FLOW Summer School on ''Grand Industrial Challenges in South of France''

Dates: May 27th-June 14th, 2019

Selection of offered courses

1- **Food, Living Organisms, Water**
2- **Energy and Materials**
3- **Data science and management**

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1-Food - Living Organisms – Water

- **WINE AND BEER TECHNOLOGY** (7.5 h)
- **MASTERING INDUSTRIAL FOOD PRODUCTION** (7.5 h)
- **MILK TO YOGURT AND CHEESE PRODUCTION** (7.5 h)
- **OPTIMIZED FERMENTATION IN FOOD INDUSTRY** (7.5 h)
- **FOOD SAFETY AND QUALITY** (7.5 h)
- **NUTRITION AND HEALTH** (7.5 h)
- **URBAN FLOOD AND RISK MITIGATION** (7.5 h)
- **ASSURING CLEAN WATER** (7.5 h)
- **SUSTAINABLE AQUATIC ECOSYSTEMS** (7.5 h)

WINE AND BEER TECHNOLOGY (7.5 h)
→**A synthetic presentation of two most consumed fermented beverages**
(C. STRUB, S. GALINDO, Z. GUNATA)
*Lecture: Understanding wine technology from harvest to wine bottling
Grape chemical composition, effect of grape variety, "terroir", climate and harvest time on the chemical composition and quality of wine, white, red, sweet and sparkling wine technology, fermentation, microbiological and physico-chemical stabilization of wines
* Lecture : sensory evaluation of wines (methodology and explanation of wine sensory attributes)
* Practical works : how to taste and evaluate wine (wines from different grape varieties and winemaking processes will be tasted)
* Practical works : artisanal manufacture of beer
* Wineyard visit

MASTERING INDUSTRIAL FOOD PRODUCTION (7.5 h)
(Francis COURTOIS)
→**A global vision with a practical approach**
One hour of class followed by a group project and a lot of interaction within the class (more than 8 students required)
→**A first approach to air conditioning and food preservation by dehydration**
Courses + Tutorial + Practical works (1 day) (more than 8 students required) "Some basic courses and industrial applications. Use of simulation software to process a real industrial case"

MILK TO YOGURT AND CHEESE PRODUCTION (7.5 h)
→ **Introduction to dairy products**
(L. Preziosi – S. Galindo – S. Marchesseau)

* Lecture : Understanding milk physico-chemistry and milk technology : from milk to fermented and cheese products (Milk composition, milk microbiology, milk stabilization and transformation, general principles of fermented dairy foods manufacture and cheese manufacturing, processed cheese technology)
* Practical works: Microbiology of cheeses and milk composition
* Visit ''Caves Roquefort''

OPTIMIZED FERMENTATION IN FOOD INDUSTRY (7.5 h)
→ **Microbial resource management from metabolic to bioprocess engineering**
(Benoît STENUIT)
* Lectures + Visit of Industrial Microbiology Technical Hall + Practical sessions - Simulation using RStudio.

FOOD SAFETY AND QUALITY (7.5 h)
(D. Chevalier-Lucia, C. Cunault, A. Fontana, M. Nigen, L. Palmade)
→ Those practical classes take place in a food processing pilot plant and are based on five themes: canning, production line, pasteurization, concentration and drying. Over these classes, students work on semi industrial pilots and practice their knowledge in Engineering sciences and Food processing in situations close to those of industrial production. Each topic consists of a learning phase (start and conduct of pilots), followed by a phase of autonomy (choice of parameters, number of trials, optimization). Industrial fluid consumption (steam, water, compressed air / vacuum, electricity) are integrated into the process and followed with a sustainable development approach.

NUTRITION AND HEALTH (7.5 h)
(Delphine GITENAY)
→ Lecture + Tutorials: the series of lectures will aim at deciphering the impact of nutrition on health. Various subjects will be studied such as food allergy, food contaminants and health risks (such as endocrine disruption or cancer for example), or on another hand how fruits and vegetables micronutrients can improve aging, prevent disease and improve physical activity. During those tutorials, the student will learn, through small projects, European regulations for nutrition and health claims as well as food labelling regulations.

URBAN FLOOD AND RISK MITIGATION (7.5 h)
(Vincent GUINOT)
→ Lecture + tutorial : specific topics such as 2D modeling, flooding modeling in urban areas and drought management

ASSURING CLEAR WATER (7.5 h)
(François ZAVISKA)
→ Lecture + tutorial: membrane design and technology for water treatment and waste water management

SUSTAINABLE AQUATIC ECOSYSTEMS (7.5 h)
(Catherine ALIAUME)
→ Lecture + tutorial + visit of a fish passage : Ecological continuity restoration, for sustainable living resources, under human pressure and global change.

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2-ENERGY AND MATERIALS

- **FROM NUCLEAR TO SOLAR** (**15 h**)
- **MATERIALS FOR SUSTAINABLE DEVELOPMENT** (**15 h**)
- **NANOMATERIALS AND NANOTECHNOLOGIES** (**15 h**)
- **WELDING TECHNOLOGIES** (**7.5 h**)

FROM NUCLEAR TO SOLAR (**15 h**)
→ **Energetic solutions in the south of France**
(Rozenn LE PARC, Thierry TALBERT)
* visit of nuclear research center/science museum VISIATOME (www.visiatome.com)
* visit of the solar furnace of Odeillo (

MATERIALS FOR SUSTAINABLE DEVELOPMENT (**15 h**)
→ **Concept, norms and practical tools**
* Lecture : introduction on sustainable development
* Training project: materials choice using the SIMAPRO software
(Jean-Louis BANTIGNIES, Renaud METZ)

NANOMATERIALS AND NANOTECHNOLOGIES (**15H**)
→ **New properties and tools, innovation and social issues**
(Ahmad MEHDI, Vincent JOURDAIN, Eric ANGLARET)
* Lectures (synthesis and properties of nanomaterials, norms and rule)+labs (synthesis of metal nanoparticles+study of their structure and optical properties)

WELDING TECHNOLOGIES (**15 h**)
→ **Introduction to welding and cutting technologies**
(Denis CERVELLIN)
* Introduction lecture
* Visit of Industrial Welding Technical Hall + Practical sessions
* Visit of the LUMA tower in Arles (architect Franck Gehry)

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3-DATA SCIENCE AND MANAGEMENT

- **DATA SCIENCE** (**15 h**)
- **AGILITY FOR MANAGEMENT** (**7.5 h**)
- **INTERFACING COMPUTERS, SENSORS AND THE INTERNET OF THINGS** (**7.5 h**)
- **PROGRAMMABLE DIGITAL AND ANALOG ELECTRONICS** (15h)

DATA SCIENCE (**15h**)
(Arnaud Casteltort, Anna Laurent, Esther Pacitti)
→This course aims at introducing some of the main components of the data science chain, from innovative data management in NoSQL databases to machine learning and artificial intelligence. More specifically, we focus on graph databases on the one hand and supervised/unsupervised machine learning and data mining/pattern mining on the other hand. Hand-on sessions will be scheduled and a visit to a company working in this area will be organized.

AGILITY FOR MANAGEMENT (7.5 h)
(Isabelle Bourdon)
→ Students discover through serious games combining practice and theory the AGIL concepts. The goal is to make them understand what Agility is for project management and some agile tools in projects. Two serious games are used : Artists and Specifiers games and Lego for Scrum game.

INTERFACING COMPUTERS, SENSORS AND THE INTERNET OF THINGS (7.5 h)
(Vincent Berry)
→ Students will manipulate arduinos, raspberrys (micro-controllers and micro-computers) and sensors for designing small devices to answer a practical demand (home automation, health care, security, monitoring,...)
Platforms/programming languages: Linux, Arduino, Python, Processing, Javascript

PROGRAMMABLE DIGITAL AND ANALOG ELECTRONICS (15 h)
(Mariane Compte, Jean-Marc Gallière, Arnaud Vena)
Introduction to programmable digital electronics (Lab, 3h)
In this lab you will discover the world of programmable digital electronics trough the programming of an ARDUINO board to control *eg* an RGB LED, an 8x8 LED display, a 3-axis accelerometer, a microphone… An ARDUINO Esplora board includes a microcontroller composed of a microprocessor with several peripherals to be directly connected with electronic components. A microprocessor is able to run a set of commands one by one according to a program, also called a firmware. In digital electronics, the firmware loaded in memory of microcontrollers can change the state of digital or analog outputs depending on the state of their inputs. These inputs / outputs are commonly connected to sensors (temperature, pressure, accelerometer ...) and actuators (motors, LEDs, display ...). The programming language of an ARDUINO board is very close to the C language. A dedicated software called Integrated Development Environment (IDE) allows you to prepare the firmware code as a text file, to be compiled and loaded into the memory of the microcontroller.

Introduction to digital integrated circuit design (Lab, 3h)
In this lab you will discover the world of microelectronic digital integrated circuit design through high level description language (VHDL) towards the programmation of Filed Programmable Gate Arrays (FPGA). High level description, simulation and synthesis of basic logic gates and more complex digital functions will be performed using the Genus-Innovus CAD tool from Cadence.

Active Analog Filters (Lecture 3h, Lab 6h)
Keywords: Operational Amplifier; Analog electronics; Active filters.
Filtering is one of the most widely used functions of signal processing in analog electronics. As opposed to passive analog filters, active (Op. Amp. based) filter architectures amplify the pass band and one can easily build high order filters from cells of first and second orders. The aim of this course is to show the assets of active filters, to analyze the main active filter architectures (Sallen-Key, Multiple Feed-Back, biquadratic and state variable filters) and to enable the students to properly choose an architecture and size its components with respect to given specifications. The theorical study performed during the lectures is illustrated during lab sessions through electrical simulation using Allegro CAD tool from Cadence.