# Detailed 3A Mundus Syllabus

Polytech Orléans

University of Orléans

Academic Year 2017-2018

## 1. Foreword

Students from MUNDUS course dedicate one year to completing their mastery of French language and immersing themselves in French culture while studying pre-specialization courses and English classes. Then they join the 4th year of engineering studies at Polytech Orléans according to standard rules to graduate as engineers in the following major:

- Engineering Physics and Embedded Systems (GPSE),
- Industrial Engineering applied to Cosmetics, Pharmacy and Food-Supply Chain (IE),
- Innovation in Concepts and Materials (ICM),
- Civil Engineering and Géo-environnement (GC),
- Technologies for Energy, Aerospace Engineering and Engine (TEAM).

Students from MUNDUS course entering the 4th year of engineering studies will study the same classes as any other student from the school. Engineering curriculum is specific to each specialty and can be structured in options from the 4th or 5th year.

## 2. Admission and tuition fees

Will be admitted to attend MUNDUS course: students who have completed a Bachelor (4+3 students) or a in year 3 of the Bachelor degree (3+3) students and achieved A2 French level. Tuition fees are €4.000 for MUNDUS course. They include tuition fees for the University of Orléans, student health insurance and registration for the two TCFs.

## 3. Course Organisation

The main goal of the training is intensive learning of French language and culture in order to validate level B2 – necessary to pass on to the 4th year – when taking the TCF. In parallel with French and English training, students will follow part of the specialized scientific teaching units. An adapted pedagogical approach with classes or labs might be chosen to help students adjust to the French educational system.

Teaching units are organized in semesters according to a yearly-set calendar passed on to students and accessible to them on the school's website (Administration/Education). Subjects, modules, relevant pedagogical elements are grouped in Teaching Units (TU or Unités d'Enseignement – UE) within each semester. There are around 300 hours of supervised teaching within a semester. Each TU insures pedagogical consistency (possibly between several subjects) and allows students to acquire identified skills. Each semester will be allocated 30 required ECTS defined in the curriculum.

Assessments are aimed at appraising the skills acquired by students for each step of the training. Exams will be written, practical or oral in the form of continuous assessment; they may be linked to projects. These exams can take place during class or at the end of the semester.

French skills improvement will be assessed by an entrance TCF test, in a continuous way and also through 3 mock TCF exams distributed all along the year (December, March, May). The year will end with the official TCF exam in mid-June.

A specialty project can also be achieved within MUNDUS course in order to validate a year of training in students' home countries (for example Benke for Chinese students doing a 3+3 course). The project supervised by one of the school's teachers will lead to the writing of an English report and a viva.

## 4. Terms for further studying

Only students who have validated:

- both MUNDUS semesters,
- level B2 of French mastery by successfully passing the official TCF,

are allowed to enroll to study engineering in the specialty matching the scientific teaching units studied in the framework of MUNDUS program.

## 5. Year repeating

There is no possibility of repeating this year.

Semester 1

| TU Code | Subject Code | Title of the Teaching Unit | Supervisor | Lectures | Lectures Classes | Classes | Labs | Project Work | Project | Total supervised hours (IW not included) | Coef | ECTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MUNDUS Year 1st semester** | | | | | | | | | | **300** | | **30** |
| **FLE** | | French as a Foreign Language - FLE 1 | PELIZZARI CARMES D. | | | | | | | 150 | ***2*** | ***14*** |
| | ***M5F01*** | *Written FLE* | | | | *63,75* | | | | | *1* | |
| | ***M5F02*** | *Spoken FLE* | | | | *86,25* | | | | | *1* | |
| **M5ANG** | | English 1 | PELIZZARI CARMES D. | | | | 30 | | | 30 | ***1*** | ***3*** |
| **M5ACI** | | Cultural activities for language immersion | PELIZZARI CARMES D. | | | | | 22 | | 0 | **0** | |
| **Specialty in Engineering Physics and Embedded Systems (GPSE)** | | | | | | | | | | | | |
| **M5EO** | | Subjects specialized in Engineering Physics and Embedded Systems 1 | WEBER R. | | | | | | | 120 | ***2*** | ***13*** |
| | ***M5E07*** | *Physics of materials* | *MILLON E.* | | | | | | | 45 | *1* | |
| | ***M5E07*** | *Analog instrumentation and measurments* | *LEDEE R.* | | | | | | | 35 | *1* | |
| | ***M5E08*** | *Windows C++ Programming* | *JENNANE R.* | | | | | | | 40 | *1* | |
| **Specialty in Civil and Geo-environmental Engineering (GC)** | | | | | | | | | | | | |
| **M5GC** | | Subjects Specialized in Civil and Geo-environmental Engineering 1 | HOXHA D. | | | | | | | 120 | ***2*** | ***13*** |
| | ***M5C02*** | *Autocad* | *JOSSERAND L.* | | | | | | | 15 | *1* | |
| | ***M5C03*** | *Geology* | MOTELICA S. | | | | | | | 51,25- | *2* | |
| | ***M5C04*** | *Geotechnics* | *LEFORESTIER L.* | | | | | | | 53,75- | *2* | |
| **Specialty in Industrial Engineering applied to Cosmetics, Pharmacy and Food-Supply Chain (GI)** | | | | | | | | | | | | |
| **M5GI** | | Subjects specialized in Industrial Engineering 1 | HIVET G. | | | | | | | 121 | ***2*** | ***13*** |
| M5N01 | | *Engineering Sciences* | *HIVET G.* | | | | | | | 55 | *2* | |
| M5N02 | | *Lean ManufacturingTools* | *HIVET G.* | | | | | | | 16 | *1* | |
| M5N03 | | *IE applied to Pharmacy, Cosmetics and Food-Supply Chain* | *HIVET G.* | | | | | | | 50 | *2* | |
| **Specialty in Innovation in Concepts and Materials (ICM)** | | | | | | | | | | | | |
| **M5IN** | | Subjects specialized in Innovation in Concepts and Materials 1 | GASSER A. | | | | | | | 110 | ***2*** | ***13*** |
| | ***M5I01*** | *Mechanics and Technology 1* | *GASSER A.* | *20* | | *37,5* | *7,5* | | | 65 | *3* | |
| | ***M5I02*** | *Materials and Thermodynamics* | *BOUCHETOU M-L.* | | | | | | | 45 | *2* | |
| **Specialty in Technologies for Energy, Aerospace Engineering and Engine (TEAM)** | | | | | | | | | | | | |
| **M5TE** | | Subjects specialized in Technologies for Energy, Aerospace Engineering and Motorization 1 | COLIN G. | | | | | | | 118,75 | ***2*** | ***13*** |
| | ***M5T01*** | *Thermodynamics and Heat Transfers* | *CAILLOL C.* | *27,5* | | *27,5* | *15* | | | 70 | *3* | |
| | ***M5T02*** | *Introduction to Design Tools* | *AUFRERE J-M.* | *13,75* | | *17,5* | *17,5* | *20* | | 48,75 | *2* | |

## Core curriculum

MUNDUS M5FLE Semester 5

# French as a Foreign Language – FLE1

Supervisor: Denise PELIZZARI CARMES ECTS: 14

### Learning Outcomes

On completing the first semester, students must achieve level A2 (intermediary) of the Common European Framework of Reference for Languages for the following languages skills:

- listening skills,
- speaking skills (continuous speaking or interaction)
- reading skills,
- writing skills.

According to the recommendations featured in the general description of level A2 in the Alliance Française frame of reference.

### Teaching Process (syllabus)

- Use of several course books dedicated to French as a Foreign Language (Alter Ego+, ICI 2 , publications by CLE INTERNATIONAL)
- Regular use of pedagogical websites: TV5 MONDE , LEPOINTDUFLE , BRAINPOP, KESAKO
- FOS (French with Oriented Goal): French for work, science, civilisation
- Progress in grammar and phonetics

### Assessment Mode

- 2 grades for each language skill
- Mock TCF at the end of the semester to validate level A2

### Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| | | 150 h | | | |

Student workload: 150 h

### Proportion of the TU in English:

**MUNDUS** **M5ANG** **Semester 5**

# English 1: Occidental Cultures

**Supervisor:** **Denise PELIZZARI CARMES** **ECTS: 3**

## Learning Outcomes

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

- Communicate in English orally, in writing and through visual media on topics related to occidental cultures.

## Teaching Process (syllabus)

- Selecting a European country, introducing it orally and writing a leaflet (BBC News Country Profiles – quiz to be prepared by 2 to 3 people work groups).
- Studying and understanding written, audio and video contents dealing with European and environmental topics.
- Writing syntheses and tackling ecological topics orally with the help of a slide show.
- Designing a French/English glossary on the different topics tackled.
- Using conferences from the website ''TED: Technology Entertainment and Design: Ideas Worth Spreading''
- Improving one's pronunciation / diction thanks to intonation and phonetic exercises (learn lines from TV series such as Seinfeld, The Big Bang theory, etc. by heart).

## Specific Activities:

How to do a presentation? (Resources to be collected from CELENE S5 Module Visual Communication)

## Assessment Mode

2 exams, 1 homework assignment, several oral presentations.

## Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| | | 30 h | | | |

Student workload: 30 h

Proportion of the TU in English: 100%

## Academic Subjects specialized in GPSE

**Engineering Physics and Embedded Systems** **5GP03** **Semestre 5**

# Physics of Materials

**Responsable :** **Eric MILLON** **ECTS : 5**

Skills :

At the end of this teaching unit, the engineering students will be able to define the main characteristics and properties of materials in general and more particularly of semiconductors and their functions in electronic components

Educational process (program)

- Materials: elaboration and properties. Order / disorder -bonding / type of materials. Crystal structure, nano-microstructure, phases. Thermodynamic aspects: phase control. Phase diagrams: miscibility, eutectic. Kinetic aspect: control of the microstructure. Control of the development of the amorphous, polycrystalline, monocrystalline properties.

- Materials: characterization. Morphological analysis (SEM / EDX, AFM). Composition analysis (RBS, XPS, SIMS). Structural analysis (DRX, TEM).

- Semiconductor (SC) and components. Introduction and general features. Wave vector, energy bands, density of state. Intrinsic SC. Doping of SC. Conductivity and mobility. Calculation of carrier concentration. Recombination, diffusion of carriers. PN junction. Polarization and characterization of junctions (ohmic, Schottky)

**Modalités d'évaluation**

**3 DS , 3 DM**

**Horaires**

| CM | CM/TD | TD | TP | PEA | Projet |
|---|---|---|---|---|---|
| 32h30 | | 12h30 | | 1h15 | |

Total heures / élève : 45 h (hors PEA)

**Part de l'UE réalisable en anglais : 1**

| Engineering Physics and Embedded Systems | Code | S5 |
|---|---|---|

# Analog Instrumentation and Measurements

**Responsible:** Roger Lédée

**Expertise:**

At the end of this teaching unit, engineering students will be able to :

- Master the use of discreet and integrated components in fundamental instrumentation and analogue measurement systems.
- Operate basic software in electronic simulation.

**Educational Process (Program):**

**Basic concepts**

- Know, understand and know how to use the basic components of analog electronics: bipolar transistor, field effect transistor, operational amplifier.
- Know, understand and know how to use some basic principles of analog electronics: amplification, feedback, filtering and positive feedback.

**Amplification**

- Know the fundamental circuits of analog electronics: amplification classes, examples of amplifier stages in classes A, B, C; Differential stages with bipolar or FET transistors; Sources and current mirrors, voltage references. Application to the internal structure of analog integrated circuits (operational amplifier).
- Understand the principles of feedback in amplifiers: different types, block diagram representation; Main effects of feedback (gain stabilization, reduction of distortions, widening of bandwidth); Stability of a loop amplifier (phase margin, gain margin); Frequency compensation.

**Filtering**

- Be able to analyze the elementary structures used in active filtering (Rauch, Sallen-Key structures); Simple feedback structures: Transfer function, Frequency representation. Examples of classical filtering functions (Butterworth, Chebyshev).

**Schedule:** CM : 20h, TD : 15h

**Method of knowledge control:** 3 written exams.

Engineering Physics and Embedded Systems **Semester 5**

Windows C++ Programming

**Responsible: Rachid JENNANE** **ECTS:**

The objective of this teaching unit is to train engineering students in Object Oriented Concepts under the C ++ Language and the Visual Studio environment. Programs must meet strict professional quality criteria (modularity, user-friendliness, optimization of processor usage, memory and disk space, etc.).

**Program:**

- Visual Studio, compilation, link edition, etc.
- Variables
- Class (member variables, member methods, properties, etc.)
- Functions
- Constructors/Destructor
- Passaging of parameters
- Arrays
- Pointers (Pointer this)
- Overloading
- Strings
- Bi-dimensional arrays
- Linked lists
- Etc.

**Evaluation methods**
Several notes of CM and TP. Grades for the work done in PEA (autonomy, serious, attendance, curiosity, motivation, etc.)

**Schedule**

| CM | CM/TD | TD | TP | PEA | Project |
|---|---|---|---|---|---|
| 7,30 h | | | 32,30 h | 12,30 h | |

Total hours / Student: 40 h

**Part de l'UE réalisable en anglais :**

## Academic Subjects Specialized in GC

Civil and Geo-environmental Engineering **M5C02** **Semester 5**

# Autocad

**Supervisor:** **Laurent Josserand** **ECTS: 1**

### Learning Outcomes

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

- Use basic Autocad controls linked to 2D and 3D drawing
- Edit introduction pages,
- Edit image rendering of the work synthesis
- Edit some of the work geometrical characteristics (inertia, volumes, etc.)

### Teaching Process (syllabus)

Different notions will be successively tackled, explained, implemented and verified through a support project that student will be in charge of modelling. The notions tackled are the following:

- basic Autocad controls linked to 2D and 3D drawing;
- introduction pages;
- computer-generated imagery rendering;
- geometrical characteristics of the work such as inertia, volume, etc.

**Supervised project work**

### Assessment Mode

The final TU grade will be an average of the project work grade and grades resulting from theoretical and technical knowledge assessment.

### Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| 0 h | 0 h | 0 h | 15 h | 0 h | 0 h |

Student workload: 15 h 0

Proportion of the TU in English: 0 %

Civil and Geo-environmental Engineering **M5C03** **Semester 5**

# Geology

**Supervisor:** **Stéphane MOTELICA** **ECTS: 6**

## Learning Outcomes

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

- Assess the main concepts of Earth science;
- Generalize;
- Interpret geological formation and maps (reading, interpreting and synthesizing);
- Identify rocks and minerals;
- Assess geological risks;
- Interpret French geological history.

## Teaching Process (syllabus)

**Rock constituent minerals**: crystalline structures, main geochemical classes, determining the most common minerals

**Magmatism**: tectonic drift, subduction magmatism, intraplate and orogenic systems, corresponding rocks and their properties (plutonic and volcanic rocks)

**Water cycle**: earthly water forms, water balance, atmosphere, surface waters, subterranean waters

**Rock degradation**: phenomena leading to degradation (physical, chemical, mineralogical), degradation sensitive rocks, consequences for the engineer, recommendations

**Continental sendimentary environment**: erosional and sediment process, geomorphology, slope (mudslide and crumbling), lacustrine, marshland, glacial and arid environments

**Diagenesis**: transformation process from sediments to rocks (compaction, cementation, light mineralogical modifications)

**Metamorphism**: rocks solid-state recrystallization, regional and contact metamorphism, dynamometamophism, corresponding rocks and their properties

**Tectonic**: rock constraints, brittle deformations (joints, rifts), ductile deformation (fold, tectonic nappes)

**Geology of France**

## Assessment Mode

Tests on: geological materials, topography, geostatistics, geochemistry, geobiology classes, hydrogeology.
Reports on: geographical information systems, topography.

## Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| 23,75H | | 6,25H | 20H | | |

Student workload: 51,25h

Proportion of the TU in English: SD/CR: **Innovation:**

Civil and Geo-environmental Engineering **M5C04** **Semester 5**

# Geotechnics

**Supervisor:** **Lydie LE FORESTIER** **ECTS: 6**

## Learning Outcomes

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

- Acquire notions about rock use criteria in civil engineering and industrial materials: silica, clay, carbonate, evaporates;
- Acquire knowledge in geochemistry, geobiology and hydrogeology;
- Master water drilling techniques and geometrician tools (optical level, tachometer);
- Know how to use Geographic Information System (GIS) coupled to geostatic tools.

## Teaching Process (syllabus)

**Geological materials: mineralogy, deposits, properties, industrial applications**

- Clays
- Silicas and silica materials ; carbonates, evaporates (chlorites, sulphates)

**Geochemistry**

- Concentration ; activity; mobility; pH
- Solid / solution equilibrium (solubility product)
- Oxidation-reduction equilibrium

**Geobiology**

- Geobiology fundamentals, biodiversity concerns
- Biology and ecology principles useful to civil engineering

**Cartographic representation**

- Geostatistics
- Geographic Information Systems (Arc GIS software)

**Topography**

- Spatial location tools
- Geometric and trigonometric levelling methods
- Optical level (altimetry plans, layout) and tachometer use (3D work plans)

**Hydrogeology**

- Drilling techniques
- Pumping tests (short and long-term)

## Assessment Mode

Tests: geological materials, topography, geostatistics, geochemistry, geobiology classes, hydrogeology
Reports: Geographic Information Systems, topography

## Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| 20H | | 22H30 | 12H30 | | |

Student workload: 85h

Proportion of the TU in English: 53,5H SD/CR: **Innovation:**

## Academic Subjects specialized in GI

Industrial Engineering applied to Pharmacy, Cosmetics and Food-Supply Chain | M5N01 | **Semester 5**

# Engineering Sciences

**Supervisor:** Gilles HIVET | **ECTS: 6**

**Learning Outcomes**

On completing this teaching unit engineering students will know the basics in:

- Electrical engineering;
- Automatism;
- Continuous automatic;
- Mechanics of materials, fluid and solid mechanics;
- Mathematical tools;
- Process engineering.

### Teaching Process (syllabus)

Appropriate differentiate training: students attend classes according to the skills they have acquired in their training before entering the school. Should there be any doubt, a positioning test is performed.

### Electrical Engineering

- Electrical components supported by the use of simulation software (e.g. LTspice IV)

### Automatism

- Recaps on combinational logic and Boole algebra
- Sequential problems: function memory, sequential registry, specified time
- GRAFCET (SFC): basic rules, simple structure, OU and ET divergence, MACRO-STEPS, use of several GRAFCETS (SFC)
- Programmable industrial automatons: architecture, functioning, programming of several API, TSX families, Siemens

### Continuous Automatic

The course solely focuses on continuous linear automatics. It is limited to first and second order systems. This system analysis is tackled through their time and frequency response.

### Fluid Mechanics

### Solid Mechanics

### Mathematical Tools

### Process Engineering

### Biochemistry

### Bacteriology

### Assessment Mode

A positioning test for all disciplines, a mini-project, continuous assessment

### Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| 20H | | 15H00 | 20H00 | | |

Student workload: 55h

| | | |
|---|---|---|
| Proportion of the TU in English: | SD/CR: | **Innovation:** |

Industrial Engineering applied to Pharmacy, Cosmetics and Food-Supply Chain | M5N02 | Semester 5

# Lean Manufacturing Tools

**Supervisor:** Gilles HIVET **ECTS: 1**

## Learning Outcomes

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

- take part in and manage Lean projects within a company

## Lean Manufacturing: tools and principles

Discovering improvement philosophies (Lean, 6sigma, TPM, etc.). Introduction to a few Lean Manufacturing tools (5 S. SMED. KAIZEN).

## Assessment Mode

A positioning test for all disciplines, a mini-project, continuous assessment

## Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| 16 | | | 20H00 | | |

Student workload: 16h

Proportion of the TU in English: SD/CR: **Innovation:**

Industrial Engineering applied to Pharmacy, Cosmetics and Food-Supply Chain **M5N03** **Semester 5**

# Industrial Engineering applied to Pharmacy, Cosmetics and Food-Supply Chain

**Supervisor:** Gilles HIVET **ECTS: 6**

## Learning Outcomes

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

- Know and understand chemical processes;
- Understand related problems in order to include them in a global production process;
- Understand pharmacists' and chemists' issues and language;
- Discuss with pharmacists and chemical engineers to define one's interfacing position towards them and production.

## Teaching Process (syllabus)

**Mass and energy balance with main values**

**Thermal transfers (computing a heat exchanger, technology)**

**Reaction engineering (kinetics and reactor)**

**Solid material treatment**

- Characterization of particles: grading, specific surface, porosity
- Crystallization: solubility, seeding, etc.
- Separation process: decanting, filtering, centrifugation, fluidization
- Treatment of solid material: drying, grinding

**Unit operations:**

- Distillations: vapour-liquid equilibrium, continuous distillation, batch distillation, etc.
- Stirring and mixing, emulsifying environment (<6 h cm/td)

**Classes**

- 4 classes dealing with engineering processes available on the platform of the Chemical Engineering Technological University Institute of Orléans

## Assessment Mode

A positioning test for all disciplines, a mini-project, continuous assessment

## Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| 20 | | 25 | 15H00 | | |

Student workload: 50h

Proportion of the TU in English: SD/CR: **Innovation:**

## Academic Subjects specialized in ICM

Innovation in Conception and Materials **M5I01** **Semester 5**

# Mechanics and Technology 1

**Supervisor:** **Alain GASSER** **ECTS: 8**

### Learning Outcomes

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

- From a real case scenario for a system made of a few parts:
  - produce and justify hypotheses on the dynamic model of the system rigid solid,
  - write the dynamic model, equations for the Dynamic Fundamental Principle and energetic theorems;
- Know and understand frequency concepts and proper modes, free and forced oscillation;
- Write and solve equations for a 1D vibration problem;
- Know the different strategies to solve dynamic equations and solve them;
- Analyze how a parameter affects results;
- Determine stress in a beam and size it;
- Describe and analyze system architecture, model parts with CAD, analyze links;
- Communicate thanks to languages specific to engineering sciences.

### Teaching Process (syllabus)

**1. Mechanical engineering**

Mechanical modelling of solids, mechanical actions and boundary conditions. Dynamic Fundamental Principle, energetic theorems, free and forced oscillations, proper modes and frequencies. Strategies to solve equations, resolution using formal and digital computing tools.

**2. Strength of materials**

Beam notion. Fundamental concepts of strength of materials. Statically determinate and indeterminate systems. Cohesive force torsor (normal force, shear force, bending moment, torsional moment). Simple forces (traction/compression, pure bending, shearing, torsion). Combination of simple forces (simple flexion, biaxial bending). Buckling.

**3. Technology**

Using rules of technical drawing and different standardized documents, completing finish machined drawing, identifying of-plan parts, drawing freehand perspectives, extracting a part from an assembly plan. CAD modelling of a part. Standard links, guidance and assembly technologies. Lubrication and sealing.

Standardised symbols and functions of basic pneumatic and hydraulic components.

Electromagnetic drafting, protection of materials, Grafcet, GEMMA, flow graph.

### Assessment Mode

Exams, tests, home assignments

### Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| 20h | | 37h30 | 7h30 | | |

Student workload: 65h

Proportion of the TU in English: SD/CR: **Innovation:**

Innovation in Conception and Materials **MUNDUS** **M5I02** **Semester 5**

# Materials and Thermodynamics

**Supervisor:** **Marie-Laure BOUCHETOU** **ECTS: 5**

## Learning Outcomes

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

- Understand material behaviour to better design, choose, model and use;
- Be able to establish links between structures, microstructures and material proprieties;
- Determine atomic structures and describe material microstructures;
- Know how to handle thermodynamic sizes, be able to use phase and transformation diagrams.

## Teaching Process (syllabus)

**1. State of matter and structural characterization of materials**

- Crystalline structures, crystal symmetry, theory of diffraction
- Emission, absorption, X-ray diffraction

**2. Thermodynamics**

- Thermodynamics sizes: internal energy, entropy, enthalpy, free energy, chemical potential, action, specific heat, equation of state
- Thermodynamics principles: zero principle, first and second laws

**3. Phase diagrams**

- Concepts: phases, microstructures, equilibrium
- Binary diagrams
- Industrial application: Fe-C and Fe-carbide system, influence of other alloy elements

**4. Transformation diagrams**

- Isothermal and isothermal transformations (TTT, TRC diagrams)

## Assessment Mode

Exams, tests, home assignments

## Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| 23.75 h | 0 h | 21.25 h | 0 h | 0 h | 0 h |

Student workload: 45.00 h

Proportion of the TU in English: 0%

## Academic Subjects specialized in TEAM

Technologies for Energy, Aerospace Engineering and Engine **M5T01** **Semester 5**

# Thermodynamics and Heat Transfers

**Supervisor:** **Christian CAILLOL** **ECTS: 8**

### Learning Outcomes

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

- Understand different thermal transfer modes and be able to compute, using approximate modelling to size energy-using processes;
- Master basic knowledge in thermodynamics and apply it to thermal driven and tractor machines.
- Understand the energy production systems and the energy analysis methods specific to these systems.

### Teaching Process (syllabus)

**1. Heat transfers**

- Generalities: introduction to temperatures and thermal flows, different transfer modes
- Radiation: heat transfer physical mechanism, black and grey bodies, Stefan-Boltzmann's law, Planck's formula, exitance in a wavelength range, Bouger's formula and approximations, form factors and enclosure radiations.
- Conduction: Fourier's law, stationary process with source term, transient state, approximations: thermal resistance, fin. Analytic resolution methods.
- Convection: convection coefficient and determination method, free and forced convection semi-empirical methods, full problem resolution

**2. Thermodynamics**

- Fundamentals: system definition, thermodynamic state, sizes and variables, state functions, thermodynamic transformations, first and second principles
- Open system assessment, application to a steam turbine
- Thermodynamic diagrams, calculation of yield
- Change of state, application to a heat-pump
- Thermal machines, study of steam cycles

**3. Labs**

Demonstration of thermal phenomena thanks to specific manipulations and the study of the thermodynamic cycles for installations close to existing installations.

- Heat transfer by radiation: emissivity measurements, Lambert's law, law $1/d^2$
- Heat transfer by conduction: conductivity measurements, transient phenomenon
- Heat transfer by convection: free/forced convection, exchanger
- Heat-pump thermodynamic cycle
- Gas compressor thermodynamic cycle

### Assessment Mode

Mini-projects, exams, home assignments, lab reports

### Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| 27.5 h | | 27.5 h | 15 h | | |

Student workload: 70 h

Proportion of the TU in English: 0 % SD/CR: **Innovation:**

Technologies for Energy, Aerospace Engineering and Engine **M5T02** **Semester 6**

# Introduction to Design Tools

**Supervisor:** **Jean-Marc AUFRERE** **ECTS: 5**

## Learning Outcomes

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

- Produce a CAD mechanism with 20 to 30 parts ;
- Describe a mechanism with the proper technologic vocabulary.

## Teaching Process (syllabus)

**1. Basic knowledge**

- Mechanic construction: rules of technical drawing, reading an assembly plan, technologies to assemble, guide rotation and translation movements, seal and lubricate; standard links, kinetic schemes, input-output laws.

**2. Computer Aided-Design (CAD)**

- Learning PTC Creo (software) basic functions
- Modelling parts, assembly, layout

**3. Carrying out mechanism design engineering**

- Collaborative CAD modelling, file management constraints
- Kinematic modelling, input-output law
- Identifying a mechanical problem, defining a model, associated hypotheses, resolution

## Assessment Mode

2 exams, project report

## Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| 13 h 45 | XX h | 17 h 30 | 17 h 30 | 20 h | XX h |

Student workload: 48 h 45

Proportion of the TU in English: 0 %

SEMESTER 2

| TU Code | Subject Code | Title of the Teaching Unit | Supervisor | Lectures | Lectures Classes | Classes | Labs | Project Work | Project | Total supervised hours (IW not included) | Coef | ECTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MUNDUS Year 2nd semester** | | | | | | | | | | **338** | | **30** |
| **M6FLE** | | French as a Foreign Language - FLE 2 | PELIZZARI CARMES D. | | | | | | | 150 | ***2*** | ***12*** |
| | ***M6F01*** | *Written FLE* | | | | *63,75* | | | | | *1* | |
| | ***M6F02*** | *Spoken FLE* | | | | *86,25* | | | | | *1* | |
| **M6ENG** | | English 2 | PELIZZARI CARMES D. | | | | 42,5 | | | 37,5 | ***1*** | ***3*** |
| **M6ACU** | | Cultural Workshops | BELLUCCI F. | 1,25 | | | 28,75 | | | 30 | ***1*** | ***2*** |
| **M6ACI** | | Cultural activities for language immersion | PELIZZARI CARMES D. | | | | | | | 0 | ***0*** | |
| **Specialty in Engineering Physics and Embedded Systems (GPSE)** | | | | | | | | | | | | |
| **M6EO3** | | Subjects specialized in Physics Engineering and Embedded Systems 2 | WEBER R. | - | - | - | - | - | - | 120 | ***2*** | ***13*** |
| | ***M6E12*** | *Solid stat lightning* | *CACHONCINLLE C* | | | | | | | 35 | *1* | |
| | ***M6E13*** | *Digital instrumentation and measurements* | *GOBBEY M. H.* | | | | | | | 35 | | |
| | ***M6E14*** | *Advanced C++ programming in Linux/Qt* | *A CHETOUANI* | | | | | | | 50 | *1* | |
| **Specialty in Civil and Geo-environmental Engineering (GC)** | | | | | | | | | | | | |
| **M6GC1** | | Subjects Specialized in Civil and Geo-environmental Engineering 2 | HOXHA D. | | | | | | | 120 | ***2*** | ***13*** |
| | ***M6C04*** | *Geochemistry* | *PROUST. C* | | | | | | | 37,5 | *1* | |
| | ***M6C03*** | *Strength of Materials* | *BRUNETAUD X.* | | | | | | | 82,5 | *2* | |
| **Specialty in Industrial Engineering applied to Pharmacy, Cosmetics and Food-Supply Chain (GI)** | | | | | | | | | | | | |
| **M6GI** | | Subjects specialized in Industrial Engineering 2 | HIVET G. | | | | | | | 115 | ***2*** | ***13*** |
| | ***M6N01*** | *Environment, Health and Safety applied to Pharmacy, Cosmetics and Food-Supply Chain* | *HIVET G.* | | | | | | | 65 | *1* | |
| | ***M6N02*** | *Engineering applied to Pharmacy, Cosmetics and Food-Supply Chain* | *HIBON DE FROHEN P.* | | | | | | | 50 | *1* | |
| **Specialty in Innovation in Concept and Materials (ICM)** | | | | | | | | | | | | |
| **M6IC** | | Subjects specialized in Innovation in Concept and Materials 2 | GASSER A. | | | | | | | 133,75 | ***2*** | ***13*** |
| | ***M6I01*** | *Mechanics and Materials* | *BLOND E.* | | | | | | | 75 | *5* | |
| | ***M6I02*** | *Electrical and Automated Engineering* | *BONHEUR B.* | | | | | | | 58,75 | *4* | |
| **Specialty in Technologies for Energy, Aerospace Engineering and Engine (TEAM)** | | | | | | | | | | | | |
| **M6TE** | | Subjects specialized in Technologies for Energy, Aerospace Engineering and Motorization 2 | COLIN G. | | | | | | | 123,75 | ***2*** | ***13*** |
| | ***M6T01*** | *Mechanics of Fluids* | *ROZENBAUM-WEBER R.* | | | | | | | 53,75- | *4* | |
| | ***M6T02*** | *Vehicles and Energy Systems* | *DEVINANT P.* | | | | | | | 70 | *6* | |
| **M6PR1** | | Scientific Project (specific to specialties 3+3) | HARBA R. | | | | | | | 56 | ***0*** | |

## Core curriculum

**MUNDUS** **M6FLE** **Semester 6**

# French as a Foreign Language – FLE2

**Supervisor:** **Denise PELIZZARI CARMES** **ECTS: 12**

### Learning Outcomes

On completing the first semester, students must achieve level B1 (intermediary) of the Common European Framework of Reference for Languages for the following languages skills:

- listening skills,
- speaking skills (continuous speaking or interaction)
- reading skills,
- writing skills.

According to the recommendations featured in the general description of level B1 in the Alliance Française frame of reference.

### Teaching Process (syllabus)

- Use of several course books dedicated to French as a Foreign Language (Alter Ego+, ICI 2 , publications by CLE INTERNATIONAL)
- Regular use of pedagogical websites: TV5 MONDE , LEPOINTDUFLE , BRAINPOP, KESAKO
- FOS (French with Oriented Goal): French for work, science, civilisation
- Progress in grammar and phonetics

### Assessment Mode

- **2** grades for each language skill
- Mock TCF at the end of the semester to validate level B1

### Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| | | 150 h | | | |

Student workload: 150 h

### Proportion of the TU in English:

**Polytech Orléans** **M6ENG** **Semester 6**

# English 2: English in the news

**Supervisor:** **Catherine MOREAU-WINWORTH** **ECTS: 3**

## Learning Outcomes

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

- Communicate in English in various situations (academic, professional, private) ;
- Study essential fields to reach the 785 points grade required to pass the TOEIC.

## Teaching Process (syllabus)

**Listening and speaking skills**

- Critical study of English-speaking media
- Oral presentation aiming at debating on news items or society reality
- Study of a famous or / and historical speech, speech release (listening and speaking skills, pronunciation)

**Reading and writing skills**

- Reading of international English-speaking articles, group work and vocabulary acquisition.
- Study of contextualized grammatical structures.
- Writing of articles, letters, syntheses and summaries.

A mock TOEIC test will be planned halfway through the semester. It will be followed by active correcting involving students.

## Assessment Mode

1 exam, oral presentations, press reviews, group projects, written assignments, active participation to debates, English speech release

## Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| | | | 37.5 | | |

Student workload: 37.5

Proportion of the TU in English: 100 %

**Humanities** **M6ACU** **Semester 6**

# Cultural Workshops

**Supervisor:** **Franck BELLUCCI** **ECTS: 2**

## Learning Outcomes

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

- Methodically explore a given cultural or artistic field;
- Give an oral or in written report of the content of their research;
- Implement team work in the form of a project;
- Develop a creative strategy specific to their research object.

It is possible to study a second foreign language instead of attending cultural workshops.
It is possible to attend classes on both cultural workshops and a second foreign language. The second foreign language hence becomes an additional optional class.

## Teaching Process (syllabus)

- Workshops: theatre, video, eloquence, writing, reading, scientific journalism, History of sciences, ethic and sociology, arts (music, fine arts, design).
- According to the workshop which has been chosen, students will create objects; produce public texts or group / individual research dissertations.
- Works will be presented in the form of exhibitions, screenings, performances, websites, debates, etc.

## Assessment Mode

1 exam + 1 homework assignment (to be handed in) + final production (group assessment) + 1 grade for personal implication / participation

## Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| | | | 30 | | |

Student workload: 30 h

## Academic Subjects specialized in GPSE

Engineering Physics and Embedded Systems **M6GPSE** **Semestre 6**

# Solid State Lighting

**Supervisor :** **Christophe CACHONCINLLE** **ECTS : 2**

**Skills :**

At the end of this teaching unit, engineering students will be able to:

- Know the basic magnitudes of visual photometry and express their values in visual or energetic unit systems.
- Calculate the flux of a source from the spatial distribution of its intensity.
- Calculate the illumination received by an oriented surface.
- Calculate the flux emitted by a source in a portion of the space
- Calculate the CEN code of a luminaire
- Select a suitable white LED light source (technology, correlated color temperature, flux, color rendering index).
- Calculate chromatic coordinates of a source in the CIE XYZ color space.
- Understanding the technical specification of a luminaire datasheet
- Realize the design of a simple luminaire developed in accordance with the European standards of ecodesign.

**Educational process:**

- Photometry
  - Concept of solid angle
  - Photometric quantities: flux, intensity, illumination, luminance
  - Visual units: lumen, candela, lux, cd.m-2
  - The Basics of Lighting Design
  - Standardized luminaire files (.IES)
- Colorimetry
  - Human vision: eyes, photopic, scotopic, mesopic vision
  - The notion of spectrum for a light source (primary and secondary sources)
  - RGB color space, CIE XYZ, color atlas
  - Colorimetric functions, trichromatic components and chromatic coordinates
  - The chromaticity diagram CIEXYZ
  - The notion of black body and correlated color temperature of a source
  - The notion of the index of the rendering of black body and its measurement.
- Sources technology
  - LEDs sources
  - Discharge lamps ( Sodium high pressure, Metalic halogenure)
  - Fluorescent lamps (fluorescent tube, CFL)

**Modalités d'évaluation**

Devoirs surveillés et TP

**Horaires**

| CM | CM/TD | TD | TP | PEA | Projet |
|---|---|---|---|---|---|
| 13.45 | | 11.15 h | 7.30h | 0 | 0 |

Total heures / élève : 60

**Part de l'UE réalisable en anglais :** 0 %

Engineering Physics and Embedded Systems | 6GP01 | Semestre 6

# Digital instrumentations and measures

Responsable : Marie-**Hélène GOBBEY** | ECTS :

## Learning Outcomes

On completing this teaching unit the successful student will have learned to:

- Master the combinatorial and sequential logic
- Master the techniques of sampling
- Communicate with a microprocessor

## Content

- Understanding and use of : the combinatorial logic (multiplexing, addressing, combinatorial functions and adress decoding), the sequential logic (multivibrators, latches, counters and sequential systems), the technical of sampling (quantification, DAC and ADC).

- Communication with the memory processor : presentation of the Arduino card, using of the inputs/outputs On-Off and $I^2C$, implementation (light sensor, LCD screen, Relay, Triac) and light control project with a digital luxmeter.

## Assessment

The final mark for this teaching unit is calculated by averaging the marks obtained during assessments of theorical and technical knowledge.

## Workload

| LECTURES | LECTURES/Classes | CLASSES | LABS | Individual Work | Project work |
|---|---|---|---|---|---|
| 16h15 | | 8h45 | 10h | 5h | |

Total heures / élève : 40h

Proportion of the TU in English : 0%

Engineering Physics and Embedded Systems | M6P03 | Semestre S6

# Advanced C++ Programming in Linux/Qt

Responsable : Aladine CHETOUANI | ECTS : 3

## Competences

At the end of this teaching unit, students will be able to :
A l'issue de cette unité d'enseignement les élèves ingénieurs seront capables de :

- Work in Linux environment
- Compile using Makefile
- Propose an object-based architecture for a given problematic
- Use inheritance and polymorphism
- Use files (read and write) to transfer data
- Develop Graphic interface in Qt

## Program :

- Manipulate some Shell commands
- Compile with Makefile
- Inheritance
- Virtual functions
- Abstract classes
- Polymorphism
- Manage files (read and write data)
- Generic classes
- Introduction to the development of graphical interfaces under Qt
- Basic application in Qt
- Keyboard and mouse management

## Evaluation

Several evaluations : minimum 2 evaluations on machine

## Schedule

| CM | CM/TD | TD | TP | PEA | Project |
|---|---|---|---|---|---|
| 8h45 h | 0 h | 0 h | 41h15 | 10 h | 0 h |

Total hours / student: 50 h

Part in english : 0 %

## Academic Subjects Specialized in Civil Engineering

Civil Engineering **M6C04** **Semester 6**

# Geochemistry

**Supervisor:** **Chantal PROUST** **ECTS: 5**

### Learning Outcomes

On completing this teaching unit preparatory cycle students will be able to understand and analyze chemical reactions of the main processes responsible for element transfer in the soil-water system.

### Teaching Process (syllabus)

- Regulation
- Chemical speciation of elements in aqueous phase
- Main acid-base statuses, dissolution-precipitation, redox in a natural state
- Study of calco-carbonic equilibrium

### Assessment Mode

Assessment on class contents, reports, individual assessment and synthesis exam.

### Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| 17.5 | xx h | 20h | XX h | XX h | XX h |

Student workload: 37h30

Proportion of the TU in English: xx %

Civil Engineering **M6C03** **Semester 6**

# Strength of Materials

**Supervisor:** **Xavier BRUNETAUD** **ECTS: 8**

## Learning Outcomes

On completing this teaching unit which covers mechanical modelling of beams (1D elements) engineering students will be able to:

- Identify the applications of calculations based on the hypotheses of the strength of materials ;
- Calculate the hyperstaticity of the structure;
- Determine the internal forces at any point of an isostatic structure for a given externally applied load;
- Determine standard and tangential load distribution in a given section;
- Calculate the longitundinal and transverse displacements and the rotations generated by tension / compression, bending, combined, bending, bending behaviour of beams inclined load and circular tension;
- Solve hyperstatic problems by calculating displacement by the energy method (virtual work per unit force);
- Quote the main properties of materials such as wood, stone, concrete, metals and plastics and related these properties to their structure.

## Teaching Process (syllabus)

**Strength of materials:**

- Calculation of the internal forces; tension/compression; bending; combined bending; biaxial bending; shear stress; torsion; calculation of the normal stress distribution and of the cross section shear; calculation of the longitudinal, transverse and rotation displacements; solving hyperstatic systems.

**Materials**

- Study of woods, stones, concrete, metals and plastics.

**LABS**

- Tension; bending; inclined load and torsion; trellis; densities and porosity; acoustic and thermal propagation; microstructure analysis.

## Assessment Mode

3 exams, 5 home assignments, 7 lab reports

## Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| 32,5 h | | 22 h | 28h | | |

Student workload: 82,5h

Proportion of the TU in English: 30 % (taught by Xavier Brunetaud)

## Academic Subjects Specialized in Industrial Engineering

Industrial Engineering applied to Pharmacy, Cosmetics and Food-Supply Chain **M6N01** **Semester 6**

# Ergonomics, Health and Safety applied to Pharmacy, Cosmetics and Food-Supply Chain

**Supervisor:** **Gilles Hivet** **ECTS: 7**

### Learning Outcomes

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

- Explain the proceedings of an ANSM (National Agency for Pharmaceutical Safety) inspection and take part in one;
- Explain stakes in quality control;
- Apply and make people apply GMP and the ISF norm, circulate related information;
- Situate GMP in relation to other FDA and ISO 22716 norms;
- Know and understand general principles, stakes and goals in risk prevention;
- Obtain the FOAD CARSAT certificate;
- Assess occupational risks ;
- Take part in analysis, enquiry, communication and training dealing with professional risk management in the workplace ;
- Perform on an electrical device while complying with safety regulations.

### Teaching Process (syllabus)

**Quality Management**

History, stakes of quality procedure. Understanding, implementing and managing regulations proper to each targeted industries: BPFs, FDA, ISO 22716, IFS, BRC, ISO 22000, HACCP; compare these norms. Knowing, understanding and managing other quality regulations (ATEX, AHSAS, ISO 9001, 14000, 14001, 50001).

**Electrical Safety**

- Recap of basic notions of electricity: regulations, voltage domains, wiring systems.
- Physiological effects: statistics, mechanisms of electrification, physiological effects, muscular effects, AC and DC effects.
- Authorization: qualification, authorization, authorization symbols, certification, employers' obligations, safe distances.
- Protection: protective measures against direct contact, protective measures against indirect contact, grounding diagram, protective equipment, ground electrodes.
- Electrical equipment: categories, class of equipment, degrees of protection (IP).
- Action: improvements to the premises, restricted access to certain premises (electricians only), logging events, corrective maintenance.
- Incidents or accidents: electrical incidents, fire, dealing with an electrocuted person.

**Health and Safety**

Notions on workplace risk management, definitions. Stakes in occupational risk management. Validation of CARSAT certificate. Risk assessment.

### Assessment Mode

3 exams, 5 home assignments, 7 lab reports

### Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| 30 h | | 30 h | 30h | | |

Student workload: 90h

| | |
|---|---|
| Proportion of the TU in English: | 30 % (taught by Xavier Brunetaud) |

Industrial Engineering applied to Pharmacy, Cosmetics and Food-Supply Chain **M6N02** **Semester 6**

# Engineering applied to Pharmacy, Cosmetics and Food-Supply Chain

**Supervisor:** **Patrick HIBON DE FROHEN** **ECTS: 6**

## Learning Outcomes

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

- Take into account the characteristics of the specifics of different pharmaceutical forms;
- Get an accurate vision of manufacturing flows to determine their critical parameters;
- Perform unit manufacturing, distribution and packaging operations;
- Get familiar with work regulations for pharmaceutical and cosmetic environments;
- Master product quality ;
- Identify different pharmaceutical and cosmetic forms: liquid, semi-solid, dry forms, their specificities and related checks.
- Identify biomanufactured products currently on the market;
- Define the different steps of pharmaceutical product production standards and biotechnologic production processes; spot related critical issues.
- Identify HAZ work regulations for pharmaceutical and cosmetic environments;
- Understand the specifics of food-supply chain processes and their impact on production.

## Teaching Process (syllabus)

- Specific food-supply chain processes; impact on production. Company tours.
- Manufacturing of three main product types: solutions / suspensions, semi-solid and dry forms and related controls.
- Study of dissolution laws and influence factors, formulation tests: solutes, solvents, additives (preservatives, antioxidant, etc.).
- Study of oxidation factors in a vitamin solution manufacturing process. Implementing clarifying filtration.
- From a stable emulsified formulation, production of an emulsion on an industrial mixer-disperser (« Disho », « Max D15 »). From a stable jellified formulation, production of an industrial batch on « Trilab ».
- Observation of standard rheological profiles (graded viscometer and rheometer).
- Distribution tests on a FETTE 1200 rotary tablet press. Coating test on a perforated Glatt turbine.
- Production of cellular culture, sampling in germ free conditions, counting, equipment preparation. Implementation of the purification steps: chromatography (Millipore column), diafiltration, centrifugation, filtration. Dressing protocol and getting through a germ free area. Hand-washing training exercises (Hygikit test).
- Process flow exercise: including each manufacturing step in HAZ environment and analyzing risks.

## Assessment Mode

Assessment of lab activities

## Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| 10 h | | 10 h | 15h | | |

Student workload: 35h

Proportion of the TU in English: 30 % (taught by Xavier Brunetaud)

## Academic subjects specialized in ICM

Innovation in Conception and Materials **M6I01** **Semester 6**

# Mechanics and Materials

**Supervisor:** **Eric BLOND** **ECTS: 8**

### Learning Outcomes

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

- Pose a continuum mechanics problem;
- Solve a simple problem in the elastic range;
- Solve a simple problem in the mechanics of (perfect) fluids;
- Interpret experiences in characterization of materials;
- Interpret experiences on transportation in matter phenomena.

### Teaching Process (syllabus)

**1. Continuum mechanics**

- Continuum kinematics, deformation, continuity equation
- Conservation laws in continuum movement, Euler's equations for fluids
- Behaviour laws, state of stress, matching stresses, criteria
- Resolution in deformation, stress, energetic approach
- Fluid statics, intrinsic equations, Bernoulli's principle

**2. Labs – Properties of materials**

- X-ray diffraction
- Heat treatment effect on hardness
- Phase diagrams
- Porosity measurement of ceramics
- Heat measurement by pyrometry and infrared thermography
- Microstructures: observation by optical microscopy
- Thermal conductivity and temperature sensors

### Assessment Mode

4 exams; several grades on home assignments; several grades on Labs

### Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| 22h30 | | 22h30 | 30h | | |

Student workload: 75h

Proportion of the TU in English: SD/CR: **Innovation:**

Innovation in Conception and Materials **M6I02** **Semester 6**

# Electrical and Automated Engineering

**Supervisor:** **Bruno Bonheur** **ECTS: 5**

## Learning Outcomes

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

- Quantify industrial electrical energy on three-phase networks and linear and non-linear balanced loads under active apparent power and power factor;
- Model from a permanent sinusoidal or continuous perspective 3 rotating machines while including macroscopically related converters and the voltage transformer;
- Characterize a sensor according to its choice on a three physical effects basis;
- Use system analysis tools and methods;
- Synthesize a three-term controller.

## Teaching Process (syllabus)

1. **Automated**

- Steps in automated design – system frequency representation
- Laplace transform applied to transfer functions
- Frequency and time response
- Study of close-loop systems – zero and pole's influence
- Design of a three-term controller
- Matlab/Simulink software will be used for all these steps.

2. **Sensors**

- Choice characteristics: measuring range, accuracy, resolution, response time
- Inductive sensors, thermal-optics for pressure temperature displacements

3. **Electrical engineering**

- Three-phase networks, apparent reactive, active and distortion power, power factor
- Voltage transformer according to Kapp's model
- Continuous motorisation and its basic DC/DC and AC/DC converters
- Modelled synchronous machine for network coupling
- Modelled polyphase induction machine with constant speed in over and under-synchronous mode
- Asynchronous machine with variable speed
- Principles of the main three-phase AC/DC converters with diode and DC/DC choppers

## Assessment Mode

Part 1: 1 lab report
Part 2 and 3: 2 exams and 2 home assignments

## Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| 33 h00 | h | 18 h15 | 7h30 | XX h | XX h |

Student workload: 58 h 45

Proportion of the TU in English: 0 %

## Academic subjects specialized in Team

Technologies for Energy, Aerospace Engineering and Engine **M6T01** **Semester 6**

# Mechanics of Fluids

**Supervisor:** Régine WEBER-ROZENBAUM **ECTS: 7**

### Learning Outcomes

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

- Study and size simple flow configurations (wall stress, hydraulic circuits, perfect fluid flows);
- Understand basic phenomena linked to the mechanics of fluids (pressure drop, aerodynamic force, etc.);
- Know the main equations which rule moving flows, their meaning and their limits.

### Teaching Process (syllabus)

**General equations in fluid mechanics**

Introduction to general equation in fluid mechanics and continuum mechanics for viscous fluids. Simplifications for a given real fluid.

**Applications of general equations – study of flow patterns**

- Several topics will be tackled in this part. Work will be performed by groups of 5 to 6 people engineering students introducing a complete study of a given flow pattern.
- Hydrostatic and wall stresses. Bernoulli's principle and generalized Bernoulli's principle
- Study of complete hydraulic circuits. General momentum theory. Continuum kinematics. Potentially complex fluids. Analytical resolution of Navier-Stokes' equations.

**Practical applications**

- Study of hydraulic circuits with FlowMaster® software
- Labs: pressure drop and hydraulic circuit; wall jet / general momentum theory; draining a cistern according to Mariotte's law / a hydrostatic cistern; eddy laminar flow / Navier-Stokes' equations.

### Assessment Mode

~20 group assessments, individual Quiz tests, 4 exams, 4 lab reports, 2 home assignments

### Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| 30 h | | 11,25 h | 12,5 h | XX h | XX h |

Student workload: 53,75 h

Proportion of the TU in English: 100 %

Technologies for Energy, Aerospace Engineering and Engine **M6T02** **Semester 6**

# Vehicles and Energy Systems

**Supervisor:** **Philippe DEVINANT** **ECTS: 6**

## Learning Outcomes

On completing this teaching unit engineering students will be able to use basic scientific, technical and industrial knowledge – on which further courses will be based – through a global "system" approach on vehicles (land and air), their propulsion (alternating thermal engine, turbo-machines) as well as essential components of energy systems (exchangers, pumps and turbines).

## Teaching Process (syllabus)

**1. Aerotechnical** 15 LECTURES

Aerotechnical industry: specificities and constraints. History. Atmosphere. Plane. Aerodynamics: profile, wing and plane, Mach effect. Propulsion: propeller, reaction. Introduction to aeronautical turbo-machines. Flight mechanics: uniform straight-ahead direction, resource. Stability. Technology: structure, materials, sizing principles. Regulatory aspects.

**2. Land vehicles and thermal engines** 25h (12,5 h LECTURES +12 ,5 h LABS)

History of land vehicles. Different components – functions performed. General dynamics and power assessment. Recaps in thermodynamics. Application to capsule engines. Introduction to positive ignition and diesel engines. Mixture preparation. Overfeeding. Engine general characteristics.

**3. Energy systems** 17,5h (5h LECTURES + 12,5h LABS)

Pumps and turbines: 6,25h LABS

Different lectures on hydraulic turbo-machines. Velocity triangle. Exchanged energy upon wheel housing: Euler's formula. Loss and yield. Machine choice criteria: specific speed. Simplified analysis of a field situation.

Exchangers: 5h LECTURES + 6,25h LABS

Basic notions characterizing heat exchanger. Different lectures with a more thorough description of vehicles cooling process. Contact free exchangers with direct transfer (temperature evolution, transmitted heat flows, etc.). Sizing methods (DLMT, NUT, efficiency).

**4. Technical conferences on some aspects of jobs linked to these technologies** 12,5h LECTURES

5. **Tests/ Exams included in class time**

## Assessment Mode

At least 4 written tests or exams (in class or at home) throughout the teaching unit

## Workload

| LECTURES | LECTURES /CLASSES | CLASSES | LABS | INDIVIDUAL WORK | PROJECT WORK |
|---|---|---|---|---|---|
| 45 h | | 12,5 h | 12,5 h | XX h | XX h |

Student workload: 70 h

Proportion of the TU in English: 100 %