spent in a company. This assessment covers:
- the tasks entrusted; - learner successes, points that have been more difficult; - what the learner appreciated in these assignments, what was less appreciated; - the outlook for the following year.

The evaluation of these two deliverables concerns the form (spelling, syntax, presentation) and the substance (compliance with the specifications, accuracy of the information provided and capacity for analysis).

The skills grid is completed by the Industrial Tutor and focuses on the skills acquired in the company during the first year. The skills targeted are those of the RNCP sheet of the Mechanical Engineer Specialty training.

Each competency is assessed through activities for which four levels are defined:
level 0: does not know how to do or not applicable; Level 1: knows how to do things under control; Level 2: knows how to do independently; Level 3: knows how to do and can train.

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	0 hrs	0 hrs	0 hrs	0 hrs	0 hrs

Social Sciences Applied to the Workplace [MECA1_SSAT]

LEAD PROFESSOR(S): Fabien THOMAS / Pascal COSSON

Objectives

The objectives of this module are as follows:
▪ acquire a rational approach to questioning in the context of a human work-related practice;
▪ acquire a data collection methodology adapted to this questioning;
▪ learn about human work-related practice;
▪ bring together "practices" and "theories" based on the professional experience of degree-apprenticeship engineering students (in conjunction with practice analysis sessions);
▪ transform this knowledge into professional know-how.

To this end, the module includes:
▪ presentations on various areas of human work;
▪ research conducted over three years, based on a work situation in the apprentice's host company (formalised via a dissertation);
▪ individual follow-up with a course teacher (questioning, structuring the research, and correction of the deliverables and dissertation).

The teaching provided is based on an alternating educational approach, specific to apprenticeship. This requires degree-apprentice engineering students to focus on real-life situations in their company. However, they should neither endorse nor denigrate the latter, nor express their personal opinions or feelings. Discipline, perspective, research work, and personal culture in various areas such as economics, social and legal matters are required.

Course contents

Introduction to the module
Defining a topic
Facilitating a meeting
Observing work
Change and innovation
Questioning sources and documents
Understanding organizations
The management function

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	49 hrs	0 hrs	0 hrs	0 hrs	0 hrs

English [MECA1_ANGL]

LEAD PROFESSOR(S): James RATCLIFF

Objectives

Objectives:

- prepare students to apply for internship in English-speaking country
- prepare students for life in a company in English-speaking country
- prepare students for living abroad, integrating with English-speakers
- prepare students for TOEIC test (grammar, vocabulary, listening, reading) - required level 785

Course contents

Training program/syllabus :

Communicative approach:

- CVs in English
- Cover Letters in English
- Video CV scripts
- Describing companies and responsibilities within companies
- Job interview practice
- Telephoning for job interviews. Leaving a message
- Telephoning: arranging a meeting.
- Describing processes
- Numbers, figures, prices, measurements, alphabet, graphs, charts etc.
- Question forms
- Communication activities in various contexts - professional, social, current affairs
- Grammar review according to individual needs
- Vocabulary for TOEIC
- Professional emails
- Professional role-plays
- Presentations skills & practice
- Case studies
- Meetings language
- Social English
- Cultural Differences – working in UK, US, Australia etc

Regular Mock T.O.E.I.C practice tests

Course material

Barron's TOEIC Test 6th Edition
English Grammar in Use with answers - Raymond Murphy
Les Guides Officiels du Test TOEIC. Grammaire Vocabulaire du Test TOEIC - Hachette
L'intégrale TOEIC - Nathan
200% TOEIC 2021 - Ellipses

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	-	0 hrs	80 hrs	0 hrs	0 hrs	0 hrs

Analysis of Professional Practices [MECA1_ANPRA]

LEAD PROFESSOR(S): Marie GOUGEON / Pascal COSSON

Objectives

Degree apprenticeship programme - Mechanical Engineering

Objective: to enable apprentices to evolve from a “student” stance to a “professional” stance through:

- Consideration of their learning methods and methodologies;
- Identification of efficient practices;
- Peer interaction;
- A link between the two training sites: the school and the host company.

Course contents

Examples of topics include:

- Integration of the apprentice into the company;
- The use of information and communication tools;
- Training at school;
- Peer-to-peer training;
- Appropriation of the training system.

Role of the facilitator:

- Introduce and conclude sessions;
- Involve participants and help them to debate;
- Help to analyse earning practices;
- Identify critical situations;
- Help apprentices to find solutions;
- Feedback information to ITII.

Example of how a session is run:

- Session objective is stated: to identify good practices for the integration of the apprentice in company;
- In sub-groups, apprentices discuss their integration in their host companies. They identify strengths and weaknesses;
- Restitution to the whole group in order to identify actions in favour of company integration;
- Group discussion on the different situations experienced by apprentices;
- Identification of action plans to be implemented where appropriate;
- Session conclusion;
- Choice of theme for the next session.

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	6 hrs	0 hrs	0 hrs	0 hrs	0 hrs

Social challenges for the companies [MECA1_ESE]

LEAD PROFESSOR(S): Pascal COSSON / Stéphane GUYARD

Objectives

Broaden the vision of apprentices in their sector of activity and especially around the dimensions often hidden in this sector or who do not have time to be worked during their training.

Sub-objectives: acquire a scientific approach, learn to work in a team.

Course contents

Apprentices will work in teams of 3 or 4, on a theme during years A1 and A2.

Year A1: Bibliographic and theoretical research
Apprentices provide a state-of-the-art in their subject matter by conducting theoretical research from relevant and reliable sources (scientific articles, school books, research organizations, experts).

Organization:
Session 1 - "launch": presentation of the system, choice (individual) of the research topic, setting up of work teams, drawing up of an action plan (see documentation techniques), start of work during the session.

session 2 - in autonomy: a time to advance in research, sharing of information.

Session 3 - "Framed Progress Point": monitoring the progress of each project, individual advice on methodology, continuation of work.

sessions 4 & 5 - "intermediate restitution": restitution before the Promotion of the results of the documentary research, qualitative evaluation by the facilitator.

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	20 hrs	0 hrs	0 hrs	0 hrs	0 hrs

International experience [MECA1_PSI]

LEAD PROFESSOR(S): Alan BALL / Pascal COSSON

Objectives

Objectives:

Internship abroad:

Allow apprentices, through the organization of their internship abroad, to organize an international project.

To give future engineers an international vision of work, professions and cultures.

Allow apprentices to experience a break with their usual environment.

Make them improve their practical skills of a foreign language.

Course contents

Familiarize yourself with the stages of the project. Identify your resources and constraints. Define an internship project. Establish an action plan.

Prepare the prospect of an internship (find contacts, communication, manage a network). Help in the preparation of the digital CV. Familiarize yourself with the ITII PDL network. Learn to talk about your journey: workshop on reflexivity.

Familiarize yourself with the notion of corporate culture. Identify your relationship to work. Understand the origin and media coverage of cultural stereotypes in order to get rid of them. Understand the concept of "Culture Sliock" and how to manage it.

Familiarize yourself with how the host company evaluates the project. Introduction to job evaluation and understanding how to build an evaluation grid. Familiarize yourself with the financial and logistical aspects of the ISP.

Familiarize yourself with the methods of academic evaluation of the PSI: the internship report. Workshop: know how to make a report and an investigation in the form of a video.

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	20 hrs	0 hrs	0 hrs	0 hrs	0 hrs

Industrial Engineering [MECA1_GI]

LEAD PROFESSOR(S): Catherine DA CUNHA

Objectives

- Know how to solve a problem
- Understand the role of the customer in the company
- Be able to use production management tools
- Understand economic indicators

Course contents

General intro
operational management
- Problem solving tools
- Conventional maintenance
- Managerial communication

Customer
- The external and internal customer
- Demand management

Transversal - Flow
- Process approach
- Production management

Economy
- Microeconomics
- Indicators and dashboard

Course material

Assessment

Individual assessment: EVI 1 (coefficient 0.25)
EVI 2 (coefficient 0.25)
EVI 3 (coefficient 0.25)
EVI 4 (coefficient 0.25)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	66 hrs	26 hrs	8 hrs	0 hrs	0 hrs

Mathematics [MECA1_MATHS]

LEAD PROFESSOR(S): Jean-Sebastien LE BRIZAUT

Objectives

Develop the basic notions in analysis and linear algebra in order to acquire a method of reasoning and calculation techniques allowing to approach the teaching of the terminal cycle

Course contents

Analysis (Polynomials, Complex theory, Fractions, numerical sequences, series)
Integration and Differential Equations
Linear Algebra : Matric calculus

Course material

Assessment

Individual assessment: EVI 1 (coefficient 1)
EVI 2 (coefficient 1)
EVI 3 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	48 hrs	18 hrs	0 hrs	0 hrs	6 hrs

Materials [MECA1_MATER]

LEAD PROFESSOR(S): Bertrand HUNEAU / Christian BURTIN

Objectives

Provide basic concepts and knowledge related to materials science. For this the structure and properties of materials in the broad sense are discussed.

Course contents

1) Courses:
- Course 1: atomic cohesion, elasticity, material family, atomic architecture and defects

- Cours2: macroscopic and microscopic plasticity in metals; hardening by: work hardening, grain size, solid solution and precipitation

- Course 3: phase diagrams, with total solubility (Cu-Ni) or partial solubilities (Pb-Sn), Fe-C diagram (steel and cast iron)

- Course 4: Fracture and toughness of ceramic and metallic materials. Application to fatigue of metallic materials

- Course 5: Influence of time on materials. Application to viscoelastic polymers

- Course 6: Influence of guidance on materials: Application to anisotropic composite materials;

2) Practical work

The practical work takes the form of projects proposed and supervised by the teaching team. There are two working sessions and one oral restitution session.

3) Knowledge Check:

2 written assignments + 1 project evaluation

Course material

JP Baïlon et JM Dorlot: Des Matériaux, PIP, troisième édition.

Assessment

Individual assessment: EVI 1 (coefficient 1)
EVI 2 (coefficient 1)
EVI 3 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	28 hrs	0 hrs	12 hrs	0 hrs	0 hrs

Rigid Multibody Dynamics [MECA1_DSOLI]

LEAD PROFESSOR(S): Pascal COSSON

Objectives

In everyday life, there are many systems (assembly of elements operating as a unit and in permanent interaction) which evolve over time: in mechanics we can cite for example robots, mechanisms, physical crash-dummies, vehicles etc. When designing such systems, the engineer is often called upon to answer one or more of these questions:

- given driving forces, what are the movements of the different elements?
- what are the driving forces to be applied to achieve the desired movements?
- what are the internal forces within the system, in order to size the connecting elements?

Objectives
The purpose of this course is to obtain the equations governing the motion of different parts of a given system, when the problem is simplified by assuming that the system consists of non-deformable solids. Two methods are presented.

A first approach to obtaining these equations of motion is to apply the Fundamental Principle of Dynamics which stipulates that in a Galilean frame of reference, for a set of non-deformable solids, the quantities of acceleration are equal to the external forces exerted on these solids. For any given system, this principle allows us to write two vector equations, one concerning the resultant of the acceleration quantities, the other the moment of these acceleration quantities.

The second approach presented corresponds to d'Alembert's Principle (also known as the Lagrange-d'Alembert principle), which leads to the writing of Lagrange equations for a system dependent on a finite number of parameters. For a set of non-deformable solids, these Lagrange equations are obtained by writing that in a Galilean frame of reference, the work of the acceleration quantities is equal to the work of the internal and external forces exerted on this system, whatever the virtual displacement considered.

Course contents

1) Review of the mathematics
2) Kinematics
3) Kinetics
4) Force Modelling
5) Fundamental Principle of Dynamics
6) Principle of Virtual Work - d'Alembert's Principle, Lagrange equations

Course material

BOUZIDI Rabah, LE VAN Anh, THOMAS Jean-Christophe: Mécanique des Solides Indéformables, Collection Science et Ingénierie des matériaux, ed LAVOISIER, 2014

P. COSSON. Dynamique des Solides Indéformables -Centrale Nantes course. 2009

Assessment

Individual assessment: EVI 1 (coefficient 1)
EVI 2 (coefficient 1)
EVI 3 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	24 hrs	36 hrs	8 hrs	0 hrs	4 hrs

Mechanical Design and Manufacturing [MECA1_COFAB]

LEAD PROFESSOR(S): Damien CHABLAT

Objectives

1. Design and D.A.O.

Evaluation and homogenisation of levels. Presentation of designer analysis tools - sizing and verification calculations in mechanical design - methods for synthesis of solutions.
Introduction of the project to be carried out in TP.

2. Industrial Manufacturing Methods and F.A.O.

Homogenisation of knowledge in mechanical manufacturing by providing theoretical and practical knowledge associated with machining methods and programming of CNC Machine Tools.

Course contents

Training Program:

1. Design and D.A.O. - Damien CHABLAT 16 + 8 hours

The user and the functions of uses, technological solutions.

Mechanism: kinematics and motion transformations, power, its path, performance, mechanism safety and critical points.

Schematization: minimum kinematic diagram, sketches and design.

Representation and its formalisms, notions of tolerances,

Digital Layout Tools: CATIA and/or SolidWorks + TracePart,

Nomenclature: management reference element, designations, definition and use of materials.

All these concepts are applied and developed in the context of a project that breaks down into a study phase and a representation and optimization phase in a CAD environment (CATIA or SolidWorks). The project is the support to highlight the major design principles. Personalized support is given to students according to the difficulties encountered.
Two types of project are proposed according to the level and origins of the students. Each project group will present the work done in front of all the students as part of a defense.

2. Industrial manufacturing methods and F.A.O. - Patrick BARON 16 + 8 hours

Process of industrialization of a product, integration of the means of design and production,

Manufacturing Project Development Methodology:

analysis of the definition drawing (quotation, material...),

development of the manufacturing range:

selection of capable processes and process definition,

choice of means of control (capability of measuring means).

Optimization of the implementation of a CNC machine:

editing of machine programs (generation, simulation, transfer),

preparation of tools:

Assembly and dimensional characterization of mounting and cutting tools.

Stabilization of the production process.

Practical Work

Realization of a project by the implementation of the digital chain in Design-Manufacturing-Measurement using the software "TopSOLID, TopCAM": from the model to the real, from the digital definition to the "chip".

Study a mechanism and prepare the manufacturing file.

In a FAO environment, generate tool paths.

Transfer programs and implement CNC machines.

Control the process using traditional measuring instruments and three-dimensional metrology.

Propose corrective actions (setting...)

Knowledge Check:

2 practical work.

Course material

Assessment

Individual assessment: EVI 1 (coefficient 0.5)
EVI 2 (coefficient 0.5)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	8 hrs	0 hrs	40 hrs	0 hrs	0 hrs

Electricity [MECA1_ELEC]

LEAD PROFESSOR(S): Christophe BATARD / Pascal COSSON

Objectives

Objectives:

Control of single- and three-phase sinusoidal regimes.

To provide the basis for the study of periodic nonsinusoidal regimes.
Prerequisites:

Handout: Electrical Signals. Definition - Characterization - Measurement

Topological definitions and conventions.

Types of signals.

Permanent regime/ Periodic regime/ Transitional regime.

Average values.

Energy - Power.

Effective value.

Apparent Power - Power factor.

Other definitions.

Measurement of different sizes.

Course contents

Training Program:

Chapter 1. Single Phase Sinusoidal Signals

Periodic signals: reminder.

Sinusoidal signals, sir.

Use of vector geometry.

Complex impedances.

Association of complex impedances.

Powers in Sinusoidal Regime.

Chapter 2. Three-phase Sinusoidal Systems

Study of balanced three-phase voltages.

Résaux Triphasés.

Coupling of the receivers.

Coupling a receiver to the network.

Powers involved in a three-phase receiver.

Power measurement using wattmeters.

Chapter 3: Periodic Non Sinusoidal Signals - Spectral Analyses - Harmonics

Introduction, reminder.

Non sinusoidal quantities in steady state.

Effects of the harmonics.

Interharmonics.

Knowledge Check:

TP - 6 hours (4h + 2h) (coefficient 0.1 and 0.1)

DS1 - 2 hours (coefficient 0.4)

DS2 - 2 hours (coefficient 0.4)

Course material

Assessment

Individual assessment: EVI 1 (coefficient 0.4)
EVI 2 (coefficient 0.4)
EVI 3 (coefficient 0.2)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	16 hrs	28 hrs	12 hrs	0 hrs	4 hrs

Algorithmics [MECA1_ALGO]

LEAD PROFESSOR(S): Raphaël CHENOUARD

Objectives

Understand a problem and describe an algorithm to solve it.
Implement an algorithm using a programming language.

Course contents

- Introduction to algorithmic
- Notion of complexity
- Visual Basic for Application (Excel)

Course material

Assessment

Individual assessment: EVI 1 (coefficient 0.67)
EVI 2 (coefficient 0.33)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	-	14 hrs	14 hrs	12 hrs	0 hrs	0 hrs