Polytech Orléans
Engineering School of the University of Orléans
Bureau des relations européennes et internationales
(European and International Relations Office)
☎: +33 (0)238 494 699
✉: international.polytech@univ-orleans.fr

Site Léonard de Vinci
8, rue Léonard de Vinci
45072 ORLÉANS cedex 02

Site Galilée
12, rue de Blois – BP 6744
45067 ORLÉANS cedex 02

Site du Pôle Universitaire d'Eure-et-Loir
21, rue de Loigny-la-Bataille
28000 CHARTRES
## Contents

Scientific courses and Syllabus .................................................................................. 3

Civil and Geo-environmental Engineering (GC) ......................................................... 4

Sustainable Construction (COD) ................................................................................ 6

Geoenvironmental Engineering (GEN) ....................................................................... 9

Public Works and Land-Use Planning (TPA) .............................................................. 13

Engineering Physics and Embedded Systems (GPSE) .............................................. 18

Plasma Engineering (GP) and Computer vision and Embedded Systems (SE) .......... 20

Innovations in Design and Materials (ICM) .............................................................. 24

Materials and structures (MS) .................................................................................. 27

Mechatronic system modelling (EcoSyM) ................................................................. 33

Multiphysics modelling and simulation (MSP) ......................................................... 38

Technologies for Energy, Aerospace Engineering and Motorization (TEAM) Syllabus 4th year ........................................................... 45

Technologies for Energy, Aerospace Engineering and Motorization (TEAM) Syllabus 5th year ........................................................... 52

All trainings - Classics teaching units .................................................................... 58

Personal Projects ..................................................................................................... 62

French Courses ........................................................................................................ 66
Scientific courses and Syllabus

- less than 10 % of the course is taught in English - documentation in English provided
- between 10 and 75 % of the course is taught in English
- more than 75 % of the course is taught in English
Civil and Geo-environmental Engineering (GC)

<table>
<thead>
<tr>
<th>Course Unit Code</th>
<th>Course Unit Title</th>
<th>Total Hours without ind. work</th>
<th>ECTS Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Fall Semester (September – December)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Sustainable Construction (COD)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9CD01</td>
<td>Dynamic and environmental impacts on structures - <em>Ouvrages sous sollicitations dynamiques et environnementales</em></td>
<td>70</td>
<td>8</td>
</tr>
<tr>
<td>9CD02</td>
<td>Construction Sites and Project Management - <em>Chantiers du bâtiment et maîtrise d’œuvre</em></td>
<td>112.5</td>
<td>11</td>
</tr>
<tr>
<td>9CD03</td>
<td>Thermal and aeralic buildings - <em>Thermique et aéralique des bâtiments</em></td>
<td>40</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td><strong>Geoenvironmental Engineering (GEN)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9GE01</td>
<td>Polluted sites and soils - <em>Sites et sols pollués</em></td>
<td>55</td>
<td>6</td>
</tr>
<tr>
<td>9GE02</td>
<td>Water Resource and Environment Management - <em>Gestion de l’eau et des milieux associés</em></td>
<td>72.5</td>
<td>8</td>
</tr>
<tr>
<td>9GE03</td>
<td>Design and Depollution Works - <em>Bureaux d’études et chantiers de dépollution</em></td>
<td>46.25</td>
<td>5</td>
</tr>
<tr>
<td>9GE04</td>
<td>Site preparation - <em>Préparation de chantier TP</em></td>
<td>48.75</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td><strong>Public Works and Land-Use Planning (TPA)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9TP01</td>
<td>Urban Design and Planning - <em>Conception des aménagements</em></td>
<td>112.5</td>
<td>12</td>
</tr>
<tr>
<td>9TP02</td>
<td>Site preparation - <em>Préparation de chantier TP</em></td>
<td>48.75</td>
<td>5</td>
</tr>
<tr>
<td>9TP03</td>
<td>Public Works - <em>Travaux publics</em></td>
<td>61.25</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td><strong>Spring Semester (January – March)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGC01</td>
<td>Project – <em>Projet d’entreprise</em></td>
<td>170</td>
<td>10</td>
</tr>
</tbody>
</table>

Students have to choose one option and then only pick up courses in this option.
# Dynamic and environmental impacts on structures

**Supervisor:** Dashor HOXHA  
**ECTS:** 8

## Learning Outcomes

On completing this teaching unit engineering students will be able to:

- Estimate wind and snow loads following Eurocodes
- Analyze behavior of structures under dynamic loads
- Design structures/buildings in seismic zones following Eurocodes 8
- Characterize soil-structure interactions, design underground structures
- Design foundations of bridges and special foundations
- Quantify the impact of environnemental agents on structures

## Teaching Process (syllabus)

### Assessment of wind and snow loads, following Eurocode rules

- Analyzes following EN 1991-3 et EN-1991-4 of wind and snow loads, design practice, simplified and computer-based models
- **Dynamics of structures**
  - SDOF, free and forced vibrations, harmonic, periodic and arbitrary dynamic loads, transfer function
  - MDOF : modal analysis, Rayleigh quotient, Ritz vectors
- **Earthquake design of buildings**
  - Eurocode 8 for design of buildings : lateral force method, modal analyses, classes of behavior
  - Eurocode-Compliant Seismic analysis
  - Seismic retrofitting of existing structures

### Soil Structure interactions

- Bases of soil-structure interaction
- Design of supports for underground constructions
- Foundations, deep foundations, special foundations under dynamic solicitation

### Assessment of environmental impact on structures

- Ageing of concrete structures, case studies
- Monitoring of ageing, methods of reparation and renovation
- Stone ageing, characterization and reparation

## Assessment Mode

Written exams, project reports

## Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>42.5h</td>
<td>8.75h</td>
<td>18.75h</td>
<td></td>
<td></td>
<td>70h</td>
</tr>
</tbody>
</table>

**Proportion of the TU in English:** |
Construction Sites and Project Management

Learning Outcomes
On completing this teaching unit engineering students will be able to:
- Plan a construction site;
- Manage a construction site financially;
- Plan construction for a specific project;
- Manage human resources according to the construction scheduling;
- Manage materials and equipment;
- Study the economic aspect of construction;
- Assess risks, comply with safety regulations;
- Read and analyze project requirements and documents;
- Read construction drawings, analyze their structure and dimension the steel reinforcement;
- Study the rehabilitation of a building according to seismic, thermal regulation; suggest reinforcement for a given structure;

Teaching Process (syllabus)
- Analyzing tender enquiries
- Identifying a building operation boundaries and interfaces
- Identifying construction modes and organizational methods used to plan a construction site
- Assessing environmental impact
- Calculating material quantities (quantity surveying)
- Introducing different technical constraints and suggestion of technical and economic variants
- Managing an actual project and calculation of structures in implementation phases (project teaching)
- Dimensioning the elements of a structure made of reinforced concrete in both average and accidental (seism) situations, application of earthquake-resistant building regulation
- Sustainable bioclimatic design and thermal rehabilitation
- Dimensioning of wooden structures. Dimensioning of wooden joints and sections. Technology of wood.

Assessment Mode
A report and oral defense for each design office project; an exam on construction sites and wood structures

Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>55h</td>
<td>31.25h</td>
<td>26.25h</td>
<td>23.75h</td>
<td></td>
<td>112.5h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:
# Thermal and aeraulic buildings

**Supervisor:** Marwen BOUASKER  
**ECTS:** 5

## Learning Outcomes
At the end of this teaching unit, the student engineers will be able to:
- Know the heat transfer modes
- Design a solar thermal collection system
- Apply the different thermal standards
- Establish the thermal balance of a room
- Design a ventilation network
- Design an air treatment battery

## Teaching Process (program)
### Thermal building insulation
- Sustainable energy
- Solar capture systems
- Thermal losses in a building
- Heat balance of a room
- Application of labels and thermal standards
- Condensation at the surface and in the mass of a wall

### Aeraulic
- Characteristic equations of ducted air flows
- Calculation of air ducts
- Fan selection (constant $j$ method, static pressure gain method)
- Aeraulic exchanges and condensations
- Air treatment

## Assessment Mode
2 exams: 1 exam on thermal building insulation and 1 exam on aeraulic

## Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
<th>40h</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.75h</td>
<td>21.25h</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Proportion of the TU in English:**
Civil and Geo-environmental Engineering

Polluted sites and soils

Supervisor: Mikael MOTEIČICA

ECTS: 6

Learning Outcomes
On completing this teaching unit engineering students will be able to:

- Understand biogeochemistry of natural media
- Evaluate and model the behavior of key-pollutants in environmental compartments
- Design innovative remediation strategies (physical, chemical and biological) for polluted sites and soils (PSS)

Teaching Process (syllabus)

Geochemistry of contaminants

- Introduction to environmental geochemistry
- Geochemistry of surface waters
- Geochemistry of groundwater
- Biogeochemistry of soils
- Hydrogeochemical modelling
- Pollution chemistry
- Ecodynamics of contaminants

Contaminated sites and soils diagnosis

- Diagnosis PSS
- Measurement and prediction of pollution (waters)
- Measurement and prediction of pollution (soils, sediments and wastes)
- Diagnosis and decontamination of hydrocarbons
- Diagnosis and decontamination of metals and metalloids
- Physico-chemical treatments
- Bioremediation
- Phytoremediation

Assessment Mode

A report for part 1 and a report and oral defense for each project for part B

Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>35h</td>
<td>15h</td>
<td>5h</td>
<td></td>
<td></td>
<td>55h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English: 3/6/3
## Water Resource and Environment Management

**Supervisor:** Christian DÉFARGE  
**ECTS:** 8

### Learning Outcomes
On completing this teaching unit engineering students will be able to:
- Consider risks in land-use planning (floods...) and water management (living organisms...)
- Implement hydrogeological methods in the field (flow, piezometric map, pumping test...)
- Model water and pollutant transfer in surface and underground hydrologic systems
- Size, implement, pilot and evaluate water and wastewater treatment processes and plants

### Teaching Process (syllabus)

#### Geobiology of resources and processes
- Living organisms present in water, bioindicators, biological water-related diseases, invasive species
- Roles of living organisms in natural waters and environments, use in water treatment processes

#### Vulnerability, risks
- Risk management chain: uncertainty/issues, security/protection, forecasting, damage repair
- Study of dangers and crisis management
- Principles and methods for the prioritization of water resource vulnerability and GIS application of the indicator-based approach

#### Field hydrology
- Flow measurement via exploration of the velocity field exploration and chemical gauging
- Drawing up a piezometric map and delimitation of the system
- Well-production test to characterize the hydrodynamic properties

#### Water management
- Notions of hydrological cycle, residence time and groundwater storage volume
- Interaction between reservoirs, mixing, tools for active resource management using hydrodynamic modeling (Modflow software)
- Mass transfer mechanisms, at pore level and at the macroscopic level, pollutant reactivity

#### Water and wastewater treatment
- Classroom lessons: Water and wastewater treatment processes and plants, case studies
- On-site lessons: Drinking water production plants (ultrafiltration, iron and manganese removal, etc.), urban and industrial wastewater treatment plants (activated sludge, biological filters, etc.)

### Assessment Mode
Reports on case studies and field work

### Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th><strong>STUDENT WORKLOAD</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>45h</td>
<td>27.5h</td>
<td>12.5h</td>
<td></td>
<td></td>
<td>72.5h</td>
</tr>
</tbody>
</table>

### Proportion of the TU in English: **Polytech Orleans**
Design and Depollution Works

Supervisor: Christian DEFARGE
ECTS: 5

Learning Outcomes
On completing this teaching unit engineering students will be able to:

- Conduct an environmental impact assessment
- Realize artificial tracer tests and interpretations
- Proportion devices for active management of aquifers and pollution mitigation
- Conduct projects and works in soil remediation

Teaching Process (syllabus)

Environmental impacts
- Impact assessments strictly speaking on the themes of field geology and water management and a specific topic such as public easement or dusts
- Hazard assessment
- Simulation of the activity of an environmental engineering consultants: study in groups of an environmental impact assessment for a quarry’s operation

Artificial tracer tests applied to engineering
- Practice of artificial tracer tests (sizing, installation and implementation, spectrofluorimetric detection, concentration-time curve)
- Synthesis and data interpretation in the karstic environment of the Val d’Orléans, report writing
- Case studies on tracer tests applied to design of depollution processes

Soil remediation works
- Alternating between classes and home work around a concrete case for understand:
  What is a remediation project? The needs of a client? How to build a remediation strategy? How to choose and size a remediation technology?
- Monitoring of a remediation project
- Elements of remediation project management

Assessment Mode
Case studies and field work reports

Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>28.75h</td>
<td>17.5h</td>
<td></td>
<td></td>
<td></td>
<td>46.25h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:
Civil and Geo-environmental Engineering 9GE04 Semester 9

**Site preparation**

**Supervisor:** Laurent JOSERAND  
**ECTS:** 5

<table>
<thead>
<tr>
<th><strong>Learning Outcomes</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>On completing this teaching unit engineering students will be able to:</td>
<td></td>
</tr>
<tr>
<td>□ Master main geophysics tests, their implementation conditions and their fields of applicability in civil engineering;</td>
<td></td>
</tr>
<tr>
<td>□ Identify pollutants in a polluted soil and measure the degree of pollution;</td>
<td></td>
</tr>
<tr>
<td>□ Make diagnoses of a site pollution and study remediation methods (Learning Outcome 3).</td>
<td></td>
</tr>
<tr>
<td>□ Propose technical solutions for a site deconstruction or dismantling an industrial site</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Teaching Process (syllabus)</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>This TU is divided in two main parts. The first one deals with geophysical in-situ tests, like resistivity, seismic. These tests will allow us to obtain data on geological layers.</td>
<td></td>
</tr>
<tr>
<td>The second one deals with Polluted site management method (Typology of pollution, regulations and hazards, stakeholders, inventory and database), Diagnosing pollution (Geochemistry of pollutants in soils and aquifers, impact of pollution, methodological tools), Measuring and predicting pollution (Sampling, sampling techniques, identifying the dominant parameters, in situ measurements, methods of analysis), Physical and biological pollution control, remediation of polluted sites</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Assessment Mode</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Classes assessments, reports, individual assessments and synthesis reports</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Workload</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>Classes</td>
</tr>
<tr>
<td>25h</td>
<td>13.75h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:
## Civil and Geo-environmental Engineering  
### 9TP01  
#### Urban Design and planning  
**Supervisor:** Xavier BRUNETAUD  
**ECTS:** 12

### Learning Outcomes
On completing this teaching unit engineering students will be able to:
- Design load-bearing structures and foundations for small engineering works according to site data and the work specifications;
- Understand the transportation issues at stake in urban environments, the main modes of transportation and the associated infrastructures as well as their planning and design techniques.
- Design and compute a pavement structure according to specifications (traffic), given supporting soil and climate environment;
- Design and dimension the rainwater and wastewater sewer system including associated storage basins;
- Draw a linear infrastructure (road, railroad) using Mensura software;
- Calculate the geometry of structural elements.

### Teaching Process (syllabus)

#### Engineering works
- Specifications, site and regulation data. Load-bearing structure design: foundation design and calculation. Overview of the main types of bridge design.

#### Transport infrastructures

#### Pavement dimensioning

#### Sewer systems design and dimensioning
- Revision on hydraulics and Mensura software. Case studies on actual rainwater / wastewater projects using Mensura.

#### Road alignment
- "Alignments" drawing on Mensura. Implementation of an alignment project on Mensura.

#### Structural design
- Calculation of the structural elements of reinforced concrete, prestressed and metallic structures. Application of seismic codes

### Assessment Mode
Construction of a model of bridge, written exams, projects reports.

### Workload
<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th><strong>STUDENT WORKLOAD</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>63.75h</td>
<td>16.25h</td>
<td>32.5h</td>
<td>16.25h</td>
<td></td>
<td><strong>112.5h</strong></td>
</tr>
</tbody>
</table>

Proportion of the TU in English: [ ]
Civil and Geo-environmental Engineering  9TP02  Semester 9

Site preparation

Supervisor:  Laurent JOSERAND  ECTS: 5

Learning Outcomes
On completing this teaching unit engineering students will be able to:
□ Master main geophysics tests, their implementation conditions and their fields of applicability in civil engineering;
□ Identify pollutants in a polluted soil and measure the degree of pollution;
□ Make diagnoses of a site pollution and study remediation methods (Learning Outcome 3).
□ Propose technical solutions for a site deconstruction or dismantling an industrial site

Teaching Process (syllabus)
This TU is divided in two main parts. The first one deals with geophysical in-situ tests, like resistivity, seismic. These tests will allow us to obtain datas on geological layer.

The second one deals with Polluted site management method (Typology of pollution, regulations and hazards, stakeholders, inventory and database ), Diagnosing pollution (Geochemistry of pollutants in soils and aquifers, impact of pollution, methodological tools), Measuring and predicting pollution (Sampling, sampling techniques, identifying the dominant parameters, in situ measurements, methods of analysis), Physical and biological pollution control, remediation of polluted sites.

Assessment Mode
Classes assessments, reports, individual assessments and synthesis reports

<table>
<thead>
<tr>
<th>Workload</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>Classes</td>
<td>Labs</td>
<td>Individual work</td>
<td>Project work</td>
<td>STUDENT WORKLOAD</td>
</tr>
<tr>
<td>25h</td>
<td>13.75h</td>
<td>10h</td>
<td>9h</td>
<td></td>
<td>48.75h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:
Civil and Geo-environmental Engineering

Public Works

Supervisor: Laurent JOSSERAND  
ECGS: 7

Learning Outcomes
On completing this teaching unit engineering students will be able to:
- Define the schedule of quantities for a construction site; optimize its tasks and organization. Through productivity, they will be able to estimate its duration, cost and environmental impact limited to greenhouse gases.
- Choose and optimize quantities of materials necessary to construction sites among which stones, soils, pipes, coated materials... Acquired knowledge about these hydrocarbon coated materials and their bonding agents will allow students to optimize their compositions;

Teaching Process (syllabus)
This TU is the logical consequence of "Road and building Construction" 8GC02. Many implementation projects allow students to deepen their knowledge and skills while giving them the opportunity to get prepared for their future professional position:
- construction sites, study of economical variants or solutions with a limited environmental impact,
- use of natural stones,
- implementation of networks (wastewater, rainwater, multitubular network, etc.),
- specific coated materials (HiMA, draining and aeronautical asphaltic concrete, etc.),
- road recycling.

Assessment Mode
Classes assessments, reports, individual assessments and synthesis reports

Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>31.25h</td>
<td>22.5h</td>
<td>7.5h</td>
<td>7.5h</td>
<td></td>
<td>61.25h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:
Civil and Geo-environmental Engineering | AGCO1 | Semester 10

**Project**

**Supervisor:** Naïma BELAYACHI  
**ECTS:** 10

### Learning Outcomes

On completing this teaching unit engineering students will be able to:

- Conduct a study to solve an industrial or research issue using an engineering approach;
- Develop and consolidate disciplinary skills acquired during the three-year training;
- Set a bill of specifications and schedule tasks;
- Perform regular follow-up with the actors of the project, plan follow-up meetings;
- Work autonomously;
- Synthesize the progress made and present them in a written report and oral presentation.

### Teaching Process (syllabus)

- Project and format selection (solo, duo or group work)
- Establishment of contact with the limited partner of the study (company or laboratory)
- Writing of the bill of specifications submitted to the limited partner for approval
- Task scheduling and follow-up meetings
- Identification of the tools and resources necessary to the project conduct
- Risk analysis and fallback solutions
- Technical realization of the study
- Update of the project follow-up and implementation of fallback solutions if required
- Delivery of a synthesis report
- Oral presentation of the results of the study

### Assessment Mode

Report and oral defense

### Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>170h</td>
<td>170h</td>
<td></td>
<td></td>
<td></td>
<td>170h</td>
</tr>
</tbody>
</table>

**Proportion of the TU in English:** [80%]
Engineering Physics and Embedded Systems (GPSE)

<table>
<thead>
<tr>
<th>Course Unit Code</th>
<th>Course Unit Title</th>
<th>Total Hours without ind. work</th>
<th>ECTS Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall Semester (September – December)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9GP02</td>
<td>Guided Experiments and Low pressure plasma or Computer vision Engineering - <em>Spécialisation et projet en photonique, plasma ou objets connectés</em></td>
<td>115</td>
<td>16</td>
</tr>
<tr>
<td><strong>Spring Semester (January – March)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGP01</td>
<td>Project – <em>Projet d’entreprise</em></td>
<td>170</td>
<td>10</td>
</tr>
</tbody>
</table>

The Fall Semester could be complete with a personal project in a lab (see Personal projects)
### Engineering Physics and Embedded Systems  9GP02  Semester 9

### Guided Experiments and Low pressure plasma or Computer vision Engineering

**Supervisors:** Rémi DUSSART  
**ECTS:** 16

### Objectives

On completing this teaching unit engineering students will be able to:

(Specialization in Plasma engineering)
- Design a plasma reactor for the treatment of materials
- Use and control the lasers and optical systems for the treatment of materials or for the optoelectronics
- Diagnose the plasmas/lasers and characterize the mateirlas after treatment

(Specialization in Embedded Systems)
- Develop some *Smartphone* and *IoT* applications
- Use Linux in the programming of connected objects
- Design systems IHM (Interaction Human Machine)

### Teaching Process (syllabus)

**Plasma engineering**
- General properties of plasmas
- Electric Discharges (DC, RF and microwaves)
- Electrical and Optical diagnosis
- Banc de tenue au flux (Laser Yag, doubling of frequencies and intensity modulation)
- Optical sensors
- Optoelectronics: guidance in integrated photonics and telecommunications
- Guided projects: choice among 4 projects

**Embedded Systems**
- Smartphone as an IoT
- Embedded Linux
- Multithreading
- Ergonomics IHM
- Design software
- Project

### Assessment Mode

Report and oral defense

### Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th><strong>STUDENT WORKLOAD</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>60h</td>
<td>10h</td>
<td>20h</td>
<td>60h</td>
<td>150h</td>
<td>150h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English: [3][3][3]

### Exchange student  UP15  Semester 9

**Project for exchange student:**
## Mini research project

**Supervisors:**

**ECTS:** 15

### Objectives

**Teaching Process (syllabus)**

**Plasma engineering**

Each student joins a research team (GREMI lab) to work on a dedicated project (e.g. plasma etching process, plasma deposition process, plasma diagnostics, microplasmas ...).

or

**Computer vision and Embedded Systems**

Each student will be involved in the research lab PRISME to work on a dedicated project of signal or image processing, computer vision or embedded systems. Learning by practice and self-learning, using software and existing libraries (imageJ, MATLAB, OpenCV, etc.)

### Assessment Mode

Report and oral defense

### Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>150h</td>
<td>150h</td>
</tr>
</tbody>
</table>

Proportion of the TU in [2][2][2]

English:
Engineering Physics and Embedded Systems  
AGP01  
Semester 10

Project

ECTS: 10

Learning Outcomes
On completing this teaching unit engineering students will be able to:

☐ Write a product specification based on a requirements analysis
☐ Establish the functional and technological specifications of a project
☐ Establish milestones and provide project deliverables
☐ Manage a project

Teaching Process (syllabus)
Organization:
During this teaching unit, students work on a technical project supervised by a scientific tutor. The project is “full time” from early January to mid-March. It ends with a written activity report, a poster in English and an oral exam.

Scientific content:

☐ The subjects of projects proposed to the student engineers are very varied. We can make a feasibility study of a new concept, design a process for a dedicated application, improve a theoretical knowledge, realize an industrial study, etc ...
☐ In any case, the student engineer must show his ability to manage a project, to take initiatives, to be able to share tasks (working in pairs), to carry out a technical study in a given time.

Assessment Mode
Written activity report, oral defense

Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>170h</td>
<td>170h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:

POLYTECH ORLEANS
## Innovations in Design and Materials (ICM)

<table>
<thead>
<tr>
<th>Course Unit Code</th>
<th>Course Unit Title</th>
<th>Total Hours without ind. work</th>
<th>ECTS Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall Semester (September – December)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9IC01</td>
<td>Business Conferences</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td><strong>Materials and structures (MS)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9MS01</td>
<td>Metallic Materials – <em>Matériaux métalliques</em></td>
<td>55</td>
<td>5</td>
</tr>
<tr>
<td>9MS02</td>
<td>Glasses and Simulation of transfers at high temperature – <em>Verres et simulation hautes températures</em></td>
<td>55</td>
<td>5</td>
</tr>
<tr>
<td>9MS03</td>
<td>Thematic Scientific Conferences – <em>Conférences scientifiques thématiques</em></td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>9MS04</td>
<td>Advanced materials and properties/structures/processes relation – <em>Matériaux avancés, couplages et procédés</em></td>
<td>40</td>
<td>4</td>
</tr>
<tr>
<td>9MS05</td>
<td>Ceramics - <em>Céramiques</em></td>
<td>50</td>
<td>4</td>
</tr>
<tr>
<td>9MS06</td>
<td>Industrial cases study – <em>Etude de cas industriels</em></td>
<td>55</td>
<td>4</td>
</tr>
<tr>
<td><strong>Mechatronic system modelling (EcoSyM)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9EC01</td>
<td>Mechatronic systems – <em>Systèmes mécatroniques</em></td>
<td>65</td>
<td>6</td>
</tr>
<tr>
<td>9EC02</td>
<td>Analysis and sizing of mechanical systems – <em>Analyse et dimensionnement de systèmes mécaniques</em></td>
<td>55</td>
<td>5</td>
</tr>
<tr>
<td>9EC03</td>
<td>Thematic scientific conferences – <em>Conférences scientifiques mécaniques</em></td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>9EC04</td>
<td>Control strategies and Robotics – <em>Automatique et robotique</em></td>
<td>80</td>
<td>7</td>
</tr>
<tr>
<td>9EC05</td>
<td>Collaborative Projects – <em>Projets transversaux</em></td>
<td>55</td>
<td>4</td>
</tr>
<tr>
<td><strong>Multiphysics modelling and simulation (MSP)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9MP01</td>
<td>Nonlinear mechanics – * Mécanique non linéaire*</td>
<td>70</td>
<td>6</td>
</tr>
<tr>
<td>9MP02</td>
<td>Composites and processes – <em>Composites et procédés</em></td>
<td>40</td>
<td>4</td>
</tr>
<tr>
<td>9MP03</td>
<td>Multiphysics couplings – <em>Couplages multiphysiques</em></td>
<td>40</td>
<td>4</td>
</tr>
<tr>
<td>9MP04</td>
<td>Thematic scientific conferences – <em>Conférences scientifiques thématiques</em></td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>9MP05</td>
<td>Advanced simulations – <em>Simulation avancée</em></td>
<td>50</td>
<td>4</td>
</tr>
<tr>
<td>9MP06</td>
<td>Industrial applications – <em>Applications industrielles</em></td>
<td>55</td>
<td>4</td>
</tr>
<tr>
<td><strong>Spring Semester (January – March)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AIC01</td>
<td>Project – <em>Projet d’entreprise</em></td>
<td>170</td>
<td>10</td>
</tr>
</tbody>
</table>

Students have to choose one option and then only pick up courses in this option.
Innovations in Design and Materials  91C01  Semester 9

Business Conferences

Supervisors: Jacques FANTINI  ECTS: 1

Learning Outcomes
On completing this teaching unit engineering students will be able to:
- Have a clearer vision of the different jobs to which the ICM specialty can lead
- Reinforce their professional and personal project
- Better knowledge of industrial applications and their link with the educational content of the business process

Teaching Process (syllabus)
Conferences by experts from the industrial world
Program: to be defined

Assessment Mode
written tests

Workload
<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>10h</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10h</td>
</tr>
</tbody>
</table>

This course is available for the 3 options: Materials and structures, Mechatronic system modelling, or Multiphysics modelling and simulation.
## Innovations in Design and Materials

### Metallic Materials

**Supervisors:** Jacques Poirier  
**ECTS:** 5

### Learning Outcomes

After this training, the students will be able to:
- Understand the metallurgical concepts necessary for the elaboration, the processing, the properties, the limitations of use of advanced alloys;
- Become familiar with the choice, corrosion and life cycle problems of metallic materials;
- To treat practical applications (energy, automobile, aeronautics, mechanical constructions, civil engineering, ...)

Advanced metal materials play a key role in the design, elaboration and use of manufactured products and structural parts. The acquired skills will enable:
- To understand how a component or metallic piece of structure is made, with what metallic materials
- How the engineers choose and master metallic materials.

### Teaching Process (syllabus)

1. **Lectures**
   - Metallurgical concepts (structure, microstructure, defects)
   - Introduction to alloys
   - Metallic alloys under extreme conditions (low temperature / high temperature, high mechanical strength, large deformations, corrosion resistance, etc.,)

2. **Industrial case studies: development, characteristics, properties in use**
   - Precious alloys (Au, Ag, Cu)
   - Cryogenic alloys
   - Fe, Ni and Fe alloys, Ni, Cr (stainless steels)
   - Advanced alloys for nuclear power and energy: zircaloy (cladding of fuel rods in nuclear reactors), Ni base alloys
   - Advanced steels for automotive: IF, DWI, HLE, TRIP, Steel cord
   - Alloys for aeronautics and energy: Super alloys, refractory metals, Cermet

3. **Industrial case studies: corrosion**

### Assessment Mode

Exams, written tests, oral presentations

### Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th><strong>STUDENT WORKLOAD</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>37.5h</td>
<td>17.5h</td>
<td></td>
<td></td>
<td></td>
<td>55h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English: 

---

## Innovations in Design and Materials

**Supervisors:** Jacques Poirier  
**ECTS:** 5

---

**POLYTECH ORLEANS**
# Glasses and Simulation of transfers at high temperature

**Supervisors:** Mohammed MALKI

<table>
<thead>
<tr>
<th>ECTS : 5</th>
</tr>
</thead>
</table>

## Learning Outcomes

On completing this teaching unit engineering students will be able to:

- Have a clear image on different families of glasses and glass ceramics
- Simulate industrial processes involving thermal transfer and thermomechanics of materials where radiation is the dominant mode of transfer

## Teaching Process (syllabus)

1. **Glasses and applications**
   
   Glasses background, silicates glasses, elaboration processes of flat glasses (float) and hollow glasses, glass fibers, metallic glasses, glass industry in France and around the world, glass ceramics, vitrification of nuclear wastes, vitrification of industrial wastes, mechanical properties of glasses, bioglasses.

2. **Simulation of transfers at high temperature**
   
   Basic study of Nastran files and frequently used entries, debugging
   Importance of radiation in transport phenomena at high temperature, radiation exchange between several surfaces, solid-liquid transformation, Simulation of some industrial processes involving thermal transfer at high temperature.

## Assessment Mode

Written tests

<table>
<thead>
<tr>
<th>Workload</th>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>35h</td>
<td>20h</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>55h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English: 

[28%]
Innovations in Design and Materials  
**Thematic Scientific Conferences**  
**Supervisors:** Jacques POIRIER  
**ECTS:** 1  

<table>
<thead>
<tr>
<th>Learning Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>The confrontation with professionals, working in the field of materials, in terms of knowledge, know-how and life skills is essential to the training of students.</td>
</tr>
<tr>
<td>The characteristics on which the engineering profession is based: creativity, curiosity, dynamism, scientific and technical competence, teamwork will be presented during these conferences.</td>
</tr>
<tr>
<td>After this cycle of conferences, the student will be able to:</td>
</tr>
<tr>
<td>- Better know the engineering professions, in the field of material</td>
</tr>
<tr>
<td>- To define their future choices with discernment (internship and future activity)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teaching Process (syllabus)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 lectures in the field of materials will be presented</td>
</tr>
<tr>
<td>For example: metals, alloys, ceramics, cement, composites, glasses, ...</td>
</tr>
<tr>
<td>Applications: energy, nuclear, aeronautics, automotive, civil engineering, health, electrical engineering, materials for instrumentation and measurement ...</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assessment Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>written tests</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
</tr>
<tr>
<td>10h</td>
</tr>
</tbody>
</table>

**Proportion of the TU in English:** | 20 |

---

POLYTECH ORLEANS
Innovations in Design and Materials 9MS04 Semester 9

Advanced materials and properties/structures/processes relation
Supervisors: Domingos DE SOUSA MENESES ECTS: 4

Learning Outcomes
On completing this teaching unit engineering students will be able to:
- Choose a suitable composite process for a given application, design and optimize this process to anticipate the induced properties.
- Perform numerical simulations of draping and injection of composites.
- Select a thermal control device
- State a multiphysics problem: identification of partial derivative equations and boundary and initial conditions.
- Simulate coupled multiphysical phenomenon using COMSOL software
- Interpret results and identify limitations

Teaching Process (syllabus)

1. Composite materials and processes

2. Thermal control
International temperature scale. Contactless temperature measurement. Control and diagnostic.

3. Multiphysics simulation

Assessment Mode
Tests, homework, reports

Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.5h</td>
<td>27.5h</td>
<td></td>
<td></td>
<td></td>
<td>40h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:

Innovations in Design and Materials 9MS05 Semester 9

Ceramics
Supervisors: Marie-Laure BOUCHETOU ECTS: 4
Learning Outcomes
On completing this teaching unit engineering students will be able to:
- Master the processes used to engineer ceramic materials
- Know the main properties of ceramic uses;
- Understand concepts necessary for engineering and forming ceramic materials, their properties and limitations of use;
- Tackle practical applications (energy, automotive and aeronautical engineering, mechanical construction, civil engineering, etc.)
- Know the main methods of characterization of advanced materials

Teaching Process (syllabus)

Ceramics : production and high temperature applications
- Recap of the fundamentals in ceramic
- Ternary phase diagrams
- Methods to produce ceramics, practical case study: silicate ceramics, refractory ceramics, techniques
- High-temperature heat treatment of ceramics. Sintering in ceramics
- Industrial case studies: engineering, characteristics, properties of use. Ceramics for energy, environment application...

Method of characterization of advanced materials
- Microstructure (optical microscope, SEM, TEM)
- Thermal analysis
- Raman spectroscopy
- Infrared spectroscopy
- NMR
- Pore size distribution, XRays tomography, BET

Assessment Mode
- written tests

Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>32.5h</td>
<td></td>
<td>17.5h</td>
<td></td>
<td></td>
<td>50h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:

Innovations in Design and Materials 9MS06 Semester 9

Industrial cases study

Supervisors: Marie-Laure BOUCHETOU ECTS: 4

Learning Outcomes
On completing this teaching unit engineering students will be able to:
- Use the knowledge and analysis methods seen in the training, to deal with concrete industrial cases
- Develop a project and analysis methodology.
- Work independently in a multidisciplinary group.
- Write a project report
- Present the results acquired

**Teaching Process (syllabus)**
During this teaching unit, students work on a technical project supervised by a scientific tutor(s).

**Organization:**
The autonomy of the student associated with a project team is the main rule that prevails in this UE. Weekly meetings are planned to manage the progress of projects.
The project will be the subject of a written report with a summary in English, and an oral presentation.

**Scientific content:**
The content will focus on real case studies, from our industrial partners, dealing with material issues (metal, refractory, ceramics, glass, composites, etc.) and/or processes.
Problems dealt with in this project framework: Materials and structures characterization, durability and corrosion of materials, establishment of basic knowledge of materials, study of physico-chemical stability, study of aging, relationship between material and structure, relation process / material / properties of use, etc.
The work of each student varies according to the project in which he will be involved, as well as his role within each project team.
This Teaching Unit is part of a process of individualization of the training of students to allow them different learning paths according to their professional and personal projects.

**Technical content:**
SysML tool to integrate the description of the temporal or event function of the systems

**Assessment Mode**
Intermediate step by oral defense in English / Triangle of the project in 3mn. 1 final defense before a jury of professionals. Report and final summary note.

**Workload**

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.5h</td>
<td>27.5h</td>
<td></td>
<td>16.25h</td>
<td></td>
<td>50h</td>
</tr>
</tbody>
</table>

**Innovations in Design and Materials**

9EC01 Semester 9

**Mechatronic systems**

**Supervisors:** Emmanuel BEURAY

**ECTS:** 6

**Learning Outcomes**
On completing this teaching unit engineering students will be able to:
- Analyze, model and configure mechatronic systems.
- Study, model and analyze the dynamic, geometric and kinematics behaviors of mechatronic mechanisms.
- Measure the needed signals then model and configure a control law of concrete mechatronic systems.
- Analyze the performance of a system from measurements as well as the limitations of modeling.
Set a speed control from the industrial documentation

Teaching Process (syllabus)
This teaching unit aims to illustrate the last course in mechatronics context stress environmental sustainability. This results in the use of components and / or systems, as close as possible of industrial applications, with the desire to model, analyze and control them. Teaching will be mainly taught through practical work on mechatronic systems.

Electromagnetic compatibility (EMC) and the low-frequency disturbances produced. Principle of piezoelectric motors. Solar energy, photovoltaic panels, principles of design and sizing of a photovoltaic system.

Practical work
DC motors and speed control; automated lifting; photovoltaic system; identification on Brushless motorization; speed variation on asynchronous motorization; electromagnetic disturbances; energy reversibility on continuous and synchronous motorization.
Steward platform (modeling and experimentation); Renault welding gun robot, screwed assembly; parametric optimization of part geometry; Study of a tripod joint; Torsen differential. Exhaust gas recirculation valve in internal combustion engines; throttle butterfly valve of gasoline engines; catenary train.

Assessment Mode
Several exams, lab reports and homework assignments

Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.5h</td>
<td>2.5h</td>
<td>55h</td>
<td>7.5h</td>
<td></td>
<td>65h</td>
</tr>
</tbody>
</table>

Proportion of the TU in %
English:

Innovations in Design and Materials 9EC02 Semester 9

Analysis and sizing of mechanical systems

Supervisors: Jean-Marc AUFREDE ECTS: 5

Learning Outcomes
On completing this teaching unit engineering students will be able to:
- Apply hydrostatic laws and study the functioning and design of the hydrostatic power transmission
- Identify the parameters needed to select a pneumatic components for the design of a circuit
- Establish strategies for optimizing and sizing of a cylindrical gear of industrial gearboxes.

Teaching Process (syllabus)
1. Dimensioning component
2. Power transmissions by fluids
   Application of the law of hydrostatics; hydraulic components; open and closed circuit; Hydraulic circuit diagram; sizing and performance, electrohydraulic servo valve technology; Criteria for sizing and
components choice; Pressure drops (location and effect); Overall assessment and sizing approach of a circuit; functions, characteristics and choice of hydraulic fluids. Specificities of pneumatic power transmission. Production: compressor, dryers, pressure regulator, etc. Uses: order of magnitude of forces, velocities, sequential automation, particular (explosive) atmosphere, "proportional pneumatic"

3. Invited lectures
Technology of electrohydraulic servo valves; static and dynamic characteristics. Equations of motion and stability of servomechanisms. Half-day visit of a servo valves production unit (Zodiac hydraulics).

4. Gear power transmissions
Kinematics; interference; geometrical dimensioning in preliminary design. Operating laws, achievable ratios, energy transit, efficiency and irreversibility of single gear planetary gears. Operating conditions; Teeth degradation; Resistance criteria; Simplified sizing methods; Verification of the load capacity of a component according to ISO6336; Optimizing the design of a component (Specific sliding, scuffing extreme factors, etc.). Dimensioning of a gear in preliminary design, minimum needed data of the technical specifications, iteration process, Using Kiss-Soft and Kiss-sys software

5. Functional tolerancing as a tool increasing energy gain
Functional tolerancing as a tool guaranteeing the performances listed in the bill of specifications (reliability, life span); converting the geometric criteria of the specifications into tolerancing conditions.

6. Lubrication
Different lubrication modes (hydrodynamic, hydrostatic, elastohydrodynamic); permanent, critical and lubricating regimes; lubrication dimensioning and performances

<table>
<thead>
<tr>
<th>Assessment Mode</th>
<th>written tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workload</td>
<td></td>
</tr>
<tr>
<td>Lectures</td>
<td>Classes</td>
</tr>
<tr>
<td>36.25h</td>
<td>18.75h</td>
</tr>
<tr>
<td>Proportion of the TU in English:</td>
<td></td>
</tr>
</tbody>
</table>

Innovations in Design and Materials 9EC03 Semester 9

**Thematic scientific conferences**

Supervisors: Jacques FANTINI

ECTS: 1

Learning Outcomes
On completing this teaching unit engineering students will be able to:

- Understand industrial issues
- Understand how they were treated and resolved
- Know the means implemented

Teaching Process (syllabus)
Manufacturers will expose the problems encountered in their company. They will explain how they were treated and resolved. The experimental and numerical tools implemented will be described and analyzed.

<table>
<thead>
<tr>
<th>Assessment Mode</th>
<th>written tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workload</td>
<td>Lectures</td>
</tr>
<tr>
<td>-------------------</td>
<td>----------</td>
</tr>
<tr>
<td></td>
<td>10h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English: ☐
## Control strategies and Robotics

**Supervisors:** Estelle COURTIAL

### Learning Outcomes

On completing this teaching unit, engineering students will be able to:

- Model and identify a process in the state space;
- Design state feedback control laws (pole placement, decoupling);
- Synthesize state observers (software sensors);
- Implement different control laws (optimal control law, predictive control, visual servoing);
- Use tools and techniques to simulate, plan and control the motion of robotic systems.

### Teaching Process (syllabus)

- Modeling processes as state space representations.
- Study of system properties (controllability, observability, stability).
- Design of state feedback control laws (pole placement, decoupling control, linearizing control).
- State observers (soft sensor): Luenberger, Kalman
- Model simplification methods (Shur, Padé)
- Introduction to robotic system modeling
- Advanced control laws: predictive control, optimal control, linear quadratic control (LQC), robustness of a linear quadratic regulator (LQR), visual servoing.
- Identification (nonlinear programming)

Various applications will be studied in class using the following tools: Matlab, Simulink and Control toolbox.

Lab works: Practical applications on mobile robots and manipulated arm.

### Assessment Mode

written tests

### Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>33.75h</td>
<td>35h</td>
<td>11.25h</td>
<td></td>
<td></td>
<td>80h</td>
</tr>
</tbody>
</table>

Proportion of the TU in [E][U]

**English:**
Innovations in Design and Materials  9EC05  Semester 9

Collaborative Projects

Supervisors:  Benoit LE ROUX  ECTS: 4

Learning Outcomes
On completing this teaching unit engineering students will be able to:

- Use the knowledge and analysis methods seen in the training, to deal with concrete industrial cases
- Develop a project and analysis methodology.
- Work independently in a multidisciplinary group.
- Write a project report
- Present the results acquired

Teaching Process (syllabus)
During this teaching unit, students work on a technical project supervised by a scientific tutor (s).

Organization:
The autonomy of the student associated with a project team is the main rule that prevails in this UE.
Weekly meetings are planned to manage the progress of projects.
The project will be the subject of a written report with a summary in English, and an oral presentation.

Scientific content:
Project management and design of mechatronics and robotics systems: project team management, risk analysis, sizing and selection of mechanical components, study of control laws and correctors in servo control, programming of robots, etc.
The work of each student varies according to the project in which he will be involved, as well as his role within each project team.
This teaching Unit is part of a process of individualization of the training of students to allow them different learning paths according to their professional and personal projects.

Technical content:
SysML tool to integrate the description of the temporal or event function of the systems

Assessment Mode :
Intermediate step by oral defense in English / Triangle of the project in 3mn. Final defense before a jury of professionals. Report and final summary note.

Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.5h</td>
<td>27.5h</td>
<td></td>
<td></td>
<td></td>
<td>55h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:
Supervisors: Alain GASSER  ECTS: 6

Learning Outcomes
On completing this teaching unit engineering students will be able to:
- Study the nonlinear aspects of mechanics of structures
- Recognize the type of material nonlinear behavior and choose an associated law
- Identify the parameters of material nonlinear behavior laws
- Use the most common nonlinear behavior laws
- Solve a problem of large displacements (geometrical nonlinearities)
- Use contact processing techniques

Teaching Process (syllabus)
Nonlinear behavior of materials
- Thermodynamical approach for material behavior law building.
- Study of different nonlinear behaviors: plasticity, damage, failure, viscoelasticity, hyperelasticity.
- Identification of the parameters of these nonlinear laws.
- Examples of use of these laws in problems of continuum media mechanics

Contact, geometrical nonlinearities
Analysis and computation of structures with nonlinear behavior (geometrical and contact):
- Origin of nonlinearities
- Mechanics with geometrical nonlinearities
- Taking into account the behavior nonlinearities
- Contact treatment

Finite element method applications
Analysis and calculation (using a finite element software) of structures with nonlinear behavior: material (plasticity, visco-elasticity, hyperelasticity), geometrical and contact non-linearities.

Assessment Mode
Written tests

Workload
<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>20h</td>
<td>50h</td>
<td></td>
<td></td>
<td></td>
<td>70h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:

Innovations in Design and Materials  9MP02  Semester 9

Composites and processes

Supervisors: Jean-Luc DANIEL  ECTS: 4

Learning Outcomes
On completing this teaching unit engineering students will be able to:
Choose a suitable composite process for a given application, design and optimize this process to anticipate the induced properties.
Perform numerical simulations of draping and injection of composites.
Implement advanced characterization techniques in the field of composites materials processes.

Teaching Process (syllabus)
- Manufacturing processes of structural composites for industrial applications.
- Choice of process for a given application.
- Composite forming and link between formability and mechanical properties of reinforcements.
- Modelling and numerical simulations of shaping processes using a geometrical approach and a finite element method (CATIA and PAM FORM).
- Permeability of reinforcements. Modeling and simulation of the injection step of LCM processes (PAM RTM).
- Induced properties and residual stresses.
- Optimization strategies of shaping and injection through examples.
- Approach and rules of design of a composite structure.
- Application to industrial case studies.

Assessment Mode
Several exams, lab reports and homework assignments

<table>
<thead>
<tr>
<th>Workload</th>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15h</td>
<td>25h</td>
<td></td>
<td></td>
<td></td>
<td>40h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:
Innovations in Design and Materials 9MP03 Semester 9

**Multiphysics couplings**

**Supervisors:** Alain GASSER

**ECTS:** 4

### Learning Outcomes

On completing this teaching unit engineering students will be able to:

- Write properly a multiphysics problem
- Use a commercial finite element code to solve a multiphysics problem
- Analyse and understand the results of multiphysics numerical simulation

### Teaching Process (syllabus)

1. **Lesson**
   - Advanced thermomechanics
   - Thermo-poromechanic
   - Numerical treatment of transport equation, coupling between time and space integration
   - Basics of the thermodynamics for irreversible processes

2. **Methods and numerical tools (FEM codes : Abaqus, Comsol )**
   - Heat and electrical charge transport
   - Thermomechanic: transient and steady-state
   - Thermo-electro-mechanic coupling
   - Thermoporoelasticity: transient effects.

### Assessment Mode

Written tests

### Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.5 h</td>
<td></td>
<td>27.5 h</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**STUDENT WORKLOAD**

40 h

**Proportion of the TU in English:**
Innovations in Design and Materials 9MP04 Semester 9

Thematic scientific conferences

Supervisors: Alain GASSER ECTS: 1

Learning Outcomes
On completing this teaching unit engineering students will be able to:
- Understand industrial problematics
- Understand how they were treated and solved
- Know the used means

Teaching Process (syllabus)
Engineers from industrial partners will come to present problematics that their company has met. They will explain how they were treated and solved. The used experimental and numerical tools will be described and analyzed.

Assessment Mode
Written tests

Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>10h</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:
Innovations in Design and Materials 9MP05 Semester 9

**Advanced simulations**

Supervisors: Jean-Luc DANIEL  ECTS: 4

**Learning Outcomes**
On completing this teaching unit engineering students will be able to:

- To know the different hypotheses constituting models of beams, plates and shells.
- Know the main finite elements based on these models.
- Define the framework for their use.
- Know how to carry out EF calculations in the field of simulation of formatting processes.

**Teaching Process (syllabus)**

- Study of simplified models of beams, plates and shells.
- Case of thin elastic shells.
- Finished elements of plates and shells.
- Case of finite transformations.
- Simulations of formatting and crash processes.

**Assessment Mode**

Written test

**Workload**

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>20h</td>
<td>30h</td>
<td></td>
<td></td>
<td></td>
<td>50h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:
Innovations in Design and Materials

9MP06  Semester 9

Industrial applications

Supervisors: Jean-Luc DANIEL  ECTS: 4

Learning Outcomes
On completing this teaching unit engineering students will be able to:

- Use the knowledge and analysis methods seen in the training, to deal with concrete industrial cases
- Develop a project and analysis methodology.
- Work independently in a multidisciplinary group.
- Write a project report
- Present the results acquired

Teaching Process (syllabus)
During this teaching unit, students work on a technical project supervised by a scientific tutor (s).

Organization:
The autonomy of the student associated with a project team is the main rule that prevails in this UE.
Weekly meetings are planned to manage the progress of projects.
The project will be the subject of a written report with a summary in English, and an oral presentation.

Scientific content:
The content will focus on real case studies, from our industrial partners, focusing on material, structure and process simulation issues.
Problems dealt with in this project framework: shaping of metal parts or composites, modeling and simulation of multi-physical behaviors, (thermal, mechanical, chemical, hygrometric, etc.), impact simulation, multi-scale modeling and simulation, design and calculation of composite parts, topological optimization, modeling of living materials, etc.
The work of each student varies according to the project in which he will be involved, as well as his role within each project team. This Teaching Unit is part of a process of individualization of the training of students to allow them different learning paths according to their professional and personal projects.

Technical content:
SysML tool to integrate the description of the temporal or event function of the systems. (idem pour les logiciels métiers)

Assessment Mode:
Intermediate step by oral defense in English / Triangle of the project in 3mn. Final defense before a jury of professionals. Report and final summary note.

Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.5h</td>
<td>27.5h</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Proportion of the TU in English:

|     | 2 | 2 |

Innovations in Design and Materials  A1C01  Semester 10
Project

Supervisors: Jacques FANTINI  ECTS: 10

Learning Outcomes
On completing this teaching unit, engineering students will be able to:

- Write a product specification based on a requirements analysis
- Establish the functional and technological specifications of a project
- Establish milestones and provide project deliverables
- Manage a project

Teaching Process (syllabus)
Organization:
During this teaching unit, students work on a technical project supervised by a scientific tutor. The project is "full time" from early January to mid-March. It ends with a written activity report, a poster in English and an oral exam.

Scientific content:

- The subjects of projects proposed to the student engineers are very varied. We can make a feasibility study of a new concept, design a process for a dedicated application, improve a theoretical knowledge, realize an industrial study, etc ...
- In any case, the student engineer must show his ability to manage a project, to take initiatives, to be able to share tasks (working in pairs), to carry out a technical study in a given time.

Assessment Mode
Written activity report, oral defense

Workload
<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>170h</td>
<td>170h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English: [0][0][0]
# Syllabus 4th year

## Technologies for Energy, Aerospace and engine

<table>
<thead>
<tr>
<th>Code UE</th>
<th>Intitulé de l'Unité d'Enseignement</th>
<th>Total encadré (hors PEA)</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEAM</td>
<td>Technologies for Energy, Aerospace and Engine</td>
<td>616.5</td>
<td>60</td>
</tr>
<tr>
<td>4th year- Fall semester</td>
<td></td>
<td>377</td>
<td>30</td>
</tr>
<tr>
<td>7TE01</td>
<td>Energy Management</td>
<td>117.5</td>
<td>9</td>
</tr>
<tr>
<td>7TE02</td>
<td>Fluid dynamics</td>
<td>117.5</td>
<td>9</td>
</tr>
<tr>
<td>7TE03</td>
<td>Electrical engineering and automatic control</td>
<td>67.5</td>
<td>6</td>
</tr>
<tr>
<td>4th year- Spring semester</td>
<td></td>
<td>239.5</td>
<td>30</td>
</tr>
<tr>
<td>8TE01</td>
<td>Assistant Engineer project</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>8TE02</td>
<td>Engine and propulsion systems</td>
<td>120</td>
<td>9</td>
</tr>
<tr>
<td>8TE03</td>
<td>Numerical and experimental tools for the engineer</td>
<td>45</td>
<td>4</td>
</tr>
</tbody>
</table>
# Energy Management

**Supervisor:** Christian CAILLOL  
**ECTS:** 9

## Learning Outcomes
On completing this teaching unit, the engineering students will be able to:

- Use the essential tools to understand the different potential energy sources (from conventional or renewable resources), whether for energy production (thermal or motor) or energy-saving strategies in buildings.

- Apply the main principles of acoustic treatment to building interiors or noisy devices.

## Teaching Process (syllabus)

1. **The main challenges for tomorrow's energy**
   Primary resources and final energy consumption in France and worldwide. Energy and macro-economics. Anthropogenic emissions, their concentration and impact on the climate.

2. **Renewable energies**

3. **Thermal design of buildings**
   Thermal optimization of buildings, thermal regulation RT2012. Introduction to HVAC engineering: air exchange, air conditioning.

4. **Vibration and acoustics**
   Determining the vibration modes of simple elements. Determining the reflection and transmission coefficients of acoustic waves during changes in propagation. Sizing of sound attenuators. Determining the resonance modes in a room and identifying solutions to dampen them. Characterizing the acoustic properties of a room.

5. **Industrial combustion**

6. **Labs in energetics**

## Assessment Mode
Written, oral

## Workload

<table>
<thead>
<tr>
<th>LECTURES</th>
<th>LECTURES/CLASSES</th>
<th>CLASSES</th>
<th>LABS</th>
<th>INDIVIDUAL WORK</th>
<th>PROJECT WORK</th>
</tr>
</thead>
<tbody>
<tr>
<td>52.5h</td>
<td></td>
<td>30h</td>
<td>35h</td>
<td>5h</td>
<td></td>
</tr>
</tbody>
</table>

Student workload: 117.5h

Proportion of the TU in English: ☑️  
SD/OR: ☑️  
Innovation: ☑️
# Fluid dynamics

**Supervisor:** Nicolas MAZELLIER  
**ECTS:** 9

### Learning Outcomes
- Understanding the physical principles of fluid dynamics and heat transfers in different regimes. Application to simple configurations.
- Understanding and analyzing the main types of flow encountered in vehicle aerodynamics and their components, and their effects on aerodynamic performance.
- Initiation into digital and experimental tools in academic or industrial geometries. Selecting the most suitable physical models. Conducting an experiment/simulation and criticizing the results.

### Teaching Process (syllabus)

1. **Gas dynamics**
   Recap of the equations of motion and energy. Dimensionless numbers and the notion of similarity. Introduction to compressible flows in a perfect fluid; isentropic relationships; shock waves; study of the converging-diverging nozzle.

2. **Boundary layer**
   Theory of the dynamic and thermal boundary layer, self-similar solutions and scaling laws. Characteristic dimensionless numbers of heat transfers. Reynolds analogy.

3. **External aerodynamics**
   The main phenomena: attached and detached flows, 2D and 3D, subsonic and supersonic. Case of the airfoil and the wing in incompressible flows. Linearized potential in compressible flows; 2D sub- and super-sonic applications. Application to vehicles and energy systems.

4. **Turbulence**
   Introduction to turbulence. Statistical approach through Reynolds formalism (RANS). Problem of closure and introduction of the turbulent viscosity model.

5. **Experimental labs**

6. **Digital labs**
   Simulation of turbulent flows on the ANSYS software suite. Application to simple cases. Airfoil from Mach 0.3 to Mach 3. Converging-diverging nozzle.

### Assessment Mode:
- written, oral

### Workload

<table>
<thead>
<tr>
<th>LECTURES</th>
<th>LECTURES /CLASSES</th>
<th>CLASSES</th>
<th>LABS</th>
<th>INDIVIDUAL WORK</th>
<th>PROJECT WORK</th>
</tr>
</thead>
<tbody>
<tr>
<td>36.25h</td>
<td></td>
<td>51.25h</td>
<td>30h</td>
<td>12.5h</td>
<td></td>
</tr>
</tbody>
</table>

Student workload: **117.5h**

**Proportion of the TU in English:** ☑  
**SD/CR:** ☑  
**Innovation:** ☑
Technologies for Energy, Aerospace and Engine 7TE03 Semester 7

Electrical engineering and automatic control

Supervisor: Guillaume COLIN ECTS: 6

Learning Outcomes
- Modeling 4 electrical machines by their equivalent schemes; associating loads to rotating machines by their mechanical characteristics; measuring electrical powers on networks with linear or non-linear loads; understanding the risks at low voltage below 500 V; implementing the 4 electrical machines; recording the mechanical characteristics of two rotating machines associated with their converter or scalar inverter
- Study of continuous linear dynamic systems and synthesizing equalizers; modeling and identifying a linear system from data; identifying the inputs and limitations of a closed-loop control system; adjusting and operating a PID, introduction to advanced industrial controls

Teaching Process (syllabus)

1. Electrotechnical engineering
Active, reactive and distorting apparent powers on linear or non-linear loads; magnetism applied to linear current transformers and linear inductance transformers, no-load current of a voltage transformer; ferromagnetic losses and technological solutions; static steady-state model of 4 electrical energy conversion machines. In electrical energy, the transformer and its Kapp model. In mechanical energy, separately excited current- or voltage-controlled DC machines. AC machines using Leblanc and Ferraris theorems, synchronous by Behn Eschenburg's model and asynchronous by the simplified scheme or in scalar control

2. Automatic control

3. Labs
Three-phase power measurements and protection of persons; Three-phase transformer; Direct current machine; Asynchronous machine; Speed variation on an asynchronous machine; Synchronous machine and alternator starter test bench; PID regulation of the thermal behavior of a building.

Assessment Mode: written, oral

Workload

<table>
<thead>
<tr>
<th>LECTURES /CLASSES</th>
<th>CLASSES</th>
<th>LABS</th>
<th>INDIVIDUAL WORK</th>
<th>PROJECT WORK</th>
</tr>
</thead>
<tbody>
<tr>
<td>15h</td>
<td>18.75h</td>
<td>33.75h</td>
<td>11.25h</td>
<td></td>
</tr>
</tbody>
</table>

Student workload: 67.5h

Proportion of the TU in English: ☐ ☐ ☐ SD/CR: ☐ Innovation: ☐
Learning Outcomes

- Applying for a position as an engineering assistant (CV, cover letter)
- Preparing a job interview
- Analyzing a customer’s expectations and needs and costing a solution.
- Developing and consolidating the disciplinary skills acquired during the first two years of training to meet the technical needs of the project
- Working independently but also as part of a team.
- Organizing and scheduling work to optimize performance and meet deadlines.

Teaching Process (syllabus)

Recruitment phase of project teams

- Consultation of the offers proposed by project managers.
- Drafting a CV and cover letter tailored to the job offer.
- Job application and preparation of the job interview.

Project Management

- Initiation to the information search tools necessary for carrying out the project.
- Initiation to drafting an estimate and scientific technical appendices.
- Introduction to the principles of an audit.

Technical realization

- Technical implementation support through discussion with project managers
- Design and implementation of experimental and/or digital databases
- Participation in drafting technical reports
- Participation in progress meetings
- Assessment of skills acquired (oral + written)

Assessment Mode: written, oral

Workload

<table>
<thead>
<tr>
<th>LECTURES</th>
<th>LECTURES /CLASSES</th>
<th>CLASSES</th>
<th>LABS</th>
<th>INDIVIDUAL WORK</th>
<th>PROJECT WORK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2.5h</td>
<td>2.5h</td>
<td>80.75h</td>
<td></td>
</tr>
</tbody>
</table>

Student workload: 5h
Learning Outcomes

- Understanding the main parameters influencing the operation of an internal combustion engine.
- Performing a summary analysis of combustion in an internal combustion engine.
- Pre-dimensioning an air or space propulsion system according to its use.

Teaching Process (syllabus)

Internal combustion engines

- Recap of theoretical cycles, shape efficiency, theoretical thermodynamic efficiency. Calculation of energy inputs in the isochoric, isobaric and isothermal phases.
- Calculation of the heat release and the net and gross heat release rate: wall losses and literature models, closure of the energy balance.
- Practical work on engine benches.

Aeronautical and space propulsion

- Main components, architecture, modularity.
- Thermodynamic and mechanical sizing of the turbojet engine
- Approximate calculation of aircraft and rocket engine performance
- Projects on a turbojet virtual simulation bench: engine control and thermodynamics

Assessment Mode: written, oral

Workload

<table>
<thead>
<tr>
<th>LECTURES</th>
<th>LECTURES/CLASSES</th>
<th>CLASSES</th>
<th>LABS</th>
<th>INDIVIDUAL WORK</th>
<th>PROJECT WORK</th>
</tr>
</thead>
<tbody>
<tr>
<td>66.25h</td>
<td>5h</td>
<td>48.75h</td>
<td>20h</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Student workload: 120h

Proportion of the TU in English: ☑️

SD/QR: ☑️

Innovation: ☑️
Numerical and experimental tools for the engineer

Supervisor: Pierre-Yves PASSAGGIA

Learning Outcomes

- Understand the mathematical properties of linear partial differential equations (PDEs)
- Understand where and how these "building blocks" are involved in the general equations of the TEAM specialty
- Programming simple numerical methods to solve sample problems
- Choose an appropriate type of sensor to measure a physical phenomenon
- Acquisition and visualization of experimental signals acquired experimentally
- Digital signal processing (statistics, spectral analysis, filtering)

Teaching Process (syllabus)

Theoretical and numerical analysis of partial differential equations

- Classification (elliptical, parabolic, hyperbolic), characteristics, standard equations
- Finite difference methods, timeplots, stability analysis
- Matlab programming:
  - 1D heat equation
  - 2D Poisson Equation
  - 1D wave equation

Signal acquisition and processing

- Sensors: sensor types, resolution, sensitivity, precision, calibration
- Acquisition cards: technology, frequency, resolution, multiplexing, gain
- Signal processing: Shannon's theorem, FFT (Welch, Hanning...), statistical tools
- Practical work with Matlab:
  - Acquisition and visualization of a signal by a pressure and velocities probes
  - Processing and analysis of signals in fluid mechanics, engines or thermal science.

Assessment Mode: Oral and assignment

Workload

<table>
<thead>
<tr>
<th>LECTURES</th>
<th>LECTURES/CLASSES</th>
<th>CLASSES</th>
<th>LABS</th>
<th>INDIVIDUAL WORK</th>
<th>PROJECT WORK</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.25h</td>
<td></td>
<td>28.75h</td>
<td></td>
<td>10h</td>
<td></td>
</tr>
</tbody>
</table>

Student workload: 45h

Proportion of the TU in English: ☑ ☑ ☑ ☑ ☑

SD/CR: ☑

Innovation: ☑
Technologies for Energy, Aerospace Engineering and Motorization (TEAM)

<table>
<thead>
<tr>
<th>Course Unit Code</th>
<th>Course Unit Title</th>
<th>Total Hours without ind. work</th>
<th>ECTS Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall Semester (September – December)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9TE01</td>
<td>Professional Lectures – Conférences métier</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td><strong>3 courses to choose below</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9TE02</td>
<td>Turbulence and Advanced CFD – Turbulence et CFD avancée</td>
<td>70</td>
<td>7</td>
</tr>
<tr>
<td>9TE03</td>
<td>Combustion and Applications – Combustion et applications</td>
<td>70</td>
<td>7</td>
</tr>
<tr>
<td>9TE04</td>
<td>Gas Dynamics – Dynamique des gaz</td>
<td>70</td>
<td>7</td>
</tr>
<tr>
<td>9TE05</td>
<td>Engines – Moteurs</td>
<td>70</td>
<td>7</td>
</tr>
<tr>
<td>9TE06</td>
<td>Engine and Hybrid Vehicle Control – Contrôle moteur et véhicule hybride</td>
<td>70</td>
<td>7</td>
</tr>
<tr>
<td>9TE07</td>
<td>Building Energy – Énergie des bâtiments</td>
<td>70</td>
<td>7</td>
</tr>
<tr>
<td>9TE08</td>
<td>Energetic Systems – Systèmes énergétiques</td>
<td>70</td>
<td>7</td>
</tr>
<tr>
<td>9TE09</td>
<td>Aeroacoustics and Elasticity – Aéroacoustique et aéroélasticité</td>
<td>70</td>
<td>7</td>
</tr>
<tr>
<td><strong>Spring Semester (January – March)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATE01</td>
<td>Project – Projet d’entreprise</td>
<td>170</td>
<td>10</td>
</tr>
</tbody>
</table>
Technologies for Energy, Aerospace Engineering and Motorization

Professional lectures
Supervisor: Ivan FEDIOUN

ECTS : 3

Learning Outcomes
On completing this teaching unit engineering students will be able to:
- To have a more precise vision of the different professions to which TEAM can lead
- Better know the industrial applications of the academic courses given during the training

Teaching Process (syllabus)
8 lecturers of 2h30 given by professional experts in their fields of competence

<table>
<thead>
<tr>
<th>Lecturer</th>
<th>Company</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>DUBOIS Thomas</td>
<td>Total</td>
<td>Energy mix, renewable energy</td>
</tr>
<tr>
<td>KETFI-CHERIF Ahmed</td>
<td>Renault</td>
<td>Hybrid and Electric Powertrain control</td>
</tr>
<tr>
<td>SLANEY David</td>
<td>GRDF</td>
<td>Energy systems</td>
</tr>
<tr>
<td>MATHEDARRE Christophe</td>
<td>Safran Aircraft Engines</td>
<td>Thermal management</td>
</tr>
<tr>
<td>MORSILI Salah-Eddine</td>
<td>EDF</td>
<td>Energetics</td>
</tr>
<tr>
<td>BOQUEL Pierre</td>
<td>ASN</td>
<td>Nuclear safety - Radioprotection</td>
</tr>
<tr>
<td>BRULEFERT Frédéric</td>
<td>LORIAS Lab’O</td>
<td>Aeronautics, military aviation</td>
</tr>
<tr>
<td>BLOT Yves</td>
<td>Safran Aircraft Engines</td>
<td>Safety/aeronautical regulations</td>
</tr>
</tbody>
</table>

Assessment Mode
Compulsory attendance

<table>
<thead>
<tr>
<th>Workload</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>20h</td>
<td></td>
<td></td>
<td></td>
<td>20h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:
Turbulence and Advanced CFD

Supervisor: Ivan FEDIOUN  ECTS: 7

Learning Outcomes
On completing this teaching unit engineering students will be able to:
- Describe, understand and analyze the physical phenomena occurring in turbulent flows;
- Use tools to process and analyze experimental and numerical results;
- Choose the correct level of description/modeling for digital simulation (MILES, LES, DES, RANS) depending on needs and available resources;
- Use the CFD ANSYS Fluent® software for RANS simulation in turbulent flows.

Teaching Process (syllabus)
1. Physical description and statistical analysis of turbulence
   - Statistical tools: random variables, statistical moments and 1 or 2-point correlations, stochastic averaging, general theorems
   - Physics of turbulence: Eulerian scales in space and time, Kolomogrov scales, Taylor’s hypothesis, homogeneous and isotropic turbulence, spectra, double-correlation dynamics, inertial law
   - Experimental approach: practical demonstration of measurement techniques in non-reactive flow (hot-wire, LDV, PIV)
   - Signal and image processing: time and space averages, Fourier transform, time and space correlations, power of spectral densities. Implementation: LVD signal processing, hot-wire

2. Operational modeling: 1-point closures (RANS)
   - Recap and complements: Reynolds’ formalism, statistical equations in incompressible flow, closure issues
   - RANS formalism in compressible flow: Favre averaging, Morkvin hypothesis
   - Newtonian closure: 1-equation (Spalart-Allmaras) and 2-equation (k-ε, k-ω,...) models, wall laws

3. Large Eddy Simulation
   - Explicit subgrid filtering and modeling: physical and spectral space, generalized central moments, eddy viscosity models (Smagorinsky, Structure-Function model), scale similarity model (Bardina), Germano identity, dynamic models (Germano-Lilly)
   - Implicit large-scale simulation: implicit filtering of a digital scheme, transfer function, dissipative and dispersive schemes, applications

4. CFD applications with ANSYS Fluent® 15.0

5. Conferences given by invited lecturers

Assessment Mode
2 short written tests, homework assignment, lab reports in CDF and experimental lab reports

Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>5h</td>
<td>25h</td>
<td>30h</td>
<td>20h</td>
<td>10h</td>
<td>70h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:
# Technologies for Energy, Aerospace Engineering and Motorization 9TE03 Semester 9
## Combustion and Applications

### Supervisor: Fabien HALTER  
ECTS: 7

### Learning Outcomes
On completing this teaching unit engineering students will be able to:

- Acquire the requisite knowledge to describe, understand and analyze laminar and turbulent combustion phenomena coming into play in industrial applications;
- Know the basic mechanisms determining the formation and reduction of pollutant emissions;
- Identify parameters influencing heat release and the formation of the main pollutants (soot, NOx) for applications such as internal combustion engines, thermal power plants (coal, gas, biofuels) and turbine engines. Know how to vary parameters to optimize the working of the energy system;
- Use CFD software to simulate a complex system;
- Acquire an overview of the tools allowing characterizing a reactive or non-reactive turbulent flow.

### Teaching Process (syllabus)

1. **Theory**
   - Combustion chemistry (thermodynamics applied to chemistry, chemical kinetics)
   - Self-ignition (theory, measurement methods, examples of detailed modeling)
   - Premixed flames (flammability limit, flame stabilization, extinction parameters, propagation velocity, flame thickness, ...); Diffusion flames
   - Combustion high-energy materials and explosives
   - Formation of pollutants and post-processing systems
   - Flame/turbulence interactions
   - Models of turbulent combustion for premixed and diffusion flames
   - Illustration of the phenomena of combustion and pollutant formation with recent technologies
   - Introduction to tools allowing to characterize a reactive or non-reactive turbulent eddy flow (lab)
   - Image processing (digital tool Matlab)

2. **Practice**
   - Use of CHEMKIN software. Application of notions tackled through 3D calculation codes (FLUENT)

3. **Autonomous supervised project**
   - Students will work by group on a project dedicated to the description and the understanding of an accidental combustion phenomenon. A guided project devoted to the characterization of acoustically perturbed flames using post-processing tools will be proposed.

Four conferences given by industrial stakeholders and researchers will be planned on different topics.

### Assessment: Mode
At least 3 written tests or exams. 3 presentations in group.

### Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>30h</td>
<td>10h</td>
<td>30h</td>
<td>3.75h</td>
<td></td>
<td>70h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:

Technologies for Energy, Aerospace Engineering 9TE04 Semester 9 and Motorization
# Gas Dynamics

**Supervisor:** Azeddine KOURTA  
**ECTS:** 7

## Learning Outcomes
On completing this teaching unit engineering students will be able to:

- Acquire the knowledge require to calculate, analyze and characterize the physical phenomena present in flows at speeds ranging from high subsonic to hypersonic;
- Master digital tools to predict these flows and understand the role of the mathematical properties of Euler’s equations (hyperbolicity, characteristics) in numerical shock-capture schemes (FVS, FDS). Review of the main schemes. Initiation into FORTRAN programming.

## Teaching Process (syllabus)

1. **Dynamics of high speed flows**
   - Recap of the 4th year course on thermodynamics, the Euler system, normal shocks
   - 1D unsteady flows: characteristics, Riemann invariants, shock tube
   - 2D steady flows: oblique shocks, interaction of shocks, Mach disc. Expansion fan, Prandtl-Meyer relation, linearized theory, characteristics, Cauchy problem
   - ‘Cold’ hypersonic airflows: entropy layer, viscous interaction, similarity

2. **Numerical methods to solve Euler’s equations**
   - Recap on Euler 1D system: conservative, primitives and characteristic variables, transformation matrices, Riemann invariants
   - Conservative schemes, first-order ‘upwind’ finite-volume schemes based on flux splitting (FVS) and approximate Riemann solvers (FDS)
   - Second-order extension: MUSCL approach, TVD schemes and flow limiters

3. **Machine applications with FORTRAN language**
   - Linear convection: programming, management of boundary conditions
   - Burgers’ equation: Riemann problem with compressive or expansive initial conditions
   - Programming Lax-Friedrichs and CIR schemes with a constant time-step
   - Application to the Sod shock tube problem with fixed boundary conditions. Management of boundary conditions: free non-reflective output, reflective closed boundaries, mixed conditions
   - Programming the Roe scheme with Harten’s entropy fix, adaptive time-step with constant CFL and ordinary boundary conditions

4. **Autonomous supervised project**

## Assessment Mode
3 short written tests, exams, homework assignments

<table>
<thead>
<tr>
<th>Workload</th>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25h</td>
<td>25h</td>
<td>20h</td>
<td>12.5h</td>
<td></td>
<td>70h</td>
</tr>
</tbody>
</table>

## Technologies for Energy, Aerospace Engineering and Motorization

**9TE05**  
**Semester 9**

**Engines**
Learning Outcomes

On completing this teaching unit engineering students will be able to:

- Understand the physical and chemical processes taking place during combustion and during fuel injection in internal combustion engines. Use modeling to understand the reaction of a given engine to a change in one of its parameters;
- Construct a model of an internal combustion engine. Optimize the dimensioning and tuning of an engine under various constraints: performance, power, and pollutant emissions, using an engine model.

Teaching Process (syllabus)

- Turbocharging: static and dynamic models of the turbocharger. Turbocharger performance and speed maps. Turbine/compressor adaptation. Pumping limit. Dynamics of the turbocharger, response time
- Specific tools: Matlab/Simulink, GTpower, Chemkin. Assembling engine models from component libraries, using the detailed models analyzed in this teaching unit

Assessment Mode

3 reports

Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.5h</td>
<td>42.5h</td>
<td></td>
<td></td>
<td>5h</td>
<td>70h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:
### Technologies for Energy, Aerospace Engineering 9TE06 Semester 9

## Engine and Hybrid Vehicle Control

**Supervisor:** Guillaume COLIN  
**ECTS:** 7

### Learning Outcomes

On completing this teaching unit engineering students will be able to:

- Master engine control systems, control strategies and the associated control devices;
- Implement control strategies for internal combustion engines;
- Apply the knowledge acquired in class to the tuning and control of internal combustion engines on a test bench, an actuator bench or via simulation;
- Perform energy balance on a hybrid vehicle and generate an energy management strategy.

### Teaching Process (syllabus)

#### 1. Theory

- History of engine control: carburetor, mechanical injection
- State of the art: sensors, actuators, hardware and software implementation of the controller, strategies
- Spark ignition engine control: basic strategies (fuel enrichment, ignition advance), pollution control (fuel enrichment adjustment, catalyst, light-off, EGR), detecting knock, anti-knock strategies, idle, start, cold start, drivability
- Diesel engine control: basic strategies (quantity of injected fuel, smoke limit), multiple injection, homogeneous charge engines, idle, start, cold start, drivability
- Development methods
- Embedded networks
- Embedded models: intake manifold dynamics, turbochargers, fuel, friction
- Automatic control: PID control and advanced control
- Control based on physical or heuristic models, torque control
- Hybrid vehicles: definitions, issues, energy management (heuristic, optimal, Equivalent Consumption Minimization Strategy)

#### 2. Practice

- Tuning an internal combustion engine; Engine control; Energy management of an hybrid vehicle
- Labs will be conducted on a real engine test bench, on an actuator bench system, and on a roller bench. 2 labs will be conducted at John Deere in Saran for a limited number of students.

This teaching unit also aims at raising awareness among engineering students regarding engine control and its tuning (engine mapping, PID control, advanced control).

#### 3. Mini-project

Project on Engine and Hybrid Vehicle Control, e.g. in 2017/2018 the pre-sizing of the technical elements of an HEV and designing the energy management with the softwares Amesim and Simulink.

### Assessment Mode

Lab reports, oral defense, homework assignments, mini-project report and defense

### Workload

<table>
<thead>
<tr>
<th>Workload</th>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20h</td>
<td></td>
<td>50h</td>
<td>30h</td>
<td></td>
<td>70h</td>
</tr>
</tbody>
</table>

### Proportion of the TU in English:

58%
and Motorization

Building Energy

Supervisor: Jean-Michel FAVIÉ

ECTS: 7

Learning Outcomes
On completing this teaching unit engineering students will be able to:

- Identify professional elements in different technical and human fields related to “chargé d’affaires” engineers specialized in building and sustainable energies;
- Master different standards, classic and sustainable production means and production modes coordination. Suggest economical and innovative solutions respectful of the environment.

Teaching Process (syllabus)
1. Environmental standards, regulations and requirements
   Thermal control, very high quality sustainable architecture (THQE), para-public labels, Agenda XXI, project conduct with decision-makers (town halls, promoters, private companies...). Environmental footprint, embedded energy et LCA (Life Cycle Analysis)
2. Thermal auditing and diagnostic
   Environmental audit, EPD (Energy Performance Diagnostic) and carbon balance. Needs identification (AMO) and implementation of eco-responsible improvements. Simple assessment models for suggested solutions
3. Passive energetics
   Conventional and bio-sourced materials. Architecture, header captors, solar walls, etc.
4. Digital models
   Homogenization theory, transitory regulation models (DF, EF, integrators)
   Predictive approach and use plan management. Release, production and consumption grouping to achieve energy management
5. Renewable energies
   How to invert primary and secondary production sources. Solar thermal energy, wind power, shallow or great depth geothermal energy. Collaboration between different production modes as a function of needs
6. Heat exchangers
   Heat pumps, fin heat exchangers. Wood burners and forests sustainable management

Assessment Mode
1 project conduct, 1 homework assignment: modeling and energies integration, written tests

Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>45h</td>
<td>18.75h</td>
<td>6.25h</td>
<td>21.25</td>
<td></td>
<td>70h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English: [2]
# Energetic Systems

**Supervisor:** Camille HESPEL  
**ECTS:** 7

## Learning Outcomes

On completing this teaching unit engineering students will be able to:

- Dimension an energy production system (combined cycle, steam power plants and boilers);
- Apply notions of security and nuclear safety.

## Teaching Process (syllabus)

### Energy production on the industrial scale

- Nuclear power plants (principle, primary and secondary cycles, safety)
- Thermal power plants (functioning of a facility)
- District heating systems

### The different components in energy production

- Steam generators
- Steam turbines
- Boilers (water circulation, furnace design)
- Exchangers

### Advanced thermodynamics

- Study of water/steam cycles
- Enthalpy and Mollier diagrams
- Study of the combine cycle gas (general functioning, principles and applications)

### System optimization

- Main controls (power, temperature, level)
- Cogeneration

### Geopolitics of energy

- National, European and international regulation
- Alternative energies
- Short and long-term issues
- Life cycle assessment

## Assessment Mode

3 exams and a written report

## Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th><strong>STUDENT WORKLOAD</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>43.75h</td>
<td>20h</td>
<td>6.25h</td>
<td>30h</td>
<td></td>
<td>70h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:
Aeroacoustics and Elasticity

Learning Outcomes
On completing this teaching unit engineering students will be able to:
- understand and describe the main physical phenomena associated with aeroacoustic (aerodynamically generated noise) and aeroelastic (coupling between aerodynamics and elastic deformations) aspects and their effects, in particular those associated with the unsteadiness of fluid flows
- carry out some simple modeling.

Teaching Process (syllabus)

1. Aeroacoustics
   General notions about aerodynamic noise, fields of application, sound propagation in flows in homogeneous media, calculation of the radiated noise, noise sources, interaction between flows and acoustics. Concrete examples of noise nuisances. Unsteady wave motion. Representative parameters of local noise motion. Intensity, noise level, noise sources. Propagation equation with and without flow. Theory to calculate aerodynamic noise (Lighthill’s analogy)

2. Aeroelasticity
   On the basis of the classic tools for steady and unsteady aerodynamics and for the mechanics of deformable solids, describe, analyze and model the main characteristics of the steady and dynamic behavior of deformable objects (airfoils, wings, rotors, etc.) subjected to the interaction between elastic, inertial and aerodynamic forces, which may lead to stationary aeroelastic divergence or unsteady flutter. Introduction to fluid-structure coupling. Recap on elasticity - strength of materials and aerodynamics. Steady aeroelasticity: formulation of the problem, analysis of the divergence of a large aspect ratio wing and of the control surface reversal phenomena. Dynamic aeroelasticity: formulation of the problem; difference between the different modes of aeroelastic coupling (resonance, flutter). Flutter in steady aerodynamics and application to a wing much more flexible in flexion than in torsion: aeroelastic stability and dynamic response using the model cross-section. Unsteady aerodynamic modeling of an airfoil and its effects on the previous results

Assessment: Mode
Several written tests, exams and homework assignments in the course of the TU

Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.5h</td>
<td>32.5h</td>
<td></td>
<td>12.5h</td>
<td></td>
<td>70h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:
### Technologies for Energy, Aerospace Engineering and Motorization

#### Project

**Supervisor:** Pierre BREQUIGNY  
**ECTS:** 10

### Learning Outcomes

On completing this teaching unit engineering students will be able to:

- Conduct a study to solve an industrial or research issue using an engineering approach;
- Develop and consolidate disciplinary skills acquired during the three-year training;
- Set a bill of specifications and schedule tasks;
- Perform regular follow-up with the actors of the project, plan follow-up meetings;
- Work autonomously;
- Synthesize the progress made and present them in a written report and oral presentation.

### Teaching Process (syllabus)

- Project and format selection (solo, duo or group work)
- Establishment of contact with the limited partner of the study (company or laboratory)
- Writing of the bill of specifications submitted to the limited partner for approval
- Task scheduling and follow-up meetings
- Identification of the tools and resources necessary to the project conduct
- Risk analysis and fallback solutions
- Technical realization of the study
- Update of the project follow-up and implementation of fallback solutions if required
- Delivery of a synthesis report
- Oral presentation of the results of the study

### Assessment Mode

Report and oral defense

### Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>170h</td>
<td>170h</td>
</tr>
</tbody>
</table>

Proportion of the TU in [ ]

**English:** [ ]
All trainings - Classics teaching units

<table>
<thead>
<tr>
<th>Course Unit Code</th>
<th>Course Unit Title</th>
<th>Total Hours without ind. work</th>
<th>ECTS Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall Semester (September – December)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9Hx01*</td>
<td>Operationnal Management – <em>Management opérationnel</em></td>
<td>36.25</td>
<td>4</td>
</tr>
<tr>
<td>9Hx03*</td>
<td>Intercultural communication - start up project</td>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>

* x = C for Civil and Geo-environmental Engineering training
  P for Engineering Physics and Embedded Systems training
  M for Innovations in Design and Materials training
  T for Technologies for Energy, Aerospace Engineering and Motorization training
Operational Management

Supervisor: Jean-Jacques YVERNAULT

ECTS: 4

Learning Outcomes
On completing this teaching unit engineering students will be able to:

- Apply methods of group leadership and negotiation;
- Understand the factors that drive motivation;
- Use quality control tools in problem-solving;
- Determine the occupational hazards of a workstation and analyze the company’s safety policy;
- Include work ethic to their trade;
- Understand the different steps of industrial patent design, writing and registration;
- Perform efficient industrial patent search and reading;
- Optimize their CV and interview skills so as to obtain an interesting internship.

Teaching Process (syllabus)
1. Operational management
Giving a debriefing of management situations encountered during the 4th year work placement; creating management cases (Personal Evolution and Employability of the UNIT project); understanding the role and responsibilities of an engineer in company management; handling complicated cases and conflicts; conducting interviews and run meetings; negotiating purchases and sales methodically.

2. Quality and safety management
Methodical problem-solving; using tools proper to lean management approach; including work ethic in management; preventing and tackling psychosocial risks; analyzing and diagnosing occupational hazards in order to control them.

3. Patent of invention and industrial property
Understanding the existing links between innovation and industrial property; knowing patent registration criteria; being able to localize the different sections of a patent of invention when reading it; knowing how to make a patent database search to find relevant information.

4. Recruitment
Writing a CV and cover letters that include the work experience gained in the 4th-year placement; planning a meeting for the next work placement; introducing and making oneself an attractive work candidate in an assessment interview role-play.

Assessment Mode
Written report on solving a management case (in teams), written report on a work ethic case. Mooc certificate on industrial property and invention patent, oral exam (recruitment simulation)

Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>32.5h</td>
<td>3.75h</td>
<td></td>
<td></td>
<td>36.25h</td>
</tr>
</tbody>
</table>

Proportion of the TU in English:
### Intercultural Communication - Start up project

**Supervisor:** Adèle BRIERLEY-LOUETTE  
**ECTS:** 2

#### Learning Outcomes

On completing this teaching unit engineering students will be able to:
- Get organized in a team to design and create a virtual « Start-Up » company which will be located in a foreign country
- Do the research and the necessary steps to the creation of this virtual company abroad
- Introduce and defend in team the research and the project of “Start-up” in front of an exam board.

#### Teaching Process (syllabus)

- Research and creation of a virtual company to set up abroad
- Autonomous team work
- Regular follow-up meetings
- Debates and oral presentations

#### Assessment Mode

1 written exam, 1 timed oral presentation, 1 professional interview, intercultural fair participation

#### Workload

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Classes</th>
<th>Labs</th>
<th>Individual work</th>
<th>Project work</th>
<th>STUDENT WORKLOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>10h</td>
<td></td>
<td></td>
<td>12.5h</td>
<td></td>
<td>10h</td>
</tr>
</tbody>
</table>

Proportion of the TU in **English:**
Personal Projects
Available during the Fall and the Spring Semesters, students can work on a project with a Polytech Orléans teacher in English.

The subject of the Project must be defined in advance on a Learning Agreement, between the student and his academic coordinators from his home institution and his host institution.

Projects can be done in the following departments:

- Civil and Geo-environmental Engineering,
- Engineering Physics and Embedded Systems,
- Innovations in Design and Materials,
- Technologies for Energy, Aerospace Engineering and Motorization,
- Industrial Engineering applied to Cosmetics, Pharmacy and food-processing Industry.

<table>
<thead>
<tr>
<th>Course Unit Code</th>
<th>Course Unit Title</th>
<th>Total Hours without ind. work</th>
<th>ECTS Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>UP05</td>
<td>Project for exchange student – Projet pour étudiant en échange</td>
<td>~ 2 weeks</td>
<td>5</td>
</tr>
<tr>
<td>UP10</td>
<td>Project for exchange student – Projet pour étudiant en échange</td>
<td>~ 1 month</td>
<td>10</td>
</tr>
<tr>
<td>UP15</td>
<td>Project for exchange student – Projet pour étudiant en échange</td>
<td>~ 6 weeks</td>
<td>15</td>
</tr>
<tr>
<td>UP20</td>
<td>Project for exchange student – Projet pour étudiant en échange</td>
<td>~ 2 months</td>
<td>20</td>
</tr>
<tr>
<td>UP30</td>
<td>Project for exchange student – Projet pour étudiant en échange</td>
<td>&gt; 3 months</td>
<td>30</td>
</tr>
</tbody>
</table>
French Course
International students can attend French courses at the French Institute of the University of Orléans. These courses take place on late afternoons, during the week, and cost 50€/semester.

At the beginning of each semester, students must take an exam to determine their level in French.

There are 4 different levels: Beginners, Intermediate, Advanced and Superior.

Each course is equivalent to 2 ECTS credits.

**Different courses:**

<table>
<thead>
<tr>
<th>Fall semester</th>
<th>Spring semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courses</td>
<td>Code</td>
</tr>
<tr>
<td>Beginner</td>
<td></td>
</tr>
<tr>
<td>Written</td>
<td>FA1O1FRE</td>
</tr>
<tr>
<td>Oral</td>
<td>FA1O1FRO</td>
</tr>
<tr>
<td>Intermediate</td>
<td></td>
</tr>
<tr>
<td>Written</td>
<td>FA2O1FRE</td>
</tr>
<tr>
<td>Oral</td>
<td>FA2O1FRO</td>
</tr>
<tr>
<td>Advanced</td>
<td></td>
</tr>
<tr>
<td>Written</td>
<td>FB1O1FRE</td>
</tr>
<tr>
<td>Oral</td>
<td>FB1O1FRO</td>
</tr>
<tr>
<td>Grammar</td>
<td>FB1O1GRA</td>
</tr>
<tr>
<td>University methodology</td>
<td>FB1O1FOU</td>
</tr>
<tr>
<td>Superior</td>
<td></td>
</tr>
<tr>
<td>Written</td>
<td>FB2O1FRE</td>
</tr>
<tr>
<td>Oral</td>
<td>FB2O1FRO</td>
</tr>
<tr>
<td>Grammar</td>
<td>FB2O1GRA</td>
</tr>
<tr>
<td>University methodology</td>
<td>FB2O1FOU</td>
</tr>
</tbody>
</table>