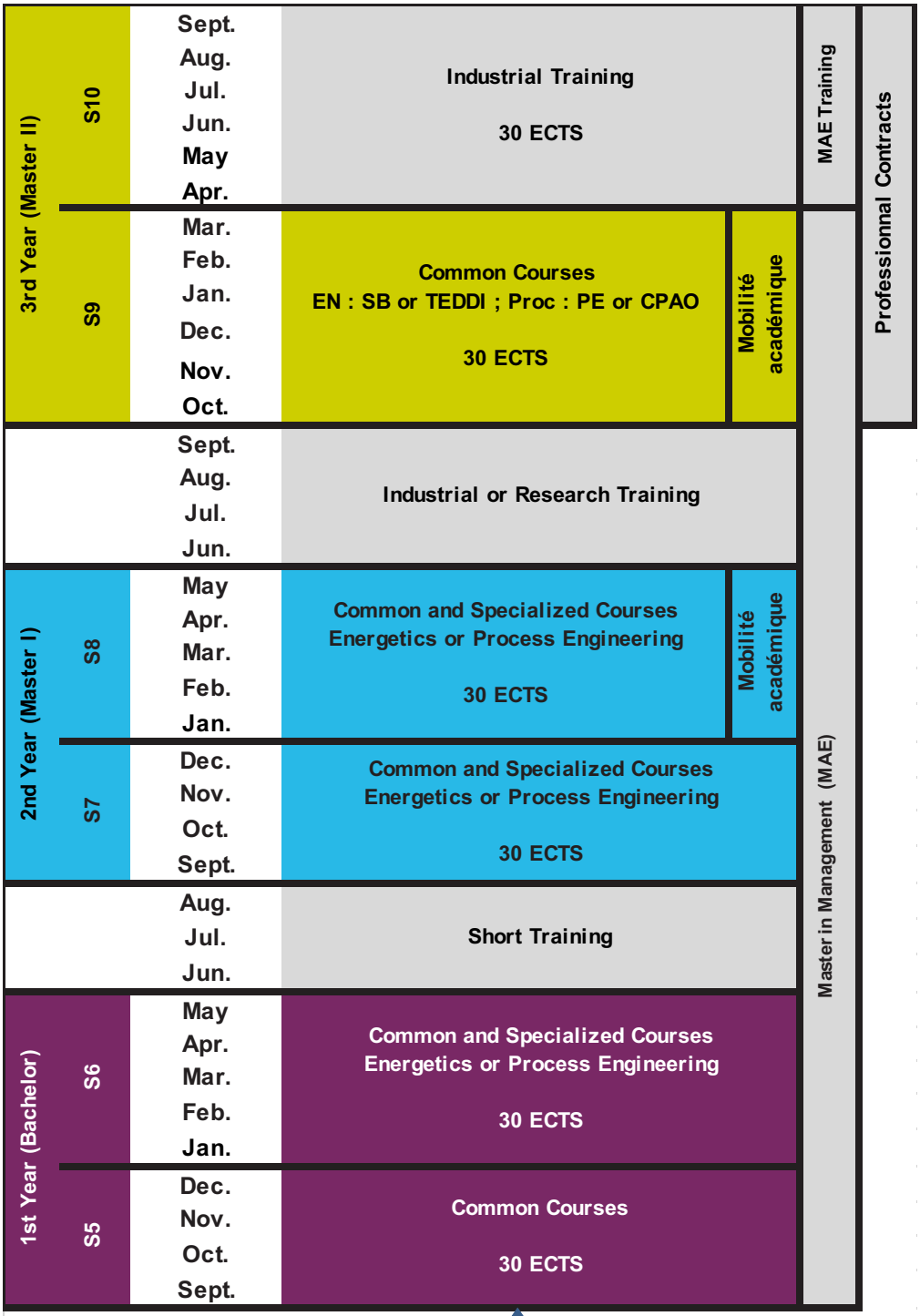
Ecole Nationale Supérieure en Génie
des Technologies Industrielles

# COURSE CATALOGUE

## First Year (L3, Sem. 5 and 6)

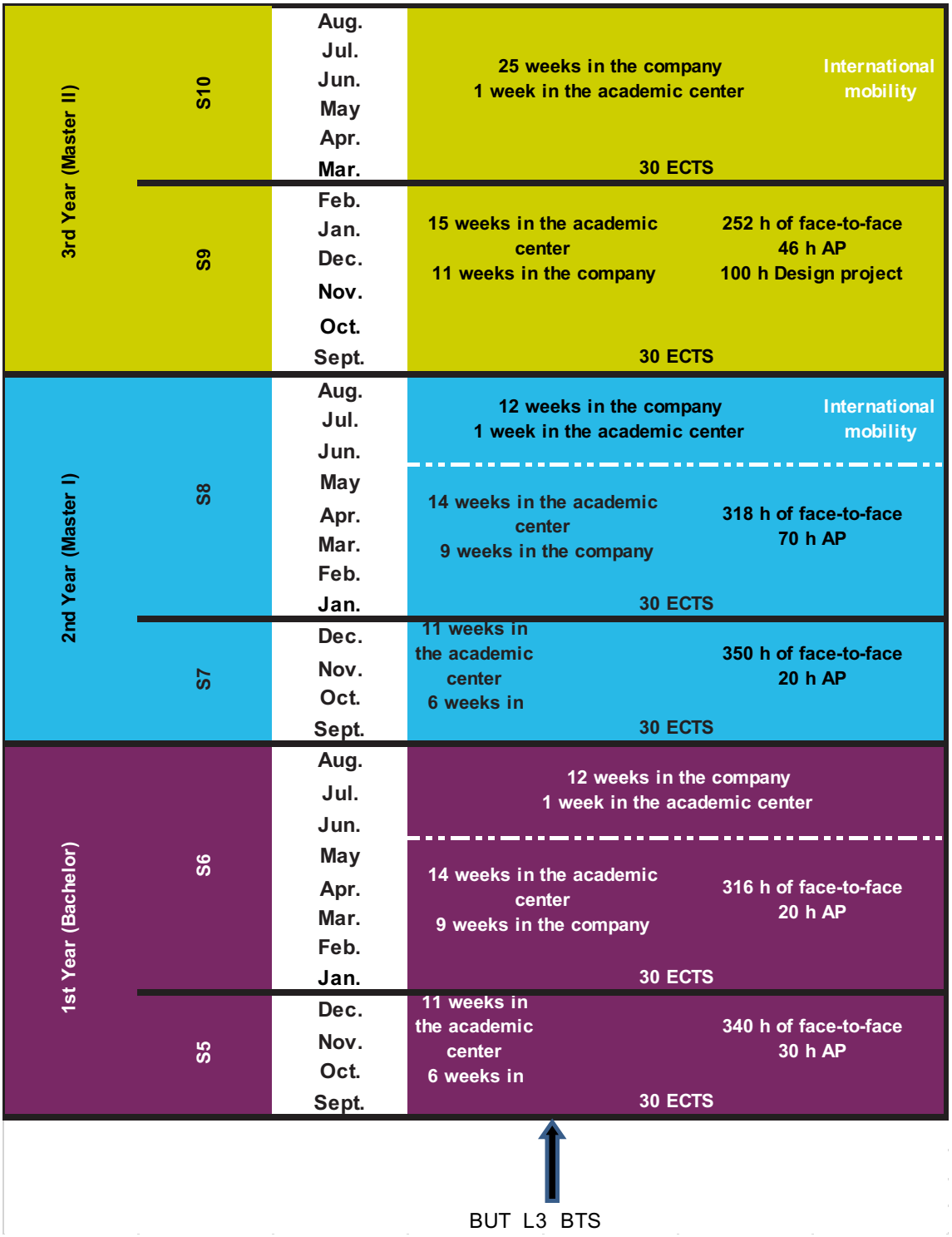
**2023 - 2024**

# GENERAL CHRONOLOGY
## Speciality Energetics and Process Engineering




Course Catalogue

# GENERAL CHRONOLOGY
## Speciality Electrical Engineering and Computer Science



## NOMENCLATURE

**UE** : Teaching unit
**EC** : Constituent Element

**CM** : Lectures
**TD** : Tutorials
**TP** : Practical work
**Proj.** : Project
**TA :** Autonomous work

**TC** : Common Course

**EN** : Speciality « Energy »
**GP** : Speciality « Process Engineering »
**GEII** : Speciality « Electrical Engineering and Computer Science»

**EN SB** : Speciality « Energy » - Pathways (3A) « Smart Building »
**EN TEDDI** : Speciality « Energy » - Pathways (3A) « Transition Énergétique et Développement Durable dans l'Industrie »

**GP PE** : Speciality « Process Engineering » – Pathways (3A) « Procédés pour l'Environnement »
**GP CPAO** : Speciality « Process Engineering » – Pathways (3A) « Conception des Procédés assistée par Ordinateur »

**GEII HT** : Speciality « Electrical Engineering and Computer Science» – Pathways (3A) « Haute Tension »

## NOMENCLATURE FOR ASSESSMENT PROCEDURES

Nature_1 (Modality_1) x Weighting_factor_1 + Nature_2 (Modality_2) x Weighting_factor_2 + …

### Assessment nature

CC: Continuous Assessment

Proj: Project

Sta: Work placement

TP: Practical Examination

CoE: Reading Comprehension (languages)

CoO: Listening Comprehension (languages)

ExE: Writing (languages)

ExO: Speaking (languages)

IntO: Oral Interaction (languages)

Cert: Certificate of competency in languages

EvaC: Skills assessment

## Assessment modalities

EE: Written examination (by default, if no information provided)

EO: Oral examination

EM: Engine examination

ES: Surprise written examination

PA: Active participation

Sout: Oral defense

Rap: Written report

Prog: Computer program

Tr: Work (within the framework of a work placement, a project or practical work)

D: File

CR: Report (within the framework of practical work)

LA: Reading articles

sd: no document is allowed (by default, if no information provided)

da: documents are allowed (da: further details on the authorized documents)

st: no smart object is allowed (mobile phones, smartwatches...) (by default, if no information provided)

ta: smart objects are allowed

sc: no calculator is allowed (by default, if no information provided) ca: calculators are allowed

**Operators**

x/y: x or y

max(x, y): Maximum in several assessments

moyenne(x): Average of several assessments of the same kind and coefficient

**Examples**

**CC (EE, 2h)**

A 2-hour written examination, no document allowed, no calculator allowed.

**CC (EM, 2h, da:tutoriels) x 1/2 + CC (EE, 2h) x 1/2**

A 2-hour engine examination, tutorials are allowed, coefficient 1/2 and a 2-hour written examination, no document allowed, no calculator allowed, coefficient 1/2

**CC (ES, 15mn) x 1/10 + CC (EE, 2h, da:tous, ca) x 9/10**

A 15-minute surprise examination, no document allowed, no calculator allowed, coefficient 1/10 and a 2-hour written examination, all documents allowed, calculator allowed, coefficient 9/10.

**TP(EO, 10mn) x 1/4 + TP(EO, 10mn) x 1/4 + TP(CR) x 1/2**

Practical work assessed by two oral examinations, each with a coefficient 1/4, and a practical work report, coefficient 1/2.

**Proj (PA, Rap, Sout)**

Project assessed by the active participation, a written report and an oral defense.

**Sta (Tr, Rap, Sout**

Work placement assessed by work, a written report and an oral defense.

**CoE(PA) x 1/4 + CoO(PA) x 1/4 + ExE(EE, 1h) x 1/4 + Cert(TOEIC) x 1/4**

Example for a foreign language: Reading comprehension assessed by the active participation, Listening comprehension assessed by the active participation, Writing assessed by a 1-hour written examination, no document allowed, Test of English (TOEIC). Same weighted grades for each assessment.

# Semestre 5

LIST OF TEACHING UNITS (UE) OF THE SEMESTER

| TC, Spe ou Path-ways | Code UE | Entitled UE | ECTS |
|---|---|---|---|
| TC | EC5LC | Languages - Engineering Culture S5 | 4 |
| GP-EN | EC5MI | Mathematics - Computer Sciences S5 | 6 |
| GP-EN | EC5TB | Thermodynamics – Balances S5 | 10 |
| GP-EN | EC5TM | Transport Phenomena – Mechanics S5 | 10 |
| GEII | EG5AP | Apprenticeship S5 | 5 |
| GEII | EG5MI | Mathematics - Computer Sciences S5 | 6 |
| GEII | EG5EL | Electronics S5 | 6 |
| GEII | EG5CE | Electronic components S5 | 5 |
| GEII | EG5SC | Signals and Circuits S5 | 4 |

# Tronc Commun

| 1st Year - Semester 5 - Commun Course | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UE Name | Code | | EC Name | Hours (h) | | | | | | | | ECTS / Coef. | |
| | UE | EC | | Tot UE | Tot EC | Tot Prés. | *CM* | *TD* | *TP* | *TA* | *Proj.* | ECTS UE | Coef. EC |
| **Languages - Engineering Culture S5** | **EC5LC** | EC5LC1 | English | **112** | 52 | **26** | *0* | *26* | ***0*** | 26 | **0** | **4** | 0.46 |
| | | EC5LC2 | Financial Management I | | 60 | **30** | *20* | *10* | ***0*** | 30 | **0** | | 0.54 |
| **Total TC** | | | | **112** | | **56** | 20 | 36 | 0 | 56 | 0 | **4** | |

TEACHING UNIT (UE) :

Languages - Engineering Culture S5

ECTS : 4

Code UE : EC5LC

SKILLS COVERED BY THE UE :

- Preparing students for the Test of English for International Communication (TOEIC)
- Understanding the basic principles of accounting

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

| CODE EC | INTILTLED EC | COEF | EVALUATION |
|---|---|---|---|
| EC5LC1 | English | 0.46 | IntO(PA)x1/8 + Cert(TOEIC)x3/8+ EvaC(EE, 1h)x2/8 + CoO/CoE/ExE(EE, 1h30)x2/8 |
| EC5LC2 | Financial Management I | 0.54 | CC(EE, 2h) |

| | | | |
|---|---|---|---|
| EC : English | | EC5LC1 | coeff : 0.46 |
| Teacher In Charge : Grenier A-C. | | | |
| CM : 0 h | TD : 26 h | TP : 0 h | Proj : 0 h |
| | | | Language Anglais |

**OVERVIEW**

The focus of this class is to strengthen the students' methodology and skills in English to successfully pass the official TOEIC (Listening and Reading) Test of English for International Communication.
The TOEIC is correlated to the Common European Framework of Reference for Languages (CEFR).

**TARGET SKILLS**

The student improves the technical skills and methodology required for the TOEIC test along with the acquisition of the specific vocabulary in order to pass the TOEIC with the highest score.
The student can communicate in everyday workplace situations in a professional environment.

**DESCRIPTION**

The course is based on Business English and covers vocabulary and grammar useful for the business environment.
Reading, listening and speaking skills are improved through the study of authentic documents.
Specific intensive training for the TOEIC test as well as mock exams.

**BIBLIOGRAPHY**

Pearson: Tests complets pour le TOEIC, 6ème edition, 2018 Hachette: La BIBLE officielle du test TOEIC, 2018
Longman : Preparation series for the new TOEIC test, Advanced Course, 2007

**REQUIREMENTS**

Level intermediate to advanced (A1 to C2)

**ASSESSMENT**

IntO(PA)x1/8 + Cert(TOEIC)x3/8+ EvaC(EE, 1h)x2/8 + CoO/CoE/ExE(EE, 1h30)x2/8

| | | | |
|---|---|---|---|
| EC : Financial Management I | | EC5LC2 | coeff : 0.54 |
| Teacher In Charge : Toua J. | | | |
| CM : 20 h | TD : 10 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

The aim of the course is to introduce accounting documents for your future business and the language and notions you will have to understand such as: depreciations, budgetary accounting, income statements, balance sheets,...
The course is based on the understanding of notions and concepts you will both have to master and put into practice. It revolves around a classical working business on the French territory with operations like understanding of general accepted accounting principles.

**LEARNING OUTCOMES**

Giving the students the opportunity to understand the situation and decisions of a company taking its economical, political and legal environment into account.
Apprehend the great rules of financial management :

- master basic accounting principles
- register accounting operations
- be able to formulate and analyze the main synthesis documents

**DESCRIPTION**

Chapter 1 : Accounting principles
Chapter 2 : Accounting documents
Chapter 3 : Accounting methods and organisation
Chapter 4 : Value added tax
Chapter 5 : Purchases and sales operations
Chapter 6 : Payments and receipts : the treasury
Chapter 7 : Fixed asset management
Chapter 8 : Inventory

**RECOMMENDED READING**

” La comptabilité générale 2014-2015 ”, F. Grandguillot et B. Grandguillot, Gualino, 2014
” Techniques comptables : DUT GEA 1ère et 2ème année ”, P. Arnaudo et L. Cassio, Nathan, 2010

Exercices d'ouvrages généralistes de BTS CGO (éditions Nathan ou Foucher Plein Pot), de DUT GEA, de DCG chez DUNOD ou de Licence universitaire

**PREREQUISITE**

**ASSESSMENT**

CC(EE, 2h)

# Tronc Commun GP et EN

| 1st Year - Semester 5 - Commun Course EN GP | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UE Name | Code UE | Code EC | EC Name | Hours (h) Tot UE | Tot EC | Tot Prés. | CM | TD | TP | TA | Proj. | ECTS / Coef. ECTS UE | Coef. EC |
| Mathematics - Computer Sciences S5 | EC5MI | EC5MI1 | Mathematics | 166 | 72 | 42 | 6 | 36 | 0 | 30 | 0 | 6 | 0.47 |
| | | EC5MI2 | Programming (FORTRAN) | | 94 | 32 | 12 | 0 | 20 | 62 | 30 | | 0.53 |
| Thermodynamics – Balances S5 | EC5TB | EC5TB1 | Introduction to Chemical Engineering | 270 | 32 | 16 | 10 | 6 | 0 | 16 | 0 | 10 | 0.12 |
| | | EC5TB2 | General Thermodynamics | | 72 | 36 | 16 | 20 | 0 | 36 | 0 | | 0.27 |
| | | EC5TB3 | Chemical Thermodynamics | | 60 | 30 | 16 | 14 | 0 | 30 | 0 | | 0.22 |
| | | EC5TB4 | Heat and Mass Balances | | 36 | 18 | 6 | 12 | 0 | 18 | 0 | | 0.13 |
| | | EC5TB5 | Thermo/Balance Practicals | | 70 | 35 | 0 | 0 | 35 | 35 | 0 | | 0.26 |
| Transport Phenomena – Mechanics S5 | EC5TM | EC5TM1 | Introduction to Transport Phenomena | 280 | 20 | 10 | 6 | 4 | 0 | 10 | 0 | 10 | 0.07 |
| | | EC5TM2 | Heat Conduction I and Diffusion | | 60 | 30 | 14 | 16 | 0 | 30 | 0 | | 0.22 |
| | | EC5TM3 | Heat Transfer by Radiation | | 40 | 20 | 6 | 14 | 0 | 20 | 0 | | 0.15 |
| | | EC5TM4 | Continuum Mechanics | | 80 | 36 | 18 | 18 | 0 | 44 | 0 | | 0.27 |
| | | EC5TM5 | Transfer Practicals | | 80 | 40 | 0 | 0 | 40 | 40 | 0 | | 0.29 |
| Total TC | | | | 716 | | 345 | 110 | 140 | 95 | 371 | 30 | 26 | |
| Tot TC + Spe (EN et GP) | | | | 828 | | 401 | | | | | | 30 | |

TEACHING UNIT (UE) :

Mathematics - Computer Sciences S5

ECTS : 6

Code UE : EC5MI

SKILLS COVERED BY THE UE :

- Demonstrate proficiency in the use of mathematical methods of engineering practice
- Demonstrate proficiency in the use of a structured programming language (FORTRAN)

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

| CODE EC | INTILTLED EC | COEF | EVALUATION |
|---|---|---|---|
| EC5MI1 | Mathematics | 0.47 | CC(EE, 2h, sd, sc) |
| EC5MI2 | Programming (FORTRAN) | 0.53 | Proj(Tr, Rap, Sout) |

| | | | |
|---|---|---|---|
| EC : Mathematics | | EC5MI1 | coeff : 0.47 |
| Teacher In Charge : Laurent S., Couture F. | | | |
| CM : 6 h | TD : 36 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

This module presents the essential mathematical tools to treat the majority of fundamental physical phenomena.

**LEARNING OUTCOMES**

- master matrix calculation,
- be able to solve analytically linear systems,
- be able to evaluate simple, double, triple, curve and surface integrals,
- be able to handle gradient, divergence and rotational,
- be able to solve analytically differential equations,
- be able to integrate, derivate spatial tensor fields,
- be able to read and understand on a mathematical point of view heat and mass transport equations.

**DESCRIPTION**

Part I. Matrix calculation

Matrix – Determinants – Resolution of linear systems – Matrix reduction.

Part II. Functions of several variables

Definition – Differential calculation.

Part III. Integrals calculation

Simple integrals – Double integrals – Triple integrals.

Part IV. Vector analysis
Differential operators – Curve and surface integrals – Transformation formula.

Part V. Differential equations
1st order differential equations – 2nd order linear differential equations.

Part VI. Laplace transformation
Generalised integrals – Laplace transformation of current functions – Convolution product – Dirac function.

Part VII. Algebra and tensor analysis
Algebra: definition of tensors and associated operations (tensor product and contracted product) in orthonormal Cartesian reference frame.
Analysis: Integration and derivation of tensor fields (vector, second and third order tensor), gradient, divergence, vector product, ...

**RECOMMENDED READING**
Mathématiques d'usage courant pour scientifiques et ingénieurs, Belorizky E., cahiers 128, Nathan

**PREREQUISITE**

**ASSESSMENT**
CC(EE, 2h, sd, sc)

| | | | |
|---|---|---|---|
| EC : Programming (FORTRAN) | | EC5MI2 | coeff : 0.53 |
| Teacher In Charge : Serra S. | | | |
| CM : 12 h | TD : 0 h | TP : 20 h | Proj : 30 h |
| | | | Language Français |

**OVERVIEW**

Basic knowledge on computers and programming are developped. Key concepts needed to write a code dedicated to scientific computing are given.

**LEARNING OUTCOMES**

- Masterize the basic concepts (OS commands, compilation, execution, files manipulation. . . )
- Conceive the architecture of a program
- Code a sequential program in Fortran

**DESCRIPTION** 1 Foreword
2 Data types
3 Operators
4 Intrinsic functions
5 Algorithms
6 Arrays
7 Sub-programs
8 Inputs – Outputs
9 Supplementary options
10 Useful information

**BIBLIOGRAPHY**

Numerical recipes in Fortran 77 : the art of scientific computing, W.H. Press et al, Cambridge University Press (1992)
Fortran 95 Handbook, A. Brainerd et al., MIT Press (1997)
Information technology – Programming Languages – Fortran – Part 1 : Base language, International Standard, ISO/IEC 1539-1 (1997)
Programmer en Fortran 90 – Guide Complet, C. Delannoy, Edition Eyrolles (2000) Manuel Complet du Langage Fortran 90 et 95, P. Lignelet, Masson (1996)
Cours Fortran 95, P. Corde et H. Delouis, IDRIS (2008)

Les apports de Fortran 2003, P. Corde et H. Delouis, IDRIS (2008)

**PREREQUISITE**

**ASSESSMENT**

Proj(Tr, Rap, Sout)

TEACHING UNIT (UE) :

Thermodynamics – Balances S5

ECTS : 10

Code UE : EC5TB

SKILLS COVERED BY THE UE :

- Demonstrate the ability to measure enthalpy, entropy and chemical potential of pure substances and mixtures
- Demonstrate the ability to formulate and to use the first and the second law of thermodynamics with or without any chemical reaction
- Demonstrate the ability to write and to solve dynamic steady-state mass and energy balances, on units (macroscopic balance) or processes (process dynamics)
- Demonstrate the ability to implement mass and energy balances notions in pilot plants while integrating an experimental perspective: measurement uncertainty, orders of magnitude...
- Demonstrate the ability to present results in a clear and relevant way

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

| CODE EC | INTILTLED EC | COEF | EVALUATION |
|---|---|---|---|
| EC5TB1 | Introduction to Chemical Engineering | 0.12 | CC(EE, 1h, sd, st) |
| EC5TB2 | General Thermodynamics | 0.27 | CC(EE, 2h,ca) |
| EC5TB3 | Chemical Thermodynamics | 0.22 | CC(EE, 2h, sd, ca) |
| EC5TB4 | Heat and Mass Balances | 0.13 | CC(EE, 2h, ca) |
| EC5TB5 | Thermo/Balance Practicals | 0.26 | moyenne(TP(CR))x1/2 + moyenne(TP(Tr, PA))x1/2 |

| | | | |
|---|---|---|---|
| EC : Introduction to Chemical Engineering | | EC5TB1 | coeff : 0.12 |
| Teacher In Charge : Ducousso M. | | | |
| CM : 10 h | TD : 6 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

This course introduces the principles of chemical engineering. The concept of unit operation is illustrated by the presentation of several processes involving different classical unit operations. The principles of mass and energy balance are also given.

**LEARNING OUTCOMES**

The course does not aim to provide a specific knowledge but rather to indicate why and how the different courses will contribute during the next three years to provide the background for a chemical engineer. An overview of the common field between chemical engineering and energetic engineering is also given.

**DESCRIPTION**

•Definition and objectives of chemical/process engineering
•Example 1: oil/water emulsion, illustrated with the production of a mayonnaise, discussing the change in scale
•Example 2: chemical reaction in a reactor (chemical kinetics and thermal features)
•Notion of unit operation: mixing, reaction, separation
•Notion of time of residence
•Example 3: a process of thermodynamics separation - distillation
•Example 4: interfacial transfers illustrated by a process of gas cleaning, discussing the effect of specific area and the mass balance
•Power and energy: units and orders of magnitude
•Example 5: the production of wine
•An overview of mechanical separation processes
•A discussion of balance sheets applied to different quantities : mass, momentum, energies, finance.

**PREREQUISITE**

Génie des procédés, ouvrage coordonné par A. Storck et G. Grevillot, Collection Tech & Doc, Lavoisier, 1993

**PRÉREQUIS**

**ASSESSMENT**

CC(EE, 1h, sd, st)

| | | | |
|---|---|---|---|
| EC : General Thermodynamics | | EC5TB2 | coeff : 0.27 |
| Teacher In Charge : Serin J-P. | | | |
| CM : 16 h | TD : 20 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

This course views and reviews the fundamental notions of thermodynamics necessary for the engineer.

**LEARNING OUTCOMES**

After the course students should:

- have some knowledge of the functions of thermodynamics
- apply the thermodynamics laws for balances of energy and entropy
- have some knowledge of the chemical or phase equilibrium laws
- have some knowledge of the phase transformations of pure substances

**DESCRIPTION**

To recall the main definitions in thermodynamics
Description of a thermodynamic system. Characteristics and variables of states First and second laws of thermodynamics for multiphase systems
Differentials of the functions of states
General laws for the thermodynamical properties of solutions Applications of Perfect gases
Thermodynamic paths and residuals functions Phase transformations of pure substances

**BIBLIOGRAPHY**

**PREREQUISITE**

**ASSESSMENT**

CC(EE, 2h,ca)

| | | | |
|---|---|---|---|
| EC : Chemical Thermodynamics | | EC5TB3 | coeff : 0.22 |
| Teacher In Charge : Laurent S. | | | |
| CM : 16 h | TD : 14 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

The role of chemical thermodynamics is to predict if a chemical system can evolve spontaneously and how it will evolve from the calculation of two fundamental state functions: energy and entropy.

**LEARNING OUTCOMES**

- be able to evaluate the enthalpy, the entropy and the chemical potential of components of ideal or real chemical systems,
- be able to calculate standard and real reaction properties (energy, entropy, Gibbs energy, . . . ) in function of temperature, pressure and composition of the system,
- be able to evaluate energy and entropy changes in close systems where a chemical reaction takes place using 1st and 2nd principles of thermodynamics,
- be able to predict the evolution of a chemical reaction and to determine the final state of the system when the equilibrium is reached.

**DESCRIPTION**

Part I. Introduction

State variables and functions – Chemical transformation – Reaction properties

Part II. First principle of thermodynamics

Internal energy and enthalpy – Thermochemistry

Part III. Second and third principles

Entropy – 2e principle – 3e principle – Change of entropy during a chemical reaction.

Part IV. Free enthalpy and chemical potential

Free energy – Free enthalpy – Change of free enthalpy in closed systems without chemical reaction– Chemical potential.

Part V. Chemical equilibrium

Chemical reaction progress – Variance – Displacement of a chemical equilibrium state.

**BIBLIOGRAPHY**

Thermodynamique chimique, Oturan M.A., Robert M., Collection Grenoble Sciences.

**PREREQUISITE**

EC15TB2 Thermodynamique générale

**ASSESSMENT**

CC(EE, 2h, sd, ca)

| | | | |
|---|---|---|---|
| EC : Heat and Mass Balances | | EC5TB4 | coeff : 0.13 |
| Teacher In Charge : Sochard S. | | | |
| CM : 6 h | TD : 12 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

This course gives some tools in order to determine mass and energy balances on different chemical units.

**LEARNING OUTCOMES**

After this course, students should:

- be able to write a total or partial mass balance
- be able to write a balance on each specie on every ideal reactor
- be able to write an energy balance
- be able to determine the molar enthalpy of a stream with the suitable reference
- understand flow sheets for units in the chemical and petroleum industry
- be able to make and control mass balances on these units.
- be able to make and control energy balances on these units.

**DESCRIPTION**

Part I : Mass Balance

1)Introduction

a)Definitions

b)The law of conservation of mass c)Process classification

2) How to set up Mass balances on continuous industrial units in steady state

a)Notation

b) Characteristic quantities of a production

c) Equations for a mesh without reaction, degree of freedom analysis

d)Equations for mixing and splitting points, degree of freedom analysis

e)Equations for a mesh with reaction

Extent of reaction method

Molecular or component balance method
Element or atomic balance method
Degree of freedom analysis
f)Method for solving material balance problems
g)Solving strategy
3) Example : production of methanol

Partie II : Energy Balances
1)Introduction
2) Thermodynamics
a)First law
b)Forms of energy
c)First law in open systems
d)Molar enthalpy calculations
e)Reference states
3) How to set up Energy balances on industrial units
4) Example of an energy balance without reaction : isothermal absorption
5) Example of an energy balance with reaction : production of sulphuric acid

**BIBLIOGRAPHY**

Chimie industrielle. Cours et problèmes résolus, Lefrançois B., Editions Lavoisier, Technique et documentation, 1995
Bilans matière et énergétique pour l'ingénierie chimique, Ghasem, henda, Editions De Boeck, 2012
Procédés de pétrochimie. Tome 1 Gaz de synthèse et ses dérivés (Le). Les grands intermédiaires hydrocarbonés, Chauvel A., Lefebvre G., Castex L., Editions TECHNIP, 1985
Procédés de pétrochimie. Tome 2 Grands intermédiaires oxygénés, chlorés et nitrés, Chauvel A., Lefebvre G., Castex L., Editions TECHNIP, 1986
Chimie industrielle (Tomes I et II), Perrin R., Scharff J.P., Editions Masson, 1993

**PREREQUISITE**

Introduction au génie des procédés
Thermodynamique Générale

**ASSESSMENT**

CC(EE, 2h, ca)

| | | | |
|---|---|---|---|
| EC : Thermo/Balance Practicals | | EC5TB5 | coeff : 0.26 |
| Teacher In Charge : Castéran F. | | | |
| CM : 0 h | TD : 0 h | TP : 35 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

In the practical ENSGTI laboratory, students have the opportunity to observe, by handling on lab-scale devices, the physical phenomena they have studied during the lectures. They check the corresponding physical laws including the heat and mass transfers quantification.
This practical work corresponds to the study of the various basic physical phenomena met in the process field.

**LEARNING OUTCOMES**

After this course the students should :

- Be familiar with the main physical phenomena encountered in thermodynamic;
- Be able to analyse a real experiment (measurement uncertainties, order of magnitude);
- Know how to present clearly scientific relevant results.

**DESCRIPTION**

- Data analysis
- Critical point determination
- Distillations
- Evaporation
- Tubular heat exchanger
- Cooling tower

(- Gas Phase Chromatography)

**BIBLIOGRAPHY**

**PRÉREQUIS**

**ASSESSMENT**

moyenne(TP(CR))x1/2 + moyenne(TP(Tr, PA))x1/2

TEACHING UNIT (UE) :

Transport Phenomena – Mechanics S5

ECTS : 10

Code UE : EC5TM

SKILLS COVERED BY THE UE :

- Understand the basic laws of transport phenomena (Fick's laws, Fourier's laws and Newton's laws) along with radiation
- Demonstrate the ability to formulate, on the microscopic scale, mass, energy and momentum balances and to know how to solve them, in simple cases
- Know the main dimensionless numbers
- Understand the basic knowledge in fluid mechanics on pilot plants while integrating an experimental perspective: measurement uncertainty, orders of magnitude...
- Demonstrate the ability to present results in a clear and relevant way

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

| CODE EC | INTILTLED EC | COEF | EVALUATION |
|---|---|---|---|
| EC5TM1 | Introduction to Transport Phenomena | 0.07 | CC(EE, 2h) |
| EC5TM2 | Heat Conduction I and Diffusion | 0.22 | CC(EE, 2h, sd, ca) |
| EC5TM3 | Heat Transfer by Radiation | 0.15 | CC(EE,2h, sd, ca) |
| EC5TM4 | Continuum Mechanics | 0.27 | CC(EE, 2h) |
| EC5TM5 | Transfer Practicals | 0.29 | moyenne(TP(CR))x1/2 + moyenne(TP(Tr, PA))x1/2 |

| | | | |
|---|---|---|---|
| EC : Introduction to Transport Phenomena | | EC5TM1 | coeff : 0.07 |
| Teacher In Charge : Marias F. | | | |
| CM : 6 h | TD : 4 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

Momentum, heat and mass transport phenomena can be found nearly everywhere in nature. During the designing of an industrial process plant, quantitative considerations play a major role. The experience that mass, energy and momentum cannot be lost provides the three conservation laws, on which the quantitative analysis of physical and chemical process totally relies and on which the process design of a plant is based. These conservation laws provide the background for process designs. However, they do not yield any information on how these quantities are transported inside a specific device. Thus it is also required to describe these phenomens in order to have complete knowledge in this field.

**LEARNING OUTCOMES**

After this course, students should:

- be able to write mass and energy balance on macroscopic and simple systems
- know the three laws for molecular transport
- know the expression of the main dimensionless number

**DESCRIPTION**

Part I: Conservation laws

The three conservations laws are derived in this first part. Their integral formulation is given for any system and examples of their application are given

Part II: Molecular transport

-Mass (Fick's first Law)
-Heat (Fourier's Law),
-Momentum (Newton's Law)

Part III: Dimensionless numbers

-Prandtl's number

-Scmidt's number
-Lewis' number

**BIBLIOGRAPHY**

Bird Stewart Lightfoot, Transport Phenomena 2nd Edition, Wiley, 2002 Beek & Muttzall, Transport Phenomena, Wiley, 1975

**PREREQUISITE**

General Mathematics
System of coordinates
Cartesian
Polar
Spherical

**ASSESSMENT**

CC(EE, 2h)

| | | | |
|---|---|---|---|
| EC : Heat Conduction I and Diffusion | | EC5TM2 | coeff : 0.22 |
| Teacher In Charge : Bernada P. | | | |
| CM : 14 h | TD : 16 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

The aim is to give the students the fundamental basis of heat transport by conduction and thermal science and the fundamental basis of mixing theory and diffusion.

**LEARNING OUTCOMES**

After this course, students should be able to:

- Write properly the heat conduction equation for several geometrical cases, Fourier's law and perfect contact conditions between two solids,
- Solve the heat conduction equation in solids, in simple steady state and transient cases,
- Calculate the heat flux transferred from a solid to a fluid or another solid.
- Write properly the diffusion equation for several geometrical cases, and mass transfer boundary conditions between two multicomponent continua,
- Solve the diffusion equation, in simple steady state and transient cases,
- Use Fick's law in order to calculate the diffusive flux in a binary fluid.

**DESCRIPTION**

I Heat transport in non deformable bodies

•Definition of the contact heat flux, Fourier's law, thermal conductivity

•Conservation of energy equation, transient and steady conduction,

•Implications of the Clausius-Duhem inequality

II Heat transfer by contact between two solid bodies

•Study of the contact conditions between two solids

III Energy balances on macroscopic systems

•Detailed method to obtain rigorous macroscopic balance equations, by integration of microscopic conservation equations over specified bodies,

•Comparison with more simple and intuitive methods

IV. Fundamental concepts and general equations of conduction

•General information, definitions
•Equations of heat for an homogeneous and isotropic medium
•Boundary conditions space-time
•Steady state. Thermal resistances. Fins.
•Non steady state. Biot criterion.

V Basis of diffusion transport
•Definition of the diffusive flux, Fick's law, diffusive coefficient

VI Generalities on mixing theory in continua
•The body species concept
•Conservation equation of mass, momentum and energy for one component
•Conservation equation of mass, momentum and energy for the mixture
•Simplification of the model: the link with Fick's law, equation of diffusion

VII Mass transfer between two multicomponent continua

**PREREQUISITE**

- Advanced transport phenomena, J.C. Slattery, Cambridge Press, 1999
- Transport phenomena, Bird, Stewart and Lightfoot, John Wiley and Sons, 1960
- Fundamental principles of heat transfer, WHITAKER Stephen. KRIEGER, 1977
- Advanced transport phenomena, J.C. Slattery, Cambridge Press, 1999
- Transport phenomena, Bird, Stewart and Lightfoot, John Wiley and Sons, 1960

**PRÉREQUIS**

Continuum Mechanics (EC15TM5)
Thermodynamics (EC15TB2)

**ASSESSMENT**

CC(EE, 2h, sd, ca)

| | | | |
|---|---|---|---|
| EC : Heat Transfer by Radiation | | EC5TM3 | coeff : 0.15 |
| Teacher In Charge : Vaxelaire J. | | | |
| CM : 6 h | TD : 14 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

Heat transfer by radiation is of high importance especially in systems where high temperature is involved. The goal of the lecture is to present the basic elements on this particular heat transfer phenomena.

**LEARNING OUTCOMES**

After this course, students should:

- have a basic knowledge on radiation phenomena
- be able to include aspects relative to radiation in relatively simple thermal systems

**DESCRIPTION**

Definitions and fundamental relationships (radiant intensity and flux. . . )
Black body radiation (black body definition; spectral energy distribution, fractional functions)

Real surfaces radiation (absorption and emission characteristics, gray surfaces, Kirchhoff law)
Heat exchange between black surfaces separated by nonabsorbing medium (geometry factor, electrical analogy)
Heat exchange between gray surfaces separated by nonabsorbing medium
Heat exchange between surfaces separated by partially absorbing medium (particular case of isothermal gas)

**BIBLIOGRAPHY**

BEJAN A. ”heat transfer”, Ed. J. Wiley, 1993, New York
BATTAGLIA J.L. et al. ”Introduction aux transferts thermiques”, Ed. Dunod, 2014, Paris
SACADURA J.F ”Initiation aux transferts thermiques”, Ed. Lavoisier, 1978, Paris

**PREREQUISITE**

**ASSESSMENT**

CC(EE,2h, sd, ca)

| | | | |
|---|---|---|---|
| EC : Continuum Mechanics | | EC5TM4 | coeff : 0.27 |
| Teacher In Charge : Couture F. | | | |
| CM : 18 h | TD : 18 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

Continuum mechanics is the theoretical basis for fluid and solid mechanics. The aim is to describe transport phenomena in continuum from the classical universal principles : mass, momentum and energy conservation.

**LEARNING OUTCOMES**

After this course, students should:

- be able to establish the basic equations of fluid mechanics ( Bernoulli, Navier Stokes ) by introducing a newtonian rheological behaviour in mass and momentum conservation,
- be able to establish the basic equations of thermal science by introducing a Newtonian rheological behaviour for fluid and a non deformable behaviour for solid in energy conservation.

**DESCRIPTION**

Continuum model:

Averaging volume – Continuity of the medium at a given time - Continuity of transformations.

Kinematics:

Lagrangian method – Eulerian method – Material derivative – Transport theorem – Conservation of mass.

Dynamics:

Forces – Momentum and moment of momentum balances – Stress tensor – Symmetry of stress tensor – Energy conservation.

Rheology - Stress-strain relations

Strain tensor – Rate of strain tensor - – Tensors properties – Stress strain relations (Newtonian fluid, linear elastic solid).

**BIBLIOGRAPHY**

DUVAUT G., Mécanique des milieux continus, Paris, Masson, 1990

BOUDET R., CHAUVIN A., Mécanique des milieux continus, Paris, Hermes, 1996
HLADICK J. Le calcul vectoriel en physique, Paris, Ellipse, 1993
HLADICK J. Le calcul tensoriel en physique, Paris, Masson, 1995

**PREREQUISITE**

**ASSESSMENT**

CC(EE, 2h)

| | | | |
|---|---|---|---|
| EC : Transfer Practicals | | EC5TM5 | coeff : 0.29 |
| Teacher In Charge : Castéran F. | | | |
| CM : 0 h | TD : 0 h | TP : 40 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

In the practical ENSGTI laboratory, students have the opportunity to observe, by handling on lab-scale devices, the physical phenomena they have studied during the lectures. They check the corresponding physical laws including the heat and mass transfers quantification.
This practical work corresponds to the study of the various basic physical phenomena met in the energy field.

**LEARNING OUTCOMES**

After this course the students should:

- Be familiar with the main physical phenomena encountered in thermal and energetic systems;
- Be able to analyse a real experiment (measurement uncertainties, order of magnitude);
- Know how to present clearly scientific relevant results.

**DESCRIPTION**

- Rheology
- pressure losses
- Centrifuge pump
- Conduction
- Convection
- Radiation
- Temperature measurement

**BIBLIOGRAPHY**

**PREREQUISITE**

**ASSESSMENT**

moyenne(TP(CR))x1/2 + moyenne(TP(Tr, PA))x1/2

# SPECIALITE GEII

| 1st Year - Semester 5 - GEII | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UE Name | Code UE | Code EC | EC Name | Hours (h) Tot UE | Tot EC | Tot Prés. | CM | TD | TP | TA | Proj. | ECTS / Coef. ECTS UE | Coef. EC |
| Apprenticeship S5 | EG5AP | EG5AP1 | Skills developed in the company | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 0.80 |
| | | EG5AP2 | Project: Company knowledge | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0.20 |
| Mathematics - Computer Sciences S5 | EG5MI | EG5MI1 | Mathematics | 0 | 70 | 40 | 20 | 20 | 0 | 30 | 0 | 6 | 0.47 |
| | | EC5MI2 | Programming (FORTRAN) | | 94 | 32 | 12 | 0 | 20 | 62 | 30 | | 0.53 |
| Electronics S5 | EG5EL | EG5EL1 | Analog electronics 1 | 160 | 80 | 40 | 20 | 20 | 0 | 40 | 0 | 6 | 0.50 |
| | | EG5EL2 | Digital electronics | | 48 | 24 | 12 | 12 | 0 | 24 | 0 | | 0.30 |
| | | EG5EL3 | TP Digital Electronics | | 32 | 16 | 0 | 0 | 16 | 16 | 0 | | 0.20 |
| Electronic components S5 | EG5CE | EG5CE1 | Semiconductor Physics | 150 | 34 | 16 | 10 | 6 | 0 | 18 | 0 | 5 | 0.22 |
| | | EG5CE2 | Analog electronics 2 | | 76 | 36 | 18 | 18 | 0 | 40 | 0 | | 0.51 |
| | | EG5CE3 | TP Components | | 40 | 20 | 0 | 0 | 20 | 20 | 0 | | 0.27 |
| Signals and Circuits S5 | EG5SC | EG5SC1 | Electrical signals and systems | 120 | 40 | 20 | 10 | 10 | 0 | 20 | 0 | 4 | 0.33 |
| | | EG5SC2 | Electrostatic - Electromagnetism | | 60 | 30 | 16 | 14 | 0 | 30 | 0 | | 0.50 |
| | | EG5SC3 | Optronics | | 20 | 10 | 6 | 4 | 0 | 10 | 0 | | 0.17 |
| Total Spec GEII | | | | 430 | | 284 | 124 | 104 | 56 | 310 | 35 | 26 | |
| Total TC + Spec GEII | | | | 542 | | 340 | | | | | | 30 | |

TEACHING UNIT (UE) :

Apprenticeship S5

ECTS : 5

Code UE : EG5AP

SKILLS COVERED BY THE UE :

- Specify industrial manufactured devices involving electrical engineering and industrial computing, based on documented and anticipated needs, in order to establish essential design requirements.
- Document the study and design of the equipment concerned in order to explain its operation, to monitor its implementation or to ensure its maintenance.
- Write design and validation reports in order to ensure traceability, which is essential for a continuous improvement process.
- Know and understand a complex and interdisciplinary scientific and technical field of specialisation in order to ensure the interface between the different partners by communicating on the progress of the work/project with both internal and external partners.
- Master the communication techniques adapted to the situation and to the interlocutors in order to lead the development of a project in accordance with the company's strategy.
- Lead a multicultural team by adapting to the constraints and specificities of each person, taking into account the cultural mix in its interactions, using adapted communication tools and methods, in order to establish an environment conducive to the success of the project in compliance with regulations, ethics, safety and health.

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

| CODE EC | INTILTLED EC | COEF | EVALUATION |
|---|---|---|---|
| EG5AP1 | Skills developed in the company | 0.8 | EvalC (entreprise)*0.6 + PA (entreprise)*0.4 |
| EG5AP2 | Project: Company knowledge | 0.2 | EvalC (Rap) |

| | | | |
|---|---|---|---|
| EC : Skills developed in the company | | EG5AP1 | coeff : 0.8 |
| Teacher In Charge : Pécastaing L. | | | |
| CM : 0 h | TD : 0 h | TP : 0 h | Proj : 5 h |
| | | | Language Français |

**INTRODUCTION**

During these first seven weeks in the company, the apprentice will have been confronted with the concepts of expression of need, specifications and will have written his first reports related to his activities.

**TARGETED SKILLS**

- Specify industrial manufactured devices involving electrical engineering and industrial computing, based on documented and anticipated needs, in order to establish essential design requirements.
- Document the study and design of the equipment concerned in order to explain its operation, to monitor its implementation or to ensure its maintenance.
- Write design and validation reports in order to ensure traceability, which is essential for a continuous improvement process.

**CONTENT**

The activities developed in this CE are established according to the specific needs of the company and in order to complete the targeted skills.

**RESSOURCES**

**PREREQUISITES**

**EVALUATION PROCEDURES**

EvalC (entreprise)*0.6 + PA (entreprise)*0.4

| | | | |
|---|---|---|---|
| EC : Project: Company knowledge | | EG5AP2 | coeff : 0.2 |
| Teacher In Charge : Pécastaing L. | | | |
| CM : 0 h | TD : 0 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**INTRODUCTION**

The apprentice engineers integrating their company will be able to familiarise themselves with the internal organisation of their company and thus better understand the role of the different departments and the often multidisciplinary aspect of a company and its communication constraints.

**TARGETED SKILLS**

- To know and understand a complex and interdisciplinary scientific and technical field of specialisation in order to ensure the interface between the different partners by communicating on the progress of the work/project with both internal and company partners.
- Master the communication techniques adapted to the situation and to the interlocutors in order to lead the development of a project in accordance with the company's strategy.
- Lead a multicultural team by adapting to the constraints and specificities of each person, taking into account the cultural mix in its interactions, using adapted communication tools and methods, in order to establish an environment conducive to the success of the project in compliance with regulations, ethics, safety and health.
- Understand the organisation of companies.

**CONTENT**

The apprentice submits a report which allows the level of skills acquired in the field of company knowledge to be judged. The report covers, among other things, the following topics: presentation, operation, sectors of activity and regulations of the host company. The apprentice also indicates his position and that of his activities.
Report of about ten pages of information, excluding table of contents, annexes, etc. From the introduction to the conclusion. The apprentice must check with his/her Apprentice Master that there is no confidential data in this report before it is submitted to the LEA.

**RESSOURCES**

**PREREQUISITES**

**EVALUATION PROCEDURES**

EvalC (Rap)

TEACHING UNIT (UE) :

Mathematics - Computer Sciences S5

ECTS : 6

Code UE : EG5MI

SKILLS COVERED BY THE UE :

- Demonstrate proficiency in the use of mathematical methods of engineering practice
- Demonstrate proficiency in the use of a structured programming language (FORTRAN)

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

| CODE EC | INTILTLED EC | COEF | EVALUATION |
|---|---|---|---|
| EG5MI1 | Mathematics | 0.47 | CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7 |
| EC5MI2 | Programming (FORTRAN) | 0.53 | Proj(Tr, Rap, Sout) |

| | | | |
|---|---|---|---|
| EC : Mathematics | | EG5MI1 | coeff : 0.47 |
| Teacher In Charge : Laurent S., Couture F. | | | |
| CM : 20 h | TD : 20 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

This module presents the essential mathematical tools to treat the majority of fundamental physical phenomena.

**LEARNING OUTCOMES**

- master matrix calculation,
- be able to solve analytically linear systems,
- be able to evaluate simple, double, triple, curve and surface integrals,
- be able to handle gradient, divergence and rotational,
- be able to solve analytically differential equations,
- be able to integrate, derivate spatial tensor fields,
- be able to read and understand on a mathematical point of view heat and mass transport equations.

**DESCRIPTION**

Part I. Matrix calculation

Matrix – Determinants – Resolution of linear systems – Matrix reduction.

Part II. Functions of several variables

Definition – Differential calculation.

Part III. Integrals calculation

Simple integrals – Double integrals – Triple integrals.

Part IV. Vector analysis
Differential operators – Curve and surface integrals – Transformation formula.

Part V. Differential equations
1st order differential equations – 2nd order linear differential equations.

Part VI. Laplace transformation
Generalised integrals – Laplace transformation of current functions – Convolution product – Dirac function.

**RECOMMENDED READING**
Mathématiques d'usage courant pour scientifiques et ingénieurs, Belorizky E., cahiers 128, Nathan

**PREREQUISITE**

**ASSESSMENT**
CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7

| | | | |
|---|---|---|---|
| EC : Programming (FORTRAN) | | EC5MI2 | coeff : 0.53 |
| Teacher In Charge : Serra S. | | | |
| CM : 12 h | TD : 0 h | TP : 20 h | Proj : 30 h |
| | | | Language Français |

**OVERVIEW**

Basic knowledge on computers and programming are developped. Key concepts needed to write a code dedicated to scientific computing are given.

**LEARNING OUTCOMES**

- Masterize the basic concepts (OS commands, compilation, execution, files manipulation. . . )
- Conceive the architecture of a program
- Code a sequential program in Fortran

**DESCRIPTION** 1 Foreword
2 Data types
3 Operators
4 Intrinsic functions
5 Algorithms
6 Arrays
7 Sub-programs
8 Inputs – Outputs
9 Supplementary options
10 Useful information

**BIBLIOGRAPHY**

Numerical recipes in Fortran 77 : the art of scientific computing, W.H. Press et al, Cambridge University Press (1992)
Fortran 95 Handbook, A. Brainerd et al., MIT Press (1997)
Information technology – Programming Languages – Fortran – Part 1 : Base language, International Standard, ISO/IEC 1539-1 (1997)
Programmer en Fortran 90 – Guide Complet, C. Delannoy, Edition Eyrolles (2000) Manuel Complet du Langage Fortran 90 et 95, P. Lignelet, Masson (1996)
Cours Fortran 95, P. Corde et H. Delouis, IDRIS (2008)

Les apports de Fortran 2003, P. Corde et H. Delouis, IDRIS (2008)

**PREREQUISITE**

**ASSESSMENT**

Proj(Tr, Rap, Sout)

TEACHING UNIT (UE) :

Electronics S5

ECTS : 6

Code UE : EG5EL

SKILLS COVERED BY THE UE :

- Propose and describe circuits made with diodes and operational amplifiers (inverting, non-inverting, summing, subtracting, differential, active filters, comparators, signal generators)
- Calculate simple analog circuit responses
- Know the basics of digital electronics
- Know how to synthesize logic circuits
- Know how to identify and wire digital circuits.
- Understand how microprocessors can work

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

| CODE EC | INTILTLED EC | COEF | EVALUATION |
|---|---|---|---|
| EG5EL1 | Analog electronics 1 | 0.5 | CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7 |
| EG5EL2 | Digital electronics | 0.3 | CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7 |
| EG5EL3 | TP Digital Electronics | 0.2 | TP (CR) |

| | | | |
|---|---|---|---|
| EC : Analog electronics 1 | | EG5EL1 | coeff : 0.5 |
| Teacher In Charge : Pécastaing L., Ibrahimi N | | | |
| CM : 20 h | TD : 20 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**INTRODUCTION**

This course aims to introduce students to the main functions of electronics.

**TARGETED SKILLS**

- Propose and describe circuits made with diodes and operational amplifiers (inverting, non-inverting, adder, subtractor, active filters, comparators, signal generators)
- Identify the specific limitations of these components
- Calculate the responses of simple analogue circuits

**CONTENT**

1. Diodes
2. Operational amplifiers in linear mode
3. Operational amplifiers in non-linear mode (comparators, multivibrators)
4. Sine wave oscillators
5. Analog filtering (Butterworth and Chebychev)
6. Real operational amplifier

**RESSOURCES**

**PREREQUISITES**

**EVALUATION PROCEDURES**

CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7

| | | | |
|---|---|---|---|
| EC : Digital electronics | | EG5EL2 | coeff : 0.3 |
| Teacher In Charge : Dumas P. | | | |
| CM : 12 h | TD : 12 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**INTRODUCTION**

The objective of this course is to upgrade the basics of combinatorial and sequential logic..

**TARGETED SKILLS**

- Basic knowledge of digital electronics
- Knowledge of the basic components of digital electronics (CMOS Door)
- Combinatorial and Sequential Logic
- Proficiency in a description language (VHDL or Verilog)

**CONTENT**

1. Studies of CMOS and Jitter doors
2. Combinatorial circuits: encoder, decoder, multiplexer, demultiplexer, arithmetic circuits
3. Sequential circuits: RS toggle, RST toggle, JK toggles, Counters, Memories
4. VHDL or Verilog hardware applications: Encoder, Counters, State Machine

**RESSOURCES**

**PREREQUISITES**

**EVALUATION PROCEDURES**

CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7

| | | | |
|---|---|---|---|
| EC : TP Digital Electronics | | EG5EL3 | coeff : 0.2 |
| Teacher In Charge : Dumas P. | | | |
| CM : 0 h | TD : 0 h | TP : 16 h | Proj : 0 h |
| | | | Language Français |

**INTRODUCTION**

The objective of the EC is to master modern digital circuit design.
The use of a description language (behavioral VHDL or Verilog) on a current hardware development tool to make complex circuits (FPGA development board).
The modular approach of VHDL (or Verilog) components provides a good understanding of the final hardware design.

**TARGETED SKILLS**

- Rapidly and modularly design complex digital electronics projects driving real systems
- Correctly master a description language and a development tool

**CONTENT**

1. Combinatorial functions (encoding-decoding)
2. Sequential functions(memorization, counting, PWM, state machines)

**RESSOURCES**

**PREREQUISITE**

**EVALUATION PROCEDURES**

TP (CR)

TEACHING UNIT (UE) :

Electronic components S5

ECTS : 5

Code UE : EG5CE

SKILLS COVERED BY THE UE :

- Possess the physical basis for the study of the operation of electronic components
- Be able to explain how transistor circuits work
- Know how to calculate the voltage and current gains, as well as the input and output impedances of a circuit based on ”small signal” models
- Know the frequency operation of transistor amplifier assemblies
- Apply the concepts discussed in class and TD analog electronics
- Experimentally highlight component limitations

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

| CODE EC | INTILTLED EC | COEF | EVALUATION |
|---|---|---|---|
| EG5CE1 | Semiconductor Physics | 0.22 | CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7 |
| EG5CE2 | Analog electronics 2 | 0.51 | CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7 |
| EG5CE3 | TP Components | 0.27 | TP (CR) |

| | | | |
|---|---|---|---|
| EC : Semiconductor Physics | | EG5CE1 | coeff : 0.22 |
| Teacher In Charge : Reess T. | | | |
| CM : 10 h | TD : 6 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**INTRODUCTION**

The objective here is to introduce students to the basic physical properties of semiconductors in order to assimilate these notions that are used in the description and analysis of electronic components. This course explains the principle and operation of the simplest of semiconductor components: the junction diode (p-n junction)

**TARGETED SKILLS**

- Possess the physical basis for the study of the operation of electronic components
- Mastering transport mechanisms in a semiconductor
- Understand the physical principles of how a p-n junction works

**CONTENT**

1. Reminders on the structure of matter in the solid state.
2. Electronic structure.
3. Charge transport mechanisms in semiconductors
4. The p-n junction

**RESSOURCES**

**PREREQUISITE**

**EVALUATION PROCEDURES**

CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7

| | | | |
|---|---|---|---|
| EC : Analog electronics 2 | | EG5CE2 | coeff : 0.51 |
| Teacher In Charge : Reess T., Ibrahimi N. | | | |
| CM : 18 h | TD : 18 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**INTRODUCTION**

This course aims to introduce students to the operation of transistor amplifier assemblies (bipolar, field effect).

**TARGETED SKILLS**

- Be able to explain how transistor circuits work
- Understand the concept of superposition of the state of polarization and low and high signal variations.
- Know how to calculate the voltage and current gains, as well as the input and output impedances of a circuit based on ”small signal” models
- Know the frequency limits of transistor amplifier assemblies

**CONTENT**

1. Bipolar transistor polarization
2. Fundamental assemblies with bipolar transistors
3. Field effect transistors (principle, polarization and amplification)
4. Low and high frequency amplification
5. Power amplification

**RESSOURCES**

**PREREQUISITE**

**EVALUATION PROCEDURES**

CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7

| | | | |
|---|---|---|---|
| EC : TP Components | | EG5CE3 | coeff : 0.27 |
| Teacher In Charge : Rivaletto M. | | | |
| CM : 0 h | TD : 0 h | TP : 20 h | Proj : 0 h |
| | | | Language Français |

**INTRODUCTION**

The objective is to experimentally apply the concepts discussed in class on electronic components.

**TARGETED SKILLS**

- Become familiar with measuring devices commonly used in electronics (multimeter, oscilloscope)
- Apply the concepts discussed in class and TD analog electronics
- Experimentally highlight component limitations

**CONTENT**

1. Operational amplifier in linear regime, application to filtering
2. Operational amplifier in non-linear regime, comparator, astable, monostable
3. Operational amplifier and transistor oscillators
4. The NE555 circuit, experimental study
5. The bipolar transistor, EC mounting frequency study

**RESSOURCES**

**PREREQUISITE**

**EVALUATION PROCEDURES**

TP (CR)

TEACHING UNIT (UE) :

Signals and Circuits S5

ECTS : 4

Code UE : EG5SC

SKILLS COVERED BY THE UE :

- Know how to master the responses of linear electronic circuits
- Solving an electrostatic problem in the presence of dielectrics
- Know the principles of electromagnetism
- Size an electromagnetic problem
- Provide the fundamental basic knowledge about the main components of optoelectronics
- Present the fields of application (information technology, optical telecommunications, transmission.)

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

| CODE EC | INTILTLED EC | COEF | EVALUATION |
|---|---|---|---|
| EG5SC1 | Electrical signals and systems | 0.33 | CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7 |
| EG5SC2 | Electrostatic - Electromagnetism | 0.5 | CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7 |
| EG5SC3 | Optronics | 0.17 | CC (EE, 1h30) |

| | | | |
|---|---|---|---|
| EC : Electrical signals and systems | | EG5SC1 | coeff : 0.33 |
| Teacher In Charge : Reess T. | | | |
| CM : 10 h | TD : 10 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**INTRODUCTION**

This module allows students to acquire basic notions on which other disciplines are based: analog electronics, automatic, instrumentation. It presents the mathematical tools necessary for the analysis of frequency and temporal responses of electrical systems.

**TARGETED SKILLS**

- Master the methods of analysis of circuits in temporal regime
- Master the methods of analysis of circuits in sinusoidal steady state

**CONTENT**

1. Reminders of general theorems for circuit analysis
2. Circuit analysis by quadrupole representation
3. The Laplace Transform: application to circuit analysis
4. Harmonic response of circuits: representation of Bode and Nyquist
5. Analysis of the temporal response of linear circuits

**RESSOURCES**

**PREREQUISITE**

**EVALUATION PROCEDURES**

CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7

| | | | |
|---|---|---|---|
| EC : Electrostatic - Electromagnetism | | EG5SC2 | coeff : 0.5 |
| Teacher In Charge : Paillol J. | | | |
| CM : 16 h | TD : 14 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**INTRODUCTION**

Applications of electrostatics and electromagnetism to propagation and radiation.

**TARGETED SKILLS**

- Solving an electrostatic problem in the presence of dielectrics
- Know the basic principles of guided wave propagation
- Know the basic principles of radiation in free space
- Know how to characterize antenna radiation
- Size an electromagnetic problem

**CONTENT**

1. Electrostatics in vacuum and media
2. Maxwell's equations
3. Free and guided propagation - transmission lines
4. Radiation in free space
5. Introduction to Antenna Theory

**RESSOURCES**

**PREREQUISITE**

Basic COURSES in electromagnetism and Mathematics

**EVALUATION PROCEDURES**

CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.7

| | | | |
|---|---|---|---|
| EC : Optronics | | EG5SC3 | coeff : 0.17 |
| Teacher In Charge : Gravrilenko V. | | | |
| CM : 6 h | TD : 4 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**INTRODUCTION**

This course aims to introduce students to the main basic components of optoelectronics and their main uses..

**TARGETED SKILLS**

- Provide the fundamental basic knowledge about the main components of optoelectronics
- Present the fields of application (information technology, optical telecommunications, transmission.)

**CONTENT**

1. Photometry elements
2. Photodetectors (Photoresistors, Photodiodes, Photovoltaic cells, Phototransistors, Photomultipliers, CCD sensors)
3. Phototransmitters (LEDs, Laser Diodes, Displays and LCD screens)
4. Fiber optic transmission

**RESSOURCES**

**PREREQUISITE**

**EVALUATION PROCEDURES**

CC (EE, 1h30)

# Semestre 6

LIST OF TEACHING UNITS (UE) OF THE SEMESTER

| TC, Spe ou Path-ways | Code UE | Entitled UE | ECTS |
|---|---|---|---|
| TC | EC6MI | Mathematics - Computer Sciences S6 | 7 |
| GP-EN | EC6TM | Thermodynamics - Mechanics S6 | 7 |
| GP-EN | EC6LC | Languages - Engineering Culture S6 | 6 |
| EN | EE6ET | Energy and Transfer S6 | 10 |
| GP | EP6CR | Chemistry and Reactor S6 | 10 |
| GEII | EG6AP | Apprenticeship S6 | 7 |
| GEII | EG6LA | Languages for the engineer S6 | 3 |
| GEII | EG6EI | Energy and industry | 5 |
| GEII | EG6EE | Electrical energy and control command S6 | 8 |

# Tronc Commun

| 1st Year - Semester 6 - Commun Course | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UE Name | Code | | EC Name | Hours (h) | | | | | | | | ECTS / Coef. | |
| | UE | EC | | Tot UE | Tot EC | Tot Prés. | *CM* | *TD* | *TP* | *TA* | *Proj.* | ECTS UE | Coef. EC |
| Mathematics - Computer Sciences S6 | EC6MI | EC6MI1 | Probability and Statistics | 180 | 40 | **20** | *10* | *10* | ***0*** | 20 | **0** | 7 | 0.17 |
| | | EC6MI2 | Scientific Calculus I | | 60 | **30** | *14* | *16* | ***0*** | 30 | **0** | | 0.33 |
| | | EC6MI3 | System Control | | 48 | **24** | *12* | *12* | ***0*** | 24 | **0** | | 0.33 |
| | | EC6MI4 | Programming (VBA) | | 32 | **16** | *8* | *8* | ***0*** | 16 | **0** | | 0.17 |
| **Total TC GP + EN** | | | | **180** | | **90** | **44** | **46** | **0** | **90** | **0** | **7** | |

TEACHING UNIT (UE) :

Mathematics - Computer Sciences S6

ECTS : 7

Code UE : EC6MI

SKILLS COVERED BY THE UE :

- Understand the basic concepts of Applied mathematics (numerical mathematical methods), Statistics and Probability
- Demonstrate the ability to design and configure a control loop
- Demonstrate proficiency in the use of a new structured programming language (Visual Basic)

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

| CODE EC | INTILTLED EC | COEF | EVALUATION |
|---|---|---|---|
| EC6MI1 | Probability and Statistics | 0.17 | CC(EE, 2h, sd, ca) |
| EC6MI2 | Scientific Calculus I | 0.33 | CC(PA)x1/4 + CC(EE, 2h, sd, st, sc)x3/4 |
| EC6MI3 | System Control | 0.33 | CC (EE, 2h, sd, ca) |
| EC6MI4 | Programming (VBA) | 0.17 | CC(PA)x1/2 + CC(EE, 2h, sd, st, sc)x1/2 |

| | | | |
|---|---|---|---|
| EC : Probability and Statistics | | EC6MI1 | coeff : 0.17 |
| Teacher In Charge : Tinsson W. | | | |
| CM : 10 h | TD : 10 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

This course will concentrate on probability theories and statistical methods. To understand and model random phenomenon is of prime importance for a lot of complex situations where the classical deterministic methods do not fit well. Special attention is paid in this course to real-life problems.

**LEARNING OUTCOMES**

After this course, students should/

- have a basic knowledge in the area of probabilities,
- be able to model a random phenomenon,
- have a basic knowledge in the aera of statistics
- be able to fit a linear statistical model

**DESCRIPTION**

3 parts
Part I : Probabilities
Part II : Inferential statistics
Part III: Statistical linear models

**BIBLIOGRAPHY**

G. Saporta, Probabilités, Analyse des Données et Statistique. Editions Technip, 2006
Murray R. Spiegel, Probabilités et statistique, Cours et Problème, Série SHAUM 1974

**PRÉREQUIS**

- Enumerative combinatorics
- Concept of probability and conditional probobility
- Random variables notions and probability distribution

**ASSESSMENT**

CC(EE, 2h, sd, ca)

| | | | |
|---|---|---|---|
| EC : Scientific Calculus I | | EC6MI2 | coeff : 0.33 |
| Teacher In Charge : Gibout S. | | | |
| CM : 14 h | TD : 16 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

The main objective of this module is to provide students with a solid foundation in scientific computing, which allows them to use the computer in the modeling framework and data analysis.

**LEARNING OUTCOMES**

Choose the most suitable algorithms for a given problem and implement them in the computer language of their choice
Take a critical look at results
Evaluate any errors related to the method

**DESCRIPTION**

1. Solution of linear systems
2. Interpolation and approximation techniques
3. Integration and numerical derivation
4. Nonlinear Equations
5. Extremums and minimization
6. Resolution of systems of ordinary differential equations

**BIBLIOGRAPHY**

**PREREQUISITE**

Basic skills in Mathematics and programming

**ASSESSMENT**

CC(PA)x1/4 + CC(EE, 2h, sd, st, sc)x3/4

| | | | |
|---|---|---|---|
| EC : System Control | | EC6MI3 | coeff : 0.33 |
| Teacher In Charge : Bernada P. | | | |
| CM : 12 h | TD : 12 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

This lecture is an introduction to PID process control and system instrumentation.

**LEARNING OUTCOMES**

After this course, students should be able to:

- Give the elements of a control loop,
- Calculate the time response of simple systems (first and second order) placed in feedback control loops with PID controllers,
- Choose an appropriate controller for simple processes (pressure, level, flow rate. . . )
- Improve the process control by using simple criteria

**DESCRIPTION**

I Introduction

Brief description of the elements of a control loop (sensor, actuators, controllers)

II Mathematical modeling of dynamic linear systems

•Definition of a transfer function,
•Study of simple linear systems (first order, second order, integrator, dead time. . . )

III Basic control actions

•Closed loop systems (feedback systems),
•PID controllers,

IV Stability of linear systems

•Routh criterion,
•Root locus diagram

V Optimization of a PID controller

•Static and dynamic criteria,

•Choice of the controller,

•Optimization of a PID (Ziegler – Nichols, Cohen and Coon)

**BIBLIOGRAPHY**

Modern control engineering, 2d edition, prentice-hall edition, K Ogata,
1990 Regulation, tomes 1,2,3, Nathan edition, C. Sermonade, A. Toussaint, 1994

**PREREQUISITE**

Maths - tensorial algebra and analysis (EC15MI1)

**ASESSMENT**

CC (EE, 2h, sd, ca)

| | | | |
|---|---|---|---|
| EC : Programming (VBA) | | EC6MI4 | coeff : 0.17 |
| Teacher In Charge : Gibout S. | | | |
| CM : 8 h | TD : 8 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

Mastering VBA / Excel

**LEARNING OUTCOMES**

- Analyze a problem and design the most suitable software solution
- Develop the application following a methodology to minimize the risk of error (tests)
- Validate and correct any nonconformities
- Take account of ergonomic constraints related to the use of graphical user interfaces

**DESCRIPTION**

1) Generalities
2) Development and execution environments
3) Object and event programming concepts
4) Data types and elements of language syntax
5) Interaction with Spreadsheets
6) Graphical User Interface

**BIBLIOGRAPHY**

**PREREQUISITE**

General principles of programming (Fortran or other)

**ASSESSMENT**

CC(PA)x1/2 + CC(EE, 2h, sd, st, sc)x1/2

# Tronc Commun GP et EN

| 1st Year - Semester 6 - Commun Course EN GP | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UE Name | Code | | EC Name | Hours (h) | | | | | | | | ECTS / Coef. | |
| | UE | EC | | Tot UE | Tot EC | Tot Prés. | CM | TD | TP | TA | Proj. | ECTS UE | Coef. EC |
| Thermodynamics - Mechanics S6 | EC6TM | EC6TM1 | Solution Thermodynamics | 200 | 68 | 34 | 18 | 16 | 0 | 34 | 0 | 7 | 0.34 |
| | | EC6TM2 | Flowsheeting | | 44 | 20 | 8 | 12 | 0 | 24 | 4 | | 0.22 |
| | | EC6TM3 | PID | | 16 | 8 | 4 | 4 | 0 | 8 | 0 | | 0.08 |
| | | EC6TM4 | Fluid Mechanics I | | 72 | 36 | 20 | 16 | 0 | 36 | 0 | | 0.36 |
| Languages - Engineering Culture S6 | EC6LC | EC6LC1 | English | 172 | 48 | 24 | 0 | 24 | 0 | 24 | 0 | 6 | 0.28 |
| | | EC6LC2 | Second Foreign Language (Spanish / German) | | 40 | 20 | 0 | 20 | 0 | 20 | 0 | | 0.23 |
| | | EC6LC3 | Professional Insertion I | | 20 | 8 | 6 | 2 | 0 | 12 | 14 | | 0.11 |
| | | EC6LC4 | Entrepreneurship | | 24 | 16 | 8 | 8 | 0 | 8 | 8 | | 0.14 |
| | | EC6LC5 | Cost Analysis and Management Control | | 40 | 20 | 20 | 0 | 0 | 20 | 0 | | 0.24 |
| Total TC GP + EN | | | | 372 | | 186 | 56 | 94 | 0 | 158 | 18 | 13 | |

TEACHING UNIT (UE) :

Thermodynamics - Mechanics S6

ECTS : 7

Code UE : EC6TM

SKILLS COVERED BY THE UE :

- Demonstrate the ability to compute the equilibrium between phases
- Know the main unit operations so as to be able to understand and to design a process flow diagram
- Demonstrate the ability to formulate and to solve a process simulation problem with a commercial process simulation software
- Demonstrate the ability to formulate and to solve a problem in Fluid Mechanics in order to calculate pressure drop

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

| CODE EC | INTILTLED EC | COEF | EVALUATION |
|---|---|---|---|
| EC6TM1 | Solution Thermodynamics | 0.34 | CC(EE, 2h) |
| EC6TM2 | Flowsheeting | 0.22 | CC(EM, 2h) |
| EC6TM3 | PID | 0.08 | CC(EE, 1h) |
| EC6TM4 | Fluid Mechanics I | 0.36 | CC(EE, 2h, sd, ca) |

| | | | |
|---|---|---|---|
| EC : Solution Thermodynamics | | EC6TM1 | coeff : 0.34 |
| Teacher In Charge : Cézac P. | | | |
| CM : 18 h | TD : 16 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

The thermodynamics of the solutions is an essential tool for the analysis of the real processes. The primary aim of this subject is to provide a comprehensive exposition on the thermodynamic properties of fluid mixtures and on phases equilibria.

**LEARNING OUTCOMES**

After this course, students should:

- have a great knowledge on thermodynamics models (ideal gas, ideal solution, gE models and Equations of state)
- be able to describe any thermodynamic equilibrium in a complex system.

**DESCRIPTION**

Chemical
Potential
Ideal Gas
Ideal Solution
Real Solution
gE models
EOS
Phases equilibria

**BIBLIOGRAPHY**

J. Vidal, Thermodynamique : application au Génie Chimique et à l'industrie pétrolière, Ed. Technip, 1997.
Smith et Van Ness, Introduction to Chemical Engineering Thermodynamics, Ed. Mc Graw-Hill, Inc, 1987

**PREREQUISITE**

Lectures of general thermodynamics and thermo chemistry

**ASSESSMENT**

CC(EE, 2h)

| | | | |
|---|---|---|---|
| EC : Flowsheeting | | EC6TM2 | coeff : 0.22 |
| Teacher In Charge : Serin J.P. | | | |
| CM : 8 h | TD : 12 h | TP : 0 h | Proj : 4 h |
| | | | Language Français |

**OVERVIEW**

This subject is dedicated to steady state process simulation. Basic concepts are first introduced. Then illustrative examples are considered using a Steady State Process Simulator (ProSim Plus ®)

**LEARNING OUTCOMES**

- be able to formulate simulation problems (process modelling at the system level)
- have a basic and theoretical knowledge of different solution strategies (modular, oriented equation) and methods (Wegstein, Broyden. . . )
- be able to use any commercial software for steady state process simulation
- be able to analyse the results of simulation (sensitivity analysis . . . )

**DESCRIPTION**

Part I: Basic Concepts

-Introduction: process classification, from design to simulation
-Model classification and formulation
-Different solution strategy (Oriented Equation, Modular . . . )
-The Modular Solution Strategy (Module Definition, Tear Streams, Recycle, Specification . . . )
-Numerical Methods

Part II: Simulation Tools

Process simulations are performed using the ProSim Plus® steady state process simulator: Simplified HDA Process, Ethylene Oxide process. . .

**BIBLIOGRAPHY**

Tutorials are available, on line, using the elearn platform

**PREREQUISITE**

Balances EC15TB4
Solution Thermodynamics EC16TM1

**ASSESSMENT**

CC(EM, 2h)

| | | | |
|---|---|---|---|
| EC : PID | | EC6TM3 | coeff : 0.08 |
| Teacher In Charge : Ricarde M. | | | |
| CM : 4 h | TD : 4 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

Piping and instrumentation Diagrams occupy an important role in the industrial units of oil and gas, chemistry and energy.
The knowledge of these Diagrams is essential for an engineer in Process engineering or in Energetics.
This teaching is illustrated with concrete industrial examples; numerous notions are approached, relative to safety, technology, construction and to the exploitation of units. Educational platform https://elearn.univ-pau.fr/

**LEARNING OUTCOMES**

The skills which will be acquired by the student face to face P&ID are:

1. Reading
2. Understanding
3. Designing
4. Drawing (Note: the use of software of drawing is not included in this course).

**DESCRIPTION**

Piping and equipment:
-outline,
-piping class.

Instrumentation:
-outline,
-identification (rules for name tag),
-sort : temperature, flow. . . .
-function : alarm, control, security. . .

OTHER NOTIONS:
-Process Control Systems (PCS) ET Safety Shutdown System (SSS)
-Safety Integrity Level (SIL)
-EXPLOSIVE ATMOSPHERES (ATEX)
-NFC and NFO valves

**BIBLIOGRAPHY**

ISO 10628-1:2014 Diagrams for the chemical and petrochemical industry – Part 1: Specification of diagrams
ISO 10628-2:2012 Diagrams for the chemical and petrochemical industry – Part 2: Graphical symbols
ISO 14617-6:2002 Symboles graphiques pour schémas – Partie 6: Fonctions de mesurage et de contrôle
ISA 5.1-2009 Instrumentation Symbols and Identification

**PREREQUISITE**

**ASSESSMENT**

CC(EE, 1h)

| | | | |
|---|---|---|---|
| EC : Fluid Mechanics I | | EC6TM4 | coeff : 0.36 |
| Teacher In Charge : Laurent S. | | | |
| CM : 20 h | TD : 16 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

The presence of a fluid flowing through pipes and pumps is quasi systematic in process engineering and energetic applications.
Fluid mechanics allows the characterisation of fluid flows (determination of velocity, pressure, head losses. . . ) by applying the classical universal principles.

**LEARNING OUTCOMES**

- be able to formulate a fluid mechanics problem by writing mass, momentum and energy conservation,
- be able to determine velocity and pressure profiles of a flowing fluid by solving the previous equations in some simple cases (steady flow of a perfect fluid, laminar steady flow of an incompressible viscous fluid),
- be able to calculate head loss and to design pumps,
- be able to evaluate the force laid by a fluid (static or flowing) on a solid wall.

**DESCRIPTION**

Part I. Call back of continuum mechanics basis:
Mass, momentum and energy conservation.

Part II. Definition and properties of a fluid:
Rheological behaviour – Viscosity – Compressibility.

Part III. Fluid statics:
Hydrostatic law – Archimede theorem – Isothermal and polytropic atmospheres.

Part IV. Fluid dynamics:
Euler equations - Bernoulli theorems - Navier-Stokes equations - Laminar flows – Momentum theorem - First principle of thermodynamics applied to a fluid.

Part V. Permanent flow of an incompressible viscous fluid in a pipe:
Head and pressure loss – Pumps and turbines.

Part VI. Permanent flow of a compressible perfect fluid in a variable section pipe:
Saint-Venant theorem-Hugoniot theorems – Isentropic flows laws – Tuyeres.

**BIBLIOGRAPHY**

Mécanique expérimentale des fluides, tomes 1 et 2, R. Comolet, 5e édition Masson.
Mécanique des fluides - éléments d'un premier parcours, P. Chassaing, Cepadues éditions, Collection Polytech.
Mécanique des fluides appliquée, R. Joulié, Ellipses.
Mémento des pertes de charge, I.E. Idel'Cik, Eyrolles.

**PREREQUISITE**

EC15TM5 Continuum mechanics

**ASSESSMENT**

CC(EE, 2h, sd, ca)

TEACHING UNIT (UE) :

Languages - Engineering Culture S6

ECTS : 6

Code UE : EC6LC

SKILLS COVERED BY THE UE :

- Demonstrate the ability to communicate in English (B2 Level)
- Demonstrate the basic knowledge of a second language
- Know the professional environment and understand the business organisation
- Understand the basics of management control system and cost analysis
- Understand the basics of entrepreneurship

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

| CODE EC | INTILTLED EC | COEF | EVALUATION |
|---|---|---|---|
| EC6LC1 | English | 0.28 | IntO(PA)x1/7 + Cert(TOEIC1)x2/7 + Cert(TOEIC2)x2/7 + ExE(EE, 1h30)x2/7 |
| EC6LC2 | Second Foreign Language (Spanish / German) | 0.23 | CoOx1/5 + ExOx1/5 + IntOx1/5 + CoEx1/5 + ExEx1/5 |
| EC6LC3 | Professional Insertion I | 0.11 | Proj(Rap, Sout) |
| EC6LC4 | Entrepreneurship | 0.14 | Proj(Sout) |
| EC6LC5 | Cost Analysis and Management Control | 0.24 | CC(EE, 2h) |

| | | | |
|---|---|---|---|
| EC : English | | EC6LC1 | coeff : 0.28 |
| Teacher In Charge : Grenier A-C. | | | |
| CM : 0 h | TD : 24 h | TP : 0 h | Proj : 0 h |
| | | | Language Anglais |

**OVERVIEW**

The focus of this class is to strengthen the English skills to successfully pass the official TOEIC (Listening and Reading) Test of English for International Communication.
The TOEIC is correlated to the Common European Framework of Reference for Languages (CEFR).

**TARGET SKILLS** The student improves the technical skills and methodology required for the TOEIC test along with the acquisition of the specific vocabulary in order to pass the TOEIC with the highest score.

**DESCRIPTION**

The course is based on Business English and covers vocabulary and grammar useful for the business environment.
Reading, listening and speaking skills are improved through the study of authentic documents.
Specific intensive training for the TOEIC test as well as mock exams.

**BIBLIOGRAPHY**

Pearson: Tests complets pour le TOEIC, 6ème edition, 2018
Hachette: La BIBLE officielle du test TOEIC, 2018
Hachette: Les tests TOEIC officiels corrigés, 2018

**REQUIREMENTS**

Niveaux intermédiaire à avancé (A1 à C2)

**ASSESSMENT**

IntO(PA)x1/7 + Cert(TOEIC1)x2/7 + Cert(TOEIC2)x2/7 + ExE(EE, 1h30)x2/7

| | | | |
|---|---|---|---|
| EC : Second Foreign Language (Spanish / German) | | EC6LC2 | coeff : 0.23 |
| Teacher In Charge : Meunier C., Requena S., Perez Olivia I. / K. Hahn | | | |
| CM : 0 h | TD : 20 h | TP : 0 h | Proj : 0 h |
| | | | Language Espagnol/Allemand |

**OVERVIEW**

El objetivo es mejorar y consolidar las diferentes competencias definidas por el Marco común europeo de referencia para las lenguas.

**LEARNING OUTCOMES**

**Spanish**

Nivel A1 o Acceso : Es capaz de comprender y utilizar expresiones cotidianas de uso muy frecuente así como frases sencillas destinadas a satisfacer necesidades de tipo inmediato. Puede presentarse a sí mismo y a otros, pedir y dar información personal básica sobre su domicilio, sus pertenencias y las personas que conoce. Puede relacionarse de forma elemental siempre que su interlocutor hable despacio y con claridad y esté dispuesto a cooperar.

Nivel A2 o Plataforma: Es capaz de comprender frases y expresiones de uso frecuente relacionadas con áreas de experiencia que le son especialmente relevantes (información básica sobre sí mismo y su familia, compras, lugares de interés, ocupaciones, etc). Sabe comunicarse a la hora de llevar a cabo tareas simples y cotidianas que no requieran más que intercambios sencillos y directos de información sobre cuestiones que le son conocidas o habituales. Sabe describir en términos sencillos aspectos de su pasado y su entorno así como cuestiones relacionadas con sus necesidades inmediatas.

Nivel B1 o Intermedio: Es capaz de comprender los puntos principales de textos claros y en lengua estándar si tratan sobre cuestiones que le son conocidas, ya sea en situaciones de trabajo, de estudio o de ocio. Sabe desenvolverse en la mayor parte de las situaciones que pueden surgir durante un viaje por zonas donde se utiliza la lengua. Es capaz de producir textos sencillos y coherentes sobre temas que le son familiares o en los que tiene un interés personal. Puede describir experiencias, acontecimientos, deseos y aspiraciones, así como justificar brevemente sus opiniones o explicar sus planes.

Nivel B2 o Intermedio alto: Es capaz de entender las ideas principales de textos complejos

que traten de temas tanto concretos como abstractos, incluso si son de carácter técnico siempre que estén dentro de su campo de especialización. Puede relacionarse con hablantes nativos con un grado suficiente de fluidez y naturalidad de modo que la comunicación se realice sin esfuerzo por parte de ninguno de los interlocutores. Puede producir textos claros y detallados sobre temas diversos así como defender un punto de vista sobre temas generales indicando los pros y los contras de las distintas opciones.

Nivel C1 o Dominio operative eficaz: Es capaz de comprender una amplia variedad de textos extensos y con cierto nivel de exigencia, así como reconocer en ellos sentidos implícitos. Sabe expresarse de forma fluida y espontánea sin muestras muy evidentes de esfuerzo para encontrar la expresión adecuada. Puede hacer un uso flexible y efectivo del idioma para fines sociales, académicos y profesionales. Puede producir textos claros, bien estructurados y detallados sobre temas de cierta complejidad, mostrando un uso correcto de los mecanismos de organización, articulación y cohesión del texto.

**German**
Einen Lebenslauf und ein Bewerbungsschreiben verfassen, sich Information über Jobangebote und Wohnungsmöglichkeiten verschaffen, an einem Gespräch über allgemeine Themen teilnehmen.

**DESCRIPTION**

**Spanish**
Variable en función del nivel.
Documentos auténticos de la vida cotidiana y de especialidad.
Documentos audio y video con trabajo de comprensión oral acompañdos de parrillas de comprensión.
Comunicación interna y externa. Interculturalidad.
Escritos profesionales (carta de presentación, CV, noticias, correos, documentos técnicos, informes. . . )
Trabajo en la red: www.ver-taal.com comprensión oral de reportajes, fragmentos de informaciones televisivas, enriquecimiento del vocabulario
Búsquedas sobre España y América Latina
Búsquedas sobre empresas españolas y latinoamericanas.

**German**
Grammatische Wiederholungen der wichtigsten Strukturen, spezifischer Wortschatz (Job – und Wohnungssuche), allgemeiner Wortschatz, Lese-und Hörverständnis (Artikel, Video..)

**BIBLIOGRAPHY**

**Spanish**
Documentos proporcionados por las profesoras en función del nivel.

Mundo laboral :http://www.oficinaempleo.com/content/manualcv1.html
TV : http://www.rtve.es/
Prensa: http://elpais.com/
Español : www.ver-taal.com
Plateforma Chamilo de l'UPPA.

**German**
Site internet de la Deutsche Welle : www.fluter.de

**PREREQUISITE**

**Spanish**
Ninguno para el grupo 1, nivel A2:B1 para el grupo 2, nivel B1/B2 para el grupo 3

**German**
5 Jahre Deutsch (9. bis 13. Klasse)

**ASSESSMENT**
CoOx1/5 + ExOx1/5 + IntOx1/5 + CoEx1/5 + ExEx1/5

| | | | |
|---|---|---|---|
| EC : Professional Insertion I | | EC6LC3 | coeff : 0.11 |
| Teacher In Charge : Mercadier J., Naudy F. | | | |
| CM : 6 h | TD : 2 h | TP : 0 h | Proj : 14 h |
| | | | Language Français |

**OVERVIEW**

The purpose of this project is to lead each student to think about his/her career. Thereafter he/she can chose training periods, projects, optional courses, international experiences during the second and third year according to his/her need.

**LEARNING OUTCOMES**

Students will be able to search any informations necessary for job hunting;

**DESCRIPTION**

Rules for the oral presentation and file content.
-Functions
-Industries
-Opportunities
-Interest of training
-Knowing the companies

**BIBLIOGRAPHY**

www.apec.fr www.kompass.fr
www.onisep.fr
www.pole-emploi.fr
www.observatoireindustrieschimiques.com

**PREREQUISITE**

**ASSESSMENT**

Proj(Rap, Sout)

| | | | |
|---|---|---|---|
| EC : Entrepreneurship | | EC6LC4 | coeff : 0.14 |
| Teacher In Charge : Belmonte J.F. | | | |
| CM : 8 h | TD : 8 h | TP : 0 h | Proj : 8 h |
| | | | Language Français |

**OVERVIEW**

This course's goal is to give the students the necessary basis to create activities (such as managing enterprises projects, creation of an enterprise) thanks to a theoretical content which permits to ask appropriate questions for a successfull project while letting enough time to put it inot practice. It belongs to the PEPITE program (Pôles Etudiants Pour l'Innovation, le Transfert et l'Entreprenariat) launched by the Ministry of National Education, of Higher Education and Research, which is developped, at a regional level, by Entreprenariat Campus Aquitaine (ECA). This course allowsthe students who want to continue their creative practice to go into an appropriate further training (Student-Entrepreneur University degree or D2E) with an individual support.

**LEARNING OUTCOMES**

- Master the GRP Lab
- Present your business model in front of a jury
- Work efficiently in groups in order to complete the project
- Master the basic entrepreneurship notions

**DESCRIPTION**

The theoretical content is organised in 4 main topics :
- notion of market
- the business model
- the financial terms
- legal forms and personal status

The Tools
- students have access to the GRP Story Teller which enables them to organize their reflections and propose a presentable version of their project to the shareholders. Students have also access to

GRP Lab where they can find documents, records and further information.

Application

Students, organised in groups, will have to work together on a fictional enterprise project (or not). They will present their business model in front of a jury made of teachers and professionals specializing in business creation.

**BIBLIOGRAPHY**

•Verstraete Thierry (dir), Histoire d'entreprendre- les réalités de l'entrepreneuriat, Edition Management et Société, 2000.
•Fayolle Alain, Introduction à l'entrepreneuriat, Dunod, collection Topos, 2011.

**PREREQUISITE**

**ASSESSMENT**

Proj(Sout)

| | | | |
|---|---|---|---|
| EC : Cost Analysis and Management Control | | EC6LC5 | coeff : 0.24 |
| Teacher In Charge : Raffanel C. | | | |
| CM : 20 h | TD : 0 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

Cost analysis is a part of management, but requires knowledge of production processes.

**LEARNING OUTCOMES**

- understand different methods of cost analysis
- be able to choose the appropriate one to help decision-making
- draw up budgets, calculate and analyse the gaps between realizations and budget estimates to correct decisions if necessary

**DESCRIPTION**

PART I- COST ANALYSIS

Cost analysis by product, activity, function or project...
-full-cost analysis
-direct costing analysis
-cost-volume-profit

PART II- MANAGEMENT CONTROL

-budgets by function
-performance control
-reporting panel

**BIBLIOGRAPHY**

ALAZARD Claude, SEPARI Sabine ”Contrôle de gestion, DCG 11, manuel et applications” 2013, éditions Expert Sup DUNOD

**PREREQUISITE**

Accountancy

**ASSESSMENT**

CC(EE, 2h)

# SPECIALITE EN

| 1st Year - Semester 6 - EN | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UE Name | Code | | EC Name | Hours (h) | | | | | | | | ECTS / Coef. | |
| | UE | EC | | Tot UE | Tot EC | Tot Prés. | *CM* | *TD* | *TP* | *TA* | *Proj.* | ECTS UE | Coef. EC |
| Energy and Transfer S6 | EE6ET | EE6ET1 | Identification and Advanced Command | 256 | 24 | **12** | *4* | *8* | *0* | 12 | 0 | 10 | 0.10 |
| | | EE6ET2 | Safety | | 40 | **20** | *10* | *10* | ***0*** | 20 | **0** | | 0.16 |
| | | EE6ET3 | Industrial Electricity | | 28 | **14** | *8* | *6* | ***0*** | 14 | **0** | | 0.11 |
| | | EE6ET4 | Automation and Instrumentation | | 40 | **20** | *10* | *10* | ***0*** | 20 | **0** | | 0.16 |
| | | EE6ET5 | Heat Conduction II | | 32 | **16** | *6* | *10* | ***0*** | 16 | **0** | | 0.13 |
| | | EE6ET6 | Acoustics | | 32 | **16** | *8* | *8* | ***0*** | 16 | **0** | | 0.13 |
| | | EE6ET7 | Computer Aided Design | | 32 | **16** | *6* | *10* | ***0*** | 16 | **0** | | 0.13 |
| | | EE6ET8 | building thermal engineering | | 28 | **14** | *6* | *8* | ***0*** | 14 | **14** | | 0.08 |
| **Total Spec EN** | | | | **256** | | **128** | 58 | 70 | | **128** | 0 | **10** | |
| **Total TC + Spec EN** | | | | **808** | | **404** | | | | | | **30** | |

TEACHING UNIT (UE) :

Energy and Transfer S6

ECTS : 10

Code UE : EE6ET

SKILLS COVERED BY THE UE :

- Understand both fundamental and technological aspects of instrumentation and metrology, encountered in thermal and energy engineering
- Control the selection and the use of actuators encountered in the speciality
- Understand the principles of advanced process control, control engineering, distributed control system and system identification encountered in the speciality
- Understand the basics of electric power industry
- Know the methods for the risk assessment related to the speciality
- Demonstrate skills in steady-state and non steady-state heat transfer by conduction
- Know the key concepts of mechanics of vibration and acoustic transmission
- Demonstrate the ability to understand, to analyse and to produce a technical drafting
- Be able to size and analyse an energy system, especially for the building sector

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

| CODE EC | INTILTLED EC | COEF | EVALUATION |
|---|---|---|---|
| EE6ET1 | Identification and Advanced Command | 0.1 | Proj(Rap,PA) |
| EE6ET2 | Safety | 0.16 | CC(EE, 2h) |
| EE6ET3 | Industrial Electricity | 0.11 | CC(EE, 1h30') |
| EE6ET4 | Automation and Instrumentation | 0.16 | CC(EE, 2h) |
| EE6ET5 | Heat Conduction II | 0.13 | CC(EE, 2h, sd, ca) |
| EE6ET6 | Acoustics | 0.13 | CC(EE, 1h30, ca) |
| EE6ET7 | Computer Aided Design | 0.13 | CC(EM,da)x1/3 + CC(EE,sd,st,sc,2h)x2/3 |
| EE6ET8 | building thermal engineering | 0.08 | Proj(Rap) |

| | | | |
|---|---|---|---|
| EC : Identification and Advanced Command | | EE6ET1 | coeff : 0.1 |
| Teacher In Charge : Bessières D. | | | |
| CM : 4 h | TD : 8 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

The main objective is to give to the students the knowledge about identification and control of dynamic systems by using numerical tools..

**LEARNING OUTCOMES**

After this course the students should:

- Know how to identify process and tune PID controller
- Matlab and Simulink to simulate, and analyze the response of dynamic systems.
- Have basic knowledge of advanced control which allows discussions with control engineers.

**DESCRIPTION**

1) Continuous-time model identification
2) Tuning PID controller
3) Simulation and Model-Based Design for dynamic systems

**RECOMMENDED READING**

Régulation P.I.D. : analogique - numérique – floue, Daniel Lequesne, Hermes Science Feedback Control of Dynamic Systems ,Gene F. Franklin, J. Da Powell,Abbas Emami-Naeini
Matlab/Simulink pour l'analyse et la commande de systemes, Yassine HADDAB, techniques de l'ingénieur.

**PREREQUISITE**

Dynamic systems and control

**ASSESSMENT**

Proj(Rap,PA)

| | | | |
|---|---|---|---|
| EC : Safety | | EE6ET2 | coeff : 0.16 |
| Teacher In Charge : Contamine F. | | | |
| CM : 10 h | TD : 10 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

The objective of this course is to make students aware of safety. Having defined the notions of danger, risk, and gravity, this course approaches some statutory aspects. An inventory of fixtures obtained from a data bank of accidentology ( BARPI) is then of use as introduction to the identification and to the evaluation of the chemical risks, then to the characterization of the effects due to the exposure in a poison gas (Lois de Haber), and finally, the evaluation of fire risks.

**LEARNING OUTCOMES**

- Notions of danger, risk
- Be aware of the main dangers
- Being capable of estimating the chemical risks, and of fire by using a method simplified by analysis of the risks

**DESCRIPTION**

General concepts: hazard, risk, severity, probability
Accidents and risk analysis

Examples of Mexico City
Risk management elements
Elements of regulation.
Search for information on the dangers associated with a product (Etiquette, F.D.S)
Toxicity

General elements indicators Health
chemical risk assessment (INRS method) – calculation of a health score
Haber's laws Notion of Probit
Fire

General elements
Indicators, What is an ATEX?
Chemical fire risk assessment (INRS method) – calculation of a fire outbreak score

**RECOMMENDED READING**

André LAURENT, Sécurité des procédés - Connaissances de base et méthodes d'analyse des risques, 2ième Edition, Lavoisier, Ed.Tec & Doc, Collection Génie de Procédés de l'Ecole de Nancy, Paris, 2011.
Notes documentaires I.N.R.S (2233)

**PREREQUISITE**

general scientific knowledge

**ASSESSMENT**

CC(EE, 2h)

| | | | |
|---|---|---|---|
| EC : Industrial Electricity | | EE6ET3 | coeff : 0.11 |
| Teacher In Charge : Subileau R. | | | |
| CM : 8 h | TD : 6 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

Nowadays, electrical energy is essential for the effective operation of industrial enterprises. The purpose of this course is giving the students some theoretical basis to understand electrical energy from its production to its use and make them aware of electrical risks.

**LEARNING OUTCOMES**

- Know electrical risks
- Know electrical energy distribution principles
- Know electronical conversion principles
- Be able to perform a first analysis of an electrical machine

**DESCRIPTION**

1 Main industrial electricity principles
2 Electrical risks sensitivity
3 Three phase grids
4 Electronical power conversion
5 Reciprocating engines

**RECOMMENDED READING**

G. SEGUIER Electricité industrielle 2ème édition , éditeur DUNOD

**PREREQUISITE**

Basic electronical concepts

**ASSESSMENT**

CC(EE, 1h30')

| | | | |
|---|---|---|---|
| EC : Automation and Instrumentation | | EE6ET4 | coeff : 0.16 |
| Teacher In Charge : Dumas P. | | | |
| CM : 10 h | TD : 10 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

The objective of this course is to provide analysis and programming methods to drive industrial Control-Command systems (automation) and show the link between sensors and actuators.
Analysis of Automation Systems or Computer Engineering systems is done with step- transition diagram or finite state machine and Petri net.

**LEARNING OUTCOMES**

- Being able to perform the analysis of an industrial system and program control systems.
- Being able to choose an automation equipment.
- Recognize limits of control systems and Supervisory Control

**DESCRIPTION**

INDUSTRIAL INSTRUMENTATION:
Chains measuring and control(sensor, conditioning, actuators)
Reminders on industrial sensors

Automation:
Command Systems(PLC, PC, PAC)
Monitoring, limitations
OPC Standard , client-server concept
SFC Analysis and standardized languages
STANDARD 1131-3 Finite State Machine analysis
Petri net

**RECOMMENDED READING**

**PREREQUISITE**

**ASSESSMENT**

CC(EE, 2h)

| | | | |
|---|---|---|---|
| EC : Heat Conduction II | | EE6ET5 | coeff : 0.13 |
| Teacher In Charge : Casas L. | | | |
| CM : 6 h | TD : 10 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

Conduction is one of the three modes of heat transfer. It is met in the large majority of the thermal systems. This part is the continuation of the course "Heat Conduction 1" where more complex problems closer to the industrial problems will be dealt with.

**LEARNING OUTCOMES**

After this course, the students must:

- Be able to judge importance of this mode of thermal transfer
- Be able to calculate exchanged heat
- Be able to deal with the principal problems of conduction in steady state and non stationary state.

**DESCRIPTION**

Analytical study of the thermocinetic problems

1. Steady state

- Location and temperature dependent thermal conductivity.
- Effect of internal energy generation
- Fins
- Multidirectional problems

2. Non steady state

- Lumped Thermal Capacity Model (thin body)
- Studies of the thick bodies (various methods of resolution)

**RECOMMENDED READING**

Boundary Value Problems of Heat Conduction. M.N. OZISIK (Dover Publications)

Heat Transfer Handbook. A Bejan, A.D. Kraus (John Wiley & Sons)

**PREREQUISITE**

Conduction I (EC15TM2)

**ASSESSMENT**

CC(EE, 2h, sd, ca)

| | | | |
|---|---|---|---|
| EC : Acoustics | | EE6ET6 | coeff : 0.13 |
| Teacher In Charge : Ducousso M. | | | |
| CM : 8 h | TD : 8 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

The Engineer in Energetics often has to install very different equipments – heater, ACV or air conditioning- that may have strong acoustic effects on the surrounding environment. Even if the engineer is not an acoustician, he/she has to know the fundamentals of acoustics to consider it in his studies.

**LEARNING OUTCOMES**

After this course, students should be able to describe mathematically and physically a sound. They may analyze its spectrum, estimate the noise rating associated and propose, if necessary, some improvements. He/she will have the main notions regarding acoustic correction and insulation.

**DESCRIPTION**

Introduction
I.Acoustic wave physical characteristics Definition – Sound wave characteristics –
II.Measure and perception of sounds
Basic indicators (sound levels and filters) – Loudness curves
III. Applied acoustics to the building sector Insulation and correction
IV. European regulations
Conclusion

**RECOMMENDED READING**

Acoustique Générale, Potel C. & Bruneau M., 2006, Ellipses. Acoustique Appliquée, Val M., 2002, Dunod.
Impacts sanitaires du bruit, état des lieux et indicateurs bruit-santé. Agence Française de Sécurité Sanitaire Environnementale (2004)
Normes Française : NF EN 12354-1, NF EN 12354-2, NF EN 12354-3

**PREREQUISITE**

Conduction I (EC15TM2)

**ASSESSMENT**

CC(EE, 1h30, ca)

| | | | |
|---|---|---|---|
| EC : Computer Aided Design | | EE6ET7 | coeff : 0.13 |
| Teacher In Charge : Gibout S. | | | |
| CM : 6 h | TD : 10 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

This module provides students with the basic techniques of graphic representation through the use of AutoCAD.
Materials Resistance concepts are also introduced.

**LEARNING OUTCOMES**

At the end of this course, students should be able to:

- Read, analyze and understand technical drawings
- Produce an unambiguous technical drawing
- Use the key functions of AutoCAD
- Analyze and predict the deformation and stress limits of mechanical parts subject to constraints

**DESCRIPTION**

Technical Drawing
- Presentation Standards
- Different types of views, sections and cuts
- Quotation
- Representation of common elements (threads, ...)
- Presentation of AutoCAD

Resistance of Materials
- Assumptions and fundamental laws
- Tension / Compression
- Shear
- Twist

**RECOMMENDED READING**

Guide du dessinateur industriel : pour maîtriser la communication technique, Chevalier Andre (Hachette Supérieur)

**PREREQUISITE**

**ASSESSMENT**

CC(EM,da)x1/3 + CC(EE,sd,st,sc,2h)x2/3

| | | | |
|---|---|---|---|
| EC : building thermal engineering | | EE6ET8 | coeff : 0.08 |
| Teacher In Charge : Kousksou T. | | | |
| CM : 6 h | TD : 8 h | TP : 0 h | Proj : 14 h |
| | | | Language Français |

**OVERVIEW**

Building are responsible for about 40% of energy consumption in France and of 20% of CO2 emissions. The new thermal regulations impose the improvement of the energy performance of new buildings by reducing their consumption by 40% in 2020.
The search for the optimum energy also requires a better integration of a building in its environment and in particular the optimal use of free gains, such as solar radiation. A dwelling must now be seen as a complex and dynamic energy system, which must be energy efficient, have little impact on the environment ... and ensure the comfort of its occupants!

**LEARNING OUTCOMES**

At the end of this module, students should be able to:

- Understand the terminology of the field of construction;
- Define the concept of thermal comfort and understand its implications in the constructive elements
- Know and identify the physical laws governing the relationship of a building with its environment
- Understand the thermal behavior of the envelopes

**DESCRIPTION**

•Needs of occupants. Concept of thermal comfort
•Building structure
•Thermal behavior of the building envelopes
•Heat balance of the building

**BIBLIOGRAPHY**

**PREREQUISITE**

All lessons in heat transfer

**ASSESSMENT**

Proj(Rap)

# SPECIALITE GP

| 1st Year - Semester 6 - GP | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UE Name | Code | | EC Name | Hours (h) | | | | | | | | ECTS / Coef. | |
| | UE | EC | | Tot UE | Tot EC | Tot Prés. | CM | TD | TP | TA | Proj. | ECTS UE | Coef. EC |
| Chemistry and Reactor S6 | EP6CR | EP6CR1 | Sensors in Solution | 260 | 48 | **24** | *12* | *12* | ***0*** | 24 | **0** | 10 | 0.19 |
| | | EP6CR2 | Macromolecular Organic Chemistry | | 56 | **28** | *10* | *6* | *12* | 28 | **0** | | 0.21 |
| | | EP6CR3 | Organic Chemistry | | 48 | **24** | *12* | *12* | ***0*** | 24 | **0** | | 0.19 |
| | | EP6CR4 | Chemical Kinetics | | 60 | **30** | *12* | *18* | ***0*** | 30 | **0** | | 0.22 |
| | | EP6CR5 | Chemical Reaction Engineering | | 48 | **24** | *12* | *12* | *0* | 24 | **0** | | 0.19 |
| **Total Spec GP** | | | | **260** | | **130** | 58 | 60 | 12 | **130** | | **10** | |
| **Total TC + Spec GP** | | | | **812** | | **406** | | | | | | **30** | |

TEACHING UNIT (UE) :

Chemistry and Reactor S6

ECTS : 10

Code UE : EP6CR

SKILLS COVERED BY THE UE :

- Understand the physicochemical reactions in solution (acid/base, redox potential, etc.)
- Understand the main reaction mechanisms in organic chemistry and polymer chemistry
- Identify the simple reaction kinetics
- Demonstrate the ability to perform mass and energy balances on ideal reactors and whole processes (systems)

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

| CODE EC | INTILTLED EC | COEF | EVALUATION |
|---|---|---|---|
| EP6CR1 | Sensors in Solution | 0.19 | CC(EE, 2h) |
| EP6CR2 | Macromolecular Organic Chemistry | 0.21 | CC(EE, 2h)x8/10 + TP(Tr, Rap)x2/10 |
| EP6CR3 | Organic Chemistry | 0.19 | CC(EE, 1h30') |
| EP6CR4 | Chemical Kinetics | 0.22 | CC(EE, 2H) |
| EP6CR5 | Chemical Reaction Engineering | 0.19 | CC(EE, 45 min)x0,35 + CC(EE, da, 1h15)x0,65 |

| | | | |
|---|---|---|---|
| EC : Sensors in Solution | | EP6CR1 | coeff : 0.19 |
| Teacher In Charge : Authier L. | | | |
| CM : 12 h | TD : 12 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

The aim of this course is to give to the students the tools allowing the assessment of the chemical reactions and species occurring in solutions

**LEARNING OUTCOMES**

A l'issue de ce module, l'étudiant sera capable de :

- know the chemical processes occurring in solutions,
- measure and monitor the chemical composition in solutions by using electrochemical sensors,
- identify the convenient sensor according to the measurement required.

**DESCRIPTION**

1-Chemistry in solution: acido-basic, redox, complexation and precipitation reactions
2-non-specific sensor with current : measurement of the resistance in solution
3-specific sensor with no current : electrodes of 1st , 2nd and 3rd species ; electrode with monocristal, solid or liquid membrane, soluble gas; crown ether- based PVC electrode ; biosensor.

**BIBLIOGRAPHY**

Miomandre, Electrochimie, des concepts aux applications, 3ème edn, DUNOD

**PREREQUISITE**

Basic level of chemistry of solutions

**ASSESSMENT**

CC(EE, 2h)

| | | | |
|---|---|---|---|
| EC : Macromolecular Organic Chemistry | | EP6CR2 | coeff : 0.21 |
| Teacher In Charge : Bousquet A. | | | |
| CM : 10 h | TD : 6 h | TP : 12 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

This course offers overview of polymer science, from the basic definitions, macromolecular properties, thermomechanical properties to the design techniques for synthetic polymers.

**LEARNING OUTCOMES**

- To get a fundamental knowledge of what a polymer is
- To know the molecular characteristics of polymeric chains
- To develop a general idea of the use and production of usual polymers
- To understand synthesis mechanisms of common polymer

**DESCRIPTION**

This course offers and overview of polymer science, from the basic definitions, macromolecular properties, thermomechanical properties to the design techniques for synthetic polymers. Microarchitecture knowledge includes tacticity, molecular-weight distribution, sequence distributions in copolymers, errors in chains such as branches, head-to- head addition ect...
Studies synthesis of polymeric materials, emphasizing interrelationships of chemical pathways, process conditions, and microarchitecture of molecules produced.
Chemical pathways include traditional approaches such as radical polymerization, and step- growth polycondensation.
Process conditions include bulk, solution, emulsion, suspension, gas phase, and batch vs. continuous fluidized bed.
Experiments in this class are broadly aimed at acquainting students with the range of properties of polymers, methods of synthesis, and physical chemistry. Some examples of laboratory work include solution polymerization of acrylamide, physical and chemical gels, viscosimetry analysis.

**BIBLIOGRAPHY**

Chimie et physico-chimie des polymères – Michel Fontanille (Dunod)

**PREREQUISITE**

Basic Organic Chemistry

**ASSESSMENT**

CC(EE, 2h)x8/10 + TP(Tr, Rap)x2/10

| | | | |
|---|---|---|---|
| EC : Organic Chemistry | | EP6CR3 | coeff : 0.19 |
| Teacher In Charge : Sotiropoulos JM | | | |
| CM : 12 h | TD : 12 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

Basic knowledge and concept in organic and macromolecular chemistry regarding its applications in the following domains: industrial organic chemistry (plastic matters, elastomer, resins, . . . ).

**LEARNING OUTCOMES**

After this course, students should understand and be able to explain the mechanism of few chemical reactions for each main family of organic and macromolecular compounds.

**DESCRIPTION**

- the reaction in organic chemistry
- aliphatics hydrocarbons
- aromatics hydrocarbons
- alkyl halides and Grignard compounds
- alcohols and phenols (C-O-H group)
- carbonyl compounds (carbon-oxygen double bond C=O)
- carboxylic acids and derivated (for example : few polymer synthesis)

**BIBLIOGRAPHY**

Chimie organique, cours - Paul Arnaud (Dunod)
Chimie Organique, Les grands principes - John McMurry (Dunod)

**PREREQUISITE**

General chemistry (basic organic chemistry)

**ASSESSMENT**

CC(EE, 1h30')

| | | | |
|---|---|---|---|
| EC : Chemical Kinetics | | EP6CR4 | coeff : 0.22 |
| Teacher In Charge : Olivier J. | | | |
| CM : 12 h | TD : 18 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

The goal of chemical kinetics is to study the rate at which a chemical reaction advances with respect to time. Indeed, a chemical reaction needs time to proceed. This aspect is of particular importance for the design of chemical reactor. The quicker the rate of reaction is the smaller is the size of the reactor where it has to be carried out. Hence this lecture develops this particular field and gives insights into the formalism on which rate of reaction should be taken into account.

**LEARNING OUTCOMES** After this course, students should:

- Etre capable de déterminer l'ordre et la constante de vitesse d'une réaction simple ou complexe compte tenu de relevés expérimentaux.
- Etre capable d'appliquer leurs connaissances au dimensionnement de réacteurs industriels

**DESCRIPTION**

Part I: Rate of chemical reaction

The definition of the rate of chemical reaction is given in this part. Mass balances are then derived on the Completely Stirred Tank Reactor and on the Plug Flow Reactor

Part II: Homogeneous kinetics. Closed systems at constant volume

This is the main part of the lecture. The mass balance is derived on a batch and completely stirred tank reactor. This law is integrated for reaction rate at order 0, 1 and 2. Concepts such as half time reaction, Arrhenius law, simple reactions, equilibrium, competitive reactions and chain reactions are developed inside this part.

**BIBLIOGRAPHY**

J. Villermaux, Génie de la reaction chimique.
B. Frémaux, Eléments de cinétique et de catalyse, Tec & Doc, 1989

**PREREQUISITE**

Introduction aux phénomènes de transport Chimie générale

Introduction au génie des procédés Résolution d'équations différentielles

**ASSESSMENT**

CC(EE, 2H)

| | | | |
|---|---|---|---|
| EC : Chemical Reaction Engineering | | EP6CR5 | coeff : 0.19 |
| Teacher In Charge : Mercadier J. | | | |
| CM : 12 h | TD : 12 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

As each chemical plant contains one (or more) reactor, chemical reaction engineering tries to determine the influence of the reactor design and operating conditions on the products of the reaction. This course concerns simple reactor design calculations for ideal reactors.

**LEARNING OUTCOMES**

At the end of the courses of chemical reaction engineering students will be able to build mass and thermal balance in idealistic reactors (plug flow and completely stirred tank reactor).
These balances must be written easily in ordinary conditions but also could be written when the volumetric flow rate changes into the reactor or in case of equilibrate reactions and for several reactions occurring at the same time.

**DESCRIPTION**

Part I: Material balance in ideal reactors for a single reaction
Ideal batch reactor
Steady state mixed flow reactor
Steady state plug flow reactor

Part II: Multiple reactions
Irreversible series/parallel reactions
Conversion, selectivity, yields

Part III: Thermal behaviour of ideal reactors
Reversible reactions
Optimal temperature progression
Energy balance in a continuous stirred tank reactor, in a plug flow reactor, in a batch reactor
Adiabatic reactor
Reactor's runaway
Data for thermal exchange in industrial reactors

**BIBLIOGRAPHY**

Schweich D., Génie de la réaction chimique, Lavoisier, technique et documentation, 2001 Villermaux J., Génie de la réaction chimique - Conception et fonctionnement des réacteurs, Tech et Doc, 1993 (2ème édition)
Euzen J.P., P. Trambouze , J.P. Wauquier, Méthodologie pour l'extrapolation des procédés chimiques, éditions Technip, 1993
Trambouze P., H. Van Landeghem, J.P. Wauquier, Les réacteurs chimiques (conception, calcul, mise en œuvre), Technip, 1984
Levenspiel O., Chemical Reaction Engineering, John Wiley & Sons, 1999 (third edition)

**PREREQUISITE**

Kinetics

**ASSESSMENT**

CC(EE, 45 min)x0,35 + CC(EE, da, 1h15)x0,65

# SPECIALITE GEII

| 1st Year - Semester 6 - GEII | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UE Name | Code UE | Code EC | EC Name | Hours (h) Tot UE | Tot EC | Tot Prés. | CM | TD | TP | TA | Proj. | ECTS / Coef. ECTS UE | Coef. EC |
| Apprenticeship S6 | EG6AP | EG6AP1 | Skills developed in the company | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 7 | 0.70 |
| | | EG6AP2 | Company assignements | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0.30 |
| Languages for the engineer S6 | EG6LA | EG6LA1 | Anglais | 88 | 48 | 24 | 0 | 24 | 0 | 24 | 0 | 3 | 0.54 |
| | | EG6LA2 | Langue 2 (Espagnol ou Allemand) | | 40 | 20 | 0 | 20 | 0 | 20 | 0 | | 0.46 |
| Energy and industry | EG6EI | EE6ET1 | Identification and advanced control | 132 | 24 | 12 | 4 | 8 | 0 | 12 | 0 | 5 | 0.19 |
| | | EG6EI2 | Security | | 40 | 20 | 10 | 10 | 0 | 20 | 0 | | 0.30 |
| | | EE6ET3 | Industrial electricity | | 28 | 14 | 8 | 6 | 0 | 14 | 0 | | 0.21 |
| | | EE6ET4 | Automation and instrumentation | | 40 | 20 | 10 | 10 | 0 | 20 | 0 | | 0.30 |
| Electrical energy and control command S6 | EG6EE | EG6EE1 | Electrical design tools | 225 | 60 | 30 | 14 | 16 | 0 | 30 | 0 | 8 | 0.27 |
| | | EG6EE2 | Control -Command 2 | | 52 | 32 | 6 | 10 | 16 | 20 | 0 | | 0.23 |
| | | EG6EE3 | Transformers and Electrical Machines | | 85 | 50 | 14 | 16 | 20 | 35 | 0 | | 0.38 |
| | | EG6EE4 | Industrial electrical devices | | 28 | 4 | 0 | 4 | 0 | 24 | 20 | | 0.12 |
| Total Spec GEII | | | | 445 | | 226 | 66 | 124 | 36 | 219 | 25 | 23 | |
| Total TC + Spé GEII | | | | 625 | | 316 | | | | | | 30 | |

TEACHING UNIT (UE) :

Apprenticeship S6

ECTS : 7

Code UE : EG6AP

SKILLS COVERED BY THE UE :

- Specify industrial manufactured devices involving electrical engineering and industrial computing, on the basis of established and anticipated needs, in order to establish essential design requirements.
- Understand the general operation of electrical energy supply or conversion equipment, in order to determine the constraints of service continuity and safety.
- Document the study and design of the equipment concerned in order to explain its operation, monitor its implementation or arrange for its maintenance.
- Understand the general operation of potentially high-voltage supervised electrical engineering systems in order to understand their operating and safety constraints.
- Know and understand a complex and interdisciplinary scientific and technical field of specialisation in order to interface between the different partners by communicating on the progress of the work/project with both internal and company partners.
- Understand how to work in an international context, by mastering one or more foreign languages, by being culturally open, by taking into account all the constraints (managerial, environmental, HR, CSR.) in order to favour synergy within the team.
- Mastering communication techniques adapted to the situation and the people involved in order to lead the development of a project in accordance with the company's strategy.
- Leading a multicultural team by adapting to the constraints and specificities of each person, taking into account the cultural mix in its interactions, using adapted communication tools and methods, in order to establish an environment conducive to the success of the project in compliance with regulations, ethics, safety and health.

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

| CODE EC | INTILTLED EC | COEF | EVALUATION |
|---|---|---|---|
| EG6AP1 | Skills developed in the company | 0.7 | EvalC (entreprise)*0.6 + PA (entreprise)*0.4 |
| EG6AP2 | Company assignements | 0.3 | EvalC (Rap*0.5 + sout*0.5) |

| | | | |
|---|---|---|---|
| EC : Skills developed in the company | | EG6AP1 | coeff : 0.7 |
| Teacher In Charge : Pécastaing L. | | | |
| CM : 0 h | TD : 0 h | TP : 0 h | Proj : 5 h |
| | | | Language Français |

**INTRODUCTION**

During this second period of twenty weeks in a company, including a long period of twelve weeks, the apprentice will be confronted with a potentially multidisciplinary project that he will be able to organise and structure. He will also identify the Corporate Social Responsability (CSR) approach of his host company.

**TARGETED SKILLS**

- To know and understand a complex and interdisciplinary scientific and technical field of specialisation in order to ensure the interface between the different partners by communicating on the progress of the work/project with both internal and external partners.
- Understand how to work in an international context, by mastering one or more foreign languages, by being culturally open, by taking into account all the constraints (managerial, environmental, etc.) in order to favour synergy within the team.
- Mastering communication techniques adapted to the situation and the people involved in order to lead the development of a project in accordance with the company's strategy.
- Leading a multicultural team by adapting to the constraints and specificities of each person, taking into account the cultural mix in its interactions, using adapted communication tools and methods, in order to establish an environment conducive to the success of the project in compliance with regulations, ethics, safety and health.

**CONTENT**

The activities developed in this EC are established according to the specific needs of the company and in order to complete the targeted skills.

**RESSOURCES**

**PREREQUISITES**

**EVALUATION PROCEDURES**

EvalC (entreprise)*0.6 + PA (entreprise)*0.4

| | | | |
|---|---|---|---|
| EC : Company assignements | | EG6AP2 | coeff : 0.3 |
| Teacher In Charge : Pécastaing L. | | | |
| CM : 0 h | TD : 0 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**INTRODUCTION**

During this second period of twenty weeks in the company, including a long period of twelve weeks, the apprentice will again be confronted with the notions of expression of needs and specifications and will have written his first reports related to his activities. He will be able to learn new scientific and technical fields, including multidisciplinary ones.

**TARGETED SKILLS**

- Specify industrial manufactured devices involving electrical engineering and industrial computing, on the basis of established and anticipated needs, in order to establish essential design requirements.
- Understand the general operation of electrical energy supply or conversion equipment, in order to determine the constraints of service continuity and safety.
- Document the study and design of the equipment concerned in order to explain its operation, monitor its implementation or arrange for its maintenance.
- Understand the general operation of potentially high-voltage supervised electrical engineering systems in order to understand their operating and safety constraints.

**CONTENT**

Based on a report of the year's activities, this document enables you to judge the level of acquisition of skills. It is based on your self-assessment in relation to the diploma's reference framework of skills. It is then supported orally.
It is not a simple activity report.
A report of about fifteen pages of information, excluding table of contents, appendices, etc. From the introduction to the conclusion.
Check with your Company Tutor that there is no confidential information in your report before submitting it to the LEA.

**RESSOURCES**

**PREREQUISITES**

**EVALUATION PROCEDURES**

EvalC (Rap*0.5 + sout*0.5)

TEACHING UNIT (UE) :

Languages for the engineer S6

ECTS : 3

Code UE : EG6LA

SKILLS COVERED BY THE UE :

- Demonstrate the ability to communicate in English (B2 Level)
- Demonstrate the basic knowledge of a second language
- Know the professional environment and understand the business organisation
- Understand the basics of management control system and cost analysis
- Understand the basics of entrepreneurship

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

| CODE EC | INTILTLED EC | COEF | EVALUATION |
|---|---|---|---|
| EG6LA1 | Anglais | 0.54 | IntO(PA)x1/7 + Cert(TOEIC1)x2/7 + Cert(TOEIC2)x2/7 + ExE(EE, 1h30)x2/7 |
| EG6LA2 | Langue 2 (Espagnol ou Allemand) | 0.46 | CoOx1/5 + ExOx1/5 + IntOx1/5 + CoEx1/5 + ExEx1/5 |

| | | | |
|---|---|---|---|
| EC : Anglais | | EG6LA1 | coeff : 0.54 |
| Teacher In Charge : Grenier A-C. | | | |
| CM : 0 h | TD : 24 h | TP : 0 h | Proj : 0 h |
| | | | Language Anglais |

**OVERVIEW**

The focus of this class is to strengthen the English skills to successfully pass the official TOEIC (Listening and Reading) Test of English for International Communication.
The TOEIC is correlated to the Common European Framework of Reference for Languages (CEFR).

**TARGET SKILLS**

The student improves the technical skills and methodology required for the TOEIC test along with the acquisition of the specific vocabulary in order to pass the TOEIC with the highest score.

**DESCRIPTION**

The course is based on Business English and covers vocabulary and grammar useful for the business environment.
Reading, listening and speaking skills are improved through the study of authentic documents.
Specific intensive training for the TOEIC test as well as mock exams.

**BIBLIOGRAPHY**

Pearson: Tests complets pour le TOEIC, 6ème edition, 2018
Hachette: La BIBLE officielle du test TOEIC, 2018
Hachette: Les tests TOEIC officiels corrigés, 2018

**REQUIREMENTS**

Niveaux intermédiaire à avancé (A1 à C2)

**ASSESSMENT**

IntO(PA)x1/7 + Cert(TOEIC1)x2/7 + Cert(TOEIC2)x2/7 + ExE(EE, 1h30)x2/7

| | | | |
|---|---|---|---|
| EC : Langue 2 (Espagnol ou Allemand) | | EG6LA2 | coeff : 0.46 |
| Teacher In Charge : Armenta A., Cobos A., Perez Olivia I. / K. Hahn | | | |
| CM : 0 h | TD : 20 h | TP : 0 h | Proj : 0 h |
| | | | Language Espagnol/Allemand |

**OVERVIEW**

El objetivo es mejorar y consolidar las diferentes competencias definidas por el Marco común europeo de referencia para las lenguas.

**LEARNING OUTCOMES**

**Spanish**

Nivel A1 o Acceso : Es capaz de comprender y utilizar expresiones cotidianas de uso muy frecuente así como frases sencillas destinadas a satisfacer necesidades de tipo inmediato. Puede presentarse a sí mismo y a otros, pedir y dar información personal básica sobre su domicilio, sus pertenencias y las personas que conoce. Puede relacionarse de forma elemental siempre que su interlocutor hable despacio y con claridad y esté dispuesto a cooperar.

Nivel A2 o Plataforma: Es capaz de comprender frases y expresiones de uso frecuente relacionadas con áreas de experiencia que le son especialmente relevantes (información básica sobre sí mismo y su familia, compras, lugares de interés, ocupaciones, etc). Sabe comunicarse a la hora de llevar a cabo tareas simples y cotidianas que no requieran más que intercambios sencillos y directos de información sobre cuestiones que le son conocidas o habituales. Sabe describir en términos sencillos aspectos de su pasado y su entorno así como cuestiones relacionadas con sus necesidades inmediatas.

Nivel B1 o Intermedio: Es capaz de comprender los puntos principales de textos claros y en lengua estándar si tratan sobre cuestiones que le son conocidas, ya sea en situaciones de trabajo, de estudio o de ocio. Sabe desenvolverse en la mayor parte de las situaciones que pueden surgir durante un viaje por zonas donde se utiliza la lengua. Es capaz de producir textos sencillos y coherentes sobre temas que le son familiares o en los que tiene un interés personal. Puede describir experiencias, acontecimientos, deseos y aspiraciones, así como justificar brevemente sus opiniones o explicar sus planes.

Nivel B2 o Intermedio alto: Es capaz de entender las ideas principales de textos complejos

que traten de temas tanto concretos como abstractos, incluso si son de carácter técnico siempre que estén dentro de su campo de especialización. Puede relacionarse con hablantes nativos con un grado suficiente de fluidez y naturalidad de modo que la comunicación se realice sin esfuerzo por parte de ninguno de los interlocutores. Puede producir textos claros y detallados sobre temas diversos así como defender un punto de vista sobre temas generales indicando los pros y los contras de las distintas opciones.

Nivel C1 o Dominio operative eficaz: Es capaz de comprender una amplia variedad de textos extensos y con cierto nivel de exigencia, así como reconocer en ellos sentidos implícitos. Sabe expresarse de forma fluida y espontánea sin muestras muy evidentes de esfuerzo para encontrar la expresión adecuada. Puede hacer un uso flexible y efectivo del idioma para fines sociales, académicos y profesionales. Puede producir textos claros, bien estructurados y detallados sobre temas de cierta complejidad, mostrando un uso correcto de los mecanismos de organización, articulación y cohesión del texto.

**German**
Einen Lebenslauf und ein Bewerbungsschreiben verfassen, sich Information über Jobangebote und Wohnungsmöglichkeiten verschaffen, an einem Gespräch über allgemeine Themen teilnehmen.

**DESCRIPTION**

**Spanish**
Variable en función del nivel.
Documentos auténticos de la vida cotidiana y de especialidad.
Documentos audio y video con trabajo de comprensión oral acompañdos de parrillas de comprensión.
Comunicación interna y externa. Interculturalidad.
Escritos profesionales (carta de presentación, CV, noticias, correos, documentos técnicos, informes...)
Trabajo en la red: www.ver-taal.com comprensión oral de reportajes, fragmentos de informaciones televisivas, enriquecimiento del vocabulario
Búsquedas sobre España y América Latina
Búsquedas sobre empresas españolas y latinoamericanas.

**German**
Grammatische Wiederholungen der wichtigsten Strukturen, spezifischer Wortschatz (Job – und Wohnungssuche), allgemeiner Wortschatz, Lese-und Hörverständnis (Artikel, Video..)

**BIBLIOGRAPHY**

**Spanish**
Documentos proporcionados por las profesoras en función del nivel.

Mundo laboral :http://www.oficinaempleo.com/content/manualcv1.html
TV : http://www.rtve.es/
Prensa: http://elpais.com/
Español : www.ver-taal.com
Plateforma Chamilo de l'UPPA.

**German**
Site internet de la Deutsche Welle : www.fluter.de

**PREREQUISITE**

**Spanish**
Ninguno para el grupo 1, nivel A2:B1 para el grupo 2, nivel B1/B2 para el grupo 3

**German**
5 Jahre Deutsch (9. bis 13. Klasse)

**ASSESSMENT**
CoOx1/5 + ExOx1/5 + IntOx1/5 + CoEx1/5 + ExEx1/5

TEACHING UNIT (UE) :

Energy and industry

ECTS : 5

Code UE : EG6EI

SKILLS COVERED BY THE UE :

- Master the fundamental and technological aspects of instrumentation and metrology encountered in thermal and energetic
- Master the choice, the use of actuators encountered in the specialty
- Master the advanced principles of regulation, control, command and identification encountered in the specialty
- Know the basic elements of industrial electricity
- Know the risk analysis methods related to the specialty
- Control heat transfer by conduction, both steady-state and unsteady
- Know how to understand, analyze and produce a technical drawing
- Be able to size and analyze an energy system, especially for the building sector

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

| CODE EC | INTILTLED EC | COEF | EVALUATION |
|---|---|---|---|
| EE6ET1 | Identification and advanced control | 0.19 | Proj(Rap,PA) |
| EG6EI2 | Security | 0.3 | CC(EE, 2h) |
| EE6ET3 | Industrial electricity | 0.21 | CC(EE, 1h30') |
| EE6ET4 | Automation and instrumentation | 0.3 | CC(EE, 2h) |

| | | | |
|---|---|---|---|
| EC : Identification and advanced control | | EE6ET1 | coeff : 0.19 |
| Teacher In Charge : Bessières D. | | | |
| CM : 4 h | TD : 8 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

The main objective is to give to the students the knowledge about identification and control of dynamic systems by using numerical tools..

**LEARNING OUTCOMES**

After this course the students should:

- Know how to identify process and tune PID controller
- Matlab and Simulink to simulate, and analyze the response of dynamic systems.
- Have basic knowledge of advanced control which allows discussions with control engineers.

**DESCRIPTION**

1) Continuous-time model identification
2) Tuning PID controller
3) Simulation and Model-Based Design for dynamic systems

**RECOMMENDED READING**

Régulation P.I.D. : analogique - numérique – floue, Daniel Lequesne, Hermes Science Feedback Control of Dynamic Systems ,Gene F. Franklin, J. Da Powell,Abbas Emami-Naeini
Matlab/Simulink pour l'analyse et la commande de systemes, Yassine HADDAB, techniques de l'ingénieur.

**PREREQUISITE**

Dynamic systems and control

**ASSESSMENT**

Proj(Rap,PA)

| | | | |
|---|---|---|---|
| EC : Security | | EG6EI2 | coeff : 0.3 |
| Teacher In Charge : Finestre V. (APAVE) | | | |
| CM : 10 h | TD : 10 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**INTRODUCTION**

The objective of this training is to make students aware of electrical safety aspects. After defining the concepts of danger, risk, and severity, this course addresses the regulatory aspects.

**TARGETED SKILLS**

- The primary goal is to provide students with an electrical accreditation. It is about teaching them to work safely on or near electrical installations for their safety but also that of others.
- ELB090 - Initial electrical accreditation : ”electrician” BT

**CONTENT**

General concepts: hazard, risk, severity, probability Accidents and risk analysis
Elements of regulation

**RESSOURCES**

**PREREQUISITE**

**EVALUATION PROCEDURES**

CC(EE, 2h)

| | | | |
|---|---|---|---|
| EC : Industrial electricity | | EE6ET3 | coeff : 0.21 |
| Teacher In Charge : Subileau R. | | | |
| CM : 8 h | TD : 6 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

Nowadays, electrical energy is essential for the effective operation of industrial enterprises. The purpose of this course is giving the students some theoretical basis to understand electrical energy from its production to its use and make them aware of electrical risks.

**LEARNING OUTCOMES**

- Know electrical risks
- Know electrical energy distribution principles
- Know electronical conversion principles
- Be able to perform a first analysis of an electrical machine

**DESCRIPTION**

1 Main industrial electricity principles
2 Electrical risks sensitivity
3 Three phase grids
4 Electronical power conversion
5 Reciprocating engines

**RECOMMENDED READING**

G. SEGUIER Electricité industrielle 2ème édition , éditeur DUNOD

**PREREQUISITE**

Basic electronical concepts

**ASSESSMENT**

CC(EE, 1h30')

| | | | |
|---|---|---|---|
| EC : Automation and instrumentation | | EE6ET4 | coeff : 0.3 |
| Teacher In Charge : Dumas P. | | | |
| CM : 10 h | TD : 10 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**OVERVIEW**

The objective of this course is to provide analysis and programming methods to drive industrial Control-Command systems (automation) and show the link between sensors and actuators.
Analysis of Automation Systems or Computer Engineering systems is done with step- transition diagram or finite state machine and Petri net.

**LEARNING OUTCOMES**

- Being able to perform the analysis of an industrial system and program control systems.
- Being able to choose an automation equipment.
- Recognize limits of control systems and Supervisory Control

**DESCRIPTION**

INDUSTRIAL INSTRUMENTATION:
Chains measuring and control(sensor, conditioning, actuators)
Reminders on industrial sensors

Automation:
Command Systems(PLC, PC, PAC)
Monitoring, limitations
OPC Standard , client-server concept
SFC Analysis and standardized languages
STANDARD 1131-3 Finite State Machine analysis
Petri net

**RECOMMENDED READING**

**PREREQUISITE**

**ASSESSMENT**

CC(EE, 2h)

TEACHING UNIT (UE) :

Electrical energy and control command S6

ECTS : 8

Code UE : EG6EE

SKILLS COVERED BY THE UE :

- Master different simulation software in Electrical Engineering.
- Master simulation tools.
- Know the basics of advanced control techniques.
- Acquire both theoretical and practical understanding of transformers and rotating machines in order to enable their implementation.
- Identify the constraints related to the choice and implementation of a single-phase or three-phase transformer.
- Develop practical implementation capabilities vis-à-vis the main electrical machines: DC, synchronous and asynchronous machines
- Be able to analyze complex industrial electrical devices and understand the technological choices that led to their development.

LIST OF COMPONENT ELEMENTS (EC)
CONSTITUTING THE TEACHING UNIT (UE)

| CODE EC | INTILTLED EC | COEF | EVALUATION |
|---|---|---|---|
| EG6EE1 | Electrical design tools | 0.27 | Proj(Rap*0.5) + CC(EM,1h30)*0.5 |
| EG6EE2 | Control -Command 2 | 0.23 | CC(EE, 1h30)*0.7+CC(CR)*0.3 |
| EG6EE3 | Transformers and Electrical Machines | 0.38 | CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.3 + TP (CR)*0.2 + TP (EM, 2h)*0.2 |
| EG6EE4 | Industrial electrical devices | 0.12 | Proj(Rap)x0,5 + Proj(Or)x0,5 |

| | | | |
|---|---|---|---|
| EC : Electrical design tools | | EG6EE1 | coeff : 0.27 |
| Teacher In Charge : Reess T., Dumas P. | | | |
| CM : 14 h | TD : 16 h | TP : 0 h | Proj : 0 h |
| | | | Language Français |

**INTRODUCTION**

The objective of this UE is to demonstrate to students the interest of software simulation in electronics and instrumentation. Two software programs are presented: Pspice, and Labview.

**TARGETED SKILLS**

- Master different simulation software in Electrical Engineering

**CONTENT**

1. Introduction to Labview programming and design of distributed test, measurement, and control systems using DAQmx and DAQmx
2. Presentation of the software simulation of electronic circuits under PSpice: application to analog electronics problems (assemblies with operational amplifiers and transistors)

**RESSOURCES**

**PREREQUISITE**

**EVALUATION PROCEDURES**

Proj(Rap*0.5) + CC(EM,1h30)*0.5

| | | | |
|---|---|---|---|
| EC : Control -Command 2 | | EG6EE2 | coeff : 0.23 |
| Teacher In Charge : Bessières D. | | | |
| CM : 6 h | TD : 10 h | TP : 16 h | Proj : 0 h |
| | | | Language Français |

**INTRODUCTION**

The objective is to provide students with the basics of advanced control, knowledge of the working methods of automation engineers in an industrial environment as well as the importance of simulation methods.

**TARGETED SKILLS**

- Master simulation tools.
- Know the basics of advanced control techniques

**CONTENT**

1. Deepening of linear automation: stability and correction of enslaved linear systems
2. State representation of continuous time systems: Introduction, Notion of control by state return, observer
3. Modeling and simulation of control systems

**RESSOURCES**

**PREREQUISITE**

EC16MI3 Contrôle-commande

**EVALUATION PROCEDURES**

CC(EE, 1h30)*0.7+CC(CR)*0.3

| | | | |
|---|---|---|---|
| EC : Transformers and Electrical Machines | | EG6EE3 | coeff : 0.38 |
| Teacher In Charge : Ruscassié R. | | | |
| CM : 14 h | TD : 16 h | TP : 20 h | Proj : 0 h |
| | | | Language Français |

**INTRODUCTION**

The objective of this CE is to provide students with knowledge and know-how on electrotechnical systems by developing the different principles of implementation associated with transformers at first, then rotating machines in a second time. Particular emphasis will be placed on the constitution and industrial applications of these electrotechnical systems.
This CE will conclude with a series of practical works allowing the wiring and the realization of measurements on transformers and rotating machines in effective operation.

**TARGETED SKILLS**

- Acquire both theoretical and practical understanding of transformers and rotating machines in order to enable their implementation.
- Identify the constraints related to the choice and implementation of a single-phase or three-phase transformer.
- Develop practical implementation capabilities vis-à-vis the main electrical machines: DC, synchronous and asynchronous machines

**CONTENU**

1. Principles of electrical engineering (recalls)
2. Magnetic torus and single-phase transformer
3. Three-phase transformers & applications
4. Principles of electromechanics: General and classification of electromechanical converters
5. Direct Current Machines (DCMs): Different Types of MCCs, Constitution & Applications
6. Alternative machines: Synchronous Machine (MS), Asynchronous Machine (MAs), Constitution & Applications

**RESSOURCES**

**PREREQUISITE**

EC Electromagnétisme & EC Electricité industrielle

**EVALUATION PROCEDURES**

CC (EE, 1h30)*0.3 + CC (EE, 1h30)*0.3 + TP (CR)*0.2 + TP (EM, 2h)*0.2

| | | | |
|---|---|---|---|
| EC : Industrial electrical devices | | EG6EE4 | coeff : 0.12 |
| Teacher In Charge : Ruscassié R. | | | |
| CM : 0 h | TD : 4 h | TP : 0 h | Proj : 20 h |
| | | | Language Français |

**INTRODUCTION**

This project-based learning cae allows students to leverage the knowledge they have gained about transformers and electrical machines as part of the in-depth analysis of complex industrial electrical devices.

**TARGETED SKILLS**

- Be able to analyze complex industrial electrical devices and understand the technological choices that led to their development.

**CONTENT**

As part of a case study carried out in pairs, students will have to analyze complex industrial electrical devices involving transformers and / or electrical machines and their associated surrounding systems (protections, control command, .).
These devices will have to be analyzed in detail in order to identify their technical characteristics and specificities, but also to understand the reason for the technological choices that led to the development of the device in its final form.
A report and a presentation will summarize the analysis carried out as part of this project-based learning.

**RESSOURCES**

**PREREQUISITE**

EC Electrical transformers and machinery

**EVALUATION PROCEDURES**

Proj(Rap)x0,5 + Proj(Or)x0,5