Undergraduate Engineering Summer School

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Grand Industrial Challenges in France

May 18th – June 12th 2026

PROVISIONAL CURRICULUM

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CONTENT

Scientific courses (lectures + scientific visit) to choose from:

Based on coursework, workload and learning outcomes, the Polytech FLOW Program is equivalent to 6 ECTS, to be validated by the home institution.

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SCIENTIFIC COURSES
60 h

SUSTAINABLE ENERGY & MATERIALS (SEM)

Sustainable energy

Materials for sustainable development

SUSTAINABLE ENERGY

Course instructors: F. Henn, T. Talbert, M. Comte, A. Vela, R. Le Parc,

Prerequisite: basic scientific knowledge

Course span: 9h lecture + 3h Lab

Provided material: non

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Software: none

Course content:

This course aims at presenting three different energetic solutions developed in the south of France. The context and energetical issues will be introduced followed as well as the concept of energy and its emergence throughout history, some recalls of the main principles…Then different energy conversions will be developed through the eyes of material engineers.

The major part will be dedicated to solar energy, the physic of the energetical photovoltaic conversion, the materials involved, the calculation and measurement of the efficiency (Lab work). We will evoke the photovoltaic energy distribution within the French electricity grid and the management of PV power plant. The classes will also give insight on thermal power with the principle of the thermodynamic conversion of concentrated solar energy. The challenges related to thermal storage, and night power release will also be discussed. The Different commercial solar thermal power plants in the world and the vision for the future will be presented…

One other type of conversion will also be part batteries for energy storage (1) or nuclear energy (2).

(1) the electrochemical conversion, What are the main electrical features of a battery depending on the couple used, e.g. Lead/acid, Li-ion, Fuel Cells? What is the link between the "inside" functioning and the "outside" (black box) performances? and finally what are the main industrial development of batteries in the framework of the sustainable energy "revolution" imposed by the climate change. (2) the nuclear conversion, the materials involved in the nuclear, the radiation damages, the security issues, the recycling and storage of nuclear wastes.

Assesments: written exam, Multiple-choice questions, report

Reference sources:
- _(1) An Introduction to Nuclear Materials: Fundamentals and Applications by K. Linga Murty, Indrajit Charit, Publisher: Wiley-VCH; 1 edition (January 29, 2013)_
- _(2) Electrochemical Energy Storage (Anglais) Broché – 3 mars 2015 by Jean-Marie Tarasco, Patrice Simon , ISTE Ltd. (3 mars 2015)_
- _(3) Welding Level 1 Trainee Guide, 3e, Paperback by NCEER_

MATERIALS FOR SUSTAINABLE DEVELOPMENT

Course instructors: J.L. Bantignies and R. Metz

Prerequisite: No prerequisite.

Course span: 4,5h lectures + 9h practical works & projects

Provided material: Computers Softwares: LCA SIMAPRO2

Course content:
Concept, norms and practical tools

The objective of this course is to introduce engineering methodology for Eco design. The industrial LCA SIMAPRO2 software will be used for practical lessons and project.

Materials for sustainable development: context and history

Life cycle assessment method: life cycle and Emission/Extraction inventory Life cycle assessment method: Impact factor calculation

LCA practical lessons: Inventory, Environmental Impact and Case study LCA project

Assessment: Multiple-choice questions, Project

Reference sources:
- *"Environmental Life Cycle Assessment" 1st Edition, Olivier Jolliet et al. CRC Press (2015) – 302 Pages, ISBN 9781439887660 – CAT# K14053*
- *https://www.pre-sustainability.com/download/SimaPro8IntroductionToLCA.pdf*

SUSTAINABLE BUILDINGS

SUSTAINABLE BUILDINGS 1

Course instructors: W.Ghannoum

Course span: 15 hours of lectures/tutorials

Course content:

This course will be dedicated to sustainable materials in construction: mainly concrete, steel, and fibre-reinforced plastic. Exercises will lead the students to calculate energy and CO_2 costs for various designs of a simple structure and discuss benefits and costs. Eventually a cost benefit analysis of building a bridge will be led. The courses will be completed by a visit of a site illustrating Material/building issues.

Assessment: Multiple-choice questions, in-class exam or report

SUSTAINABLE BUILDINGS 2

Course instructors: D. Cervellin, C. Reynaud, Y. Duhamel

Prerequisite: none

Course span: 1 hours of lectures + 12h lab

Provided material: welding equipment

Software: DAO software

Course content:

Welding plays a critical role in all industrial sectors, particularly in energy and materials plants. This course provides an introduction to the science and technologies of welding.

Students will also gain access to PRO3D, the technological platform at the University of Montpellier dedicated to prototyping and additive manufacturing (including 3D printing with polymers, resins, and metals). Through hands-on experience in developing a prototype, students will familiarize themselves with additive manufacturing techniques, complementing the theoretical knowledge acquired during the SEM session.

Assessment: none

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DATA & INFORMATION PROCESSING (DIP)

Data science & artificial intelligence

Design & development of mobile apps for IOS/IPADOS/MACOS

DATA SCIENCE AND ARTIFICIAL INTELLIGENCE

Dates: May 18th – May 29th 2026

DATA MINING AND MACHINE LEARNING

Course instructors: A. Laurent + other instructors

Prerequisite: No prerequisite. Basic notions of SQL and Python programming are a plus

Course span: 24 hours of lectures and hands-on labs delivered over a week

Provided material: Computers Softwares: Weka, Python, PostgreSQL, SQL, Neo4j

Course content: This course is an introduction to data management, data mining and artificial intelligence. It presents the main methods of data management (SQL, OLAP/reporting, graph databases, …), data mining and machine learning from the

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computer science perspective: supervised and unsupervised algorithms, deep learning, generative AI and pattern mining. The course also focuses on evaluation methods and applications to health and environment. You will explore several datasets and methods through a hands-on lab.

Assessment: Surveys of the labs

CLOUD, IOT & AI PROTOTYPI

Course instructors: IBM

Prerequisite: No prerequisite.

Course span: 6 hours of hands-on labs

Provided material:

Course content: Discover a cloud computing platform (IBM Cloud) and measure the interest proposed by this large catalog of services around the Internet of Things (IoT), Artificial Intelligence (IA) and data management, and quickly develop IoT solutions, with data collection and augmentation using AI services (natural language processing, computer vision, etc.). A lab will then allow you to build an IoT data processing chain through Node-Red. This block-based graphical coding interface will allow you to acquire, store, monitor and explore data without coding.

Assessment: Screenshots of the lab key step

DESIGN AND DEVELOPMENT OF MOBILE APPS FOR IOS/IPADOS/MACOS

Dates: June 2nd – June 12th 2026

Course instructors: C. Fiorio, V. Berry, O. De Jonckere

Prerequisite: skills in Object-Oriented Programming, practice of basic design patterns

Course span: 30 hours of lectures and hands-on labs delivered over a week

Provided material: iPads / in room Mac Book Pro laptops

Software: Swift playground, Xcode, Git, Firestore

Course content:

- Intro to iOS development & useful design patterns
- Swift as a programming language (syntax, specificities, tool chain)
- MVVM UI conception pattern (separation of concern, delegation, observer pattern, ...)
- SwiftUI framework for modeling UIs in a declarative way
- Designing views with graphical widgets
- Navigating between views
- Maintaining a single source of truth
- Ensuring widgets reactive behavior
- Storing and retrieving data from the web:
- Coding/Decoding json content
- Communicating with an APIsDAO & DTO design patterns
- Communicating with a remote database

Optional: depending on the student's progression speed, the MVI UI conception pattern will be presented and practiced

- Mode of Delivery: Project-based approach
- Expected Learning Outcomes
- Project on building an iOS mobile app
- Short lectures interleaved with lab sessions dedicated to the project
- At the end of this course, the student will be able to:
- Design patterns, frameworks and their practice (Delegator / Delegate, Observer/Observable, MVVM,MVI,...)
- Employ the Xcode IDE to implement a mobile app for the Apple eco-system, while interacting with other programmers
- Employ various components of the SwiftUI and Combine frameworks to maintain data consistency and ensure reactivity of UI components and views in a mobile app
- Design and implement a multi-view mobile app for iOS,iPadOS & MacOS platforms, as a working solution to a real-world problem.

12h face to face + 4h individual work

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FOOD, WINE & WATER (FEAT)

Introduction to Food Processing

Wine & Beer Technology

Water Science & technology

This track offers about 60 hours of lectures and projects related to some challenges in the fields of food and water sciences. First sessions will present the major unit operation in food processing systems and how to master them to improve sustainability. The second sessions will give a synthetic presentation of the most fermented beverage iconic of the South of France: beer and wine, from harvest to winemaking and aroma. The last sessions will focus on conventional and innovative technologies for water treatment, waste management and on ecological systems and biodiversity preservation. During these 4 weeks you will be interacting with researchers experts in various fields of food and water and discovering the activities developed in the South of France. Lecturers are members of two major engineering schools of Montpellier: Polytech Montpellier and Institut Agro of Montpellier. The provisional syllabus of the track is detailed below. It includes some references that might support you during the school or guide your way for a more thorough exploration of the covered material.

INTRODUCTION TO FOOD ENGINEERING (IFE)

(6h lectures + 6h practical works)

Course instructors: D. Chevalier-Lucia, C. Cunault, L. Palmade, K. Rosentrater,

Prerequisite: none

Course span: 6 hours of lectures + 6 h lab

Provided material: welding equipment

Course content:

1. **Analyzing and designing major unit operations in food processing systems:**
Introduction to food science and food industry, food engineering, engineering basics, impacts on chemistry. Energy sources, energy balances / Psychrometrics, thermodynamics / Heat transfer / Preservation Drying, dehydration / Thermal processing / Fluid flow / Extrusion processing / Examples, exercises

2. Practical Works:

Those practical classes (6h) take place in a food processing pilot plant and are based on some of the major unit operation in food processing such as canning, production line, pasteurization, concentration and drying. Over these classes, students work on semi-industrial pilots and practice their knowledge on 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). Organizational aspects, metrology and internal communication are the strengths of this practical training as well as scientific and technical aspects. Industrial fluid consumption (steam, water, compressed air / vacuum, electricity) are integrated into the process and followed with a sustainable development approach.

<u>Assessment:</u> Written exam, multiple-choice questions, calculation questions, short questions

<u>*Reference sources:*</u>

- Heldman, D. R., Lund, D. B. 2007. *Handbook of Food Engineering*, 2nd ed. CRC Press.
- Singh, R. P., Heldman, D. R. 2014. *Introduction to Food Engineering*, 5th edition. Elsevier.
- Valantas, K. J., Rotstein, E., Singh, R. P. 1997. *Handbook of Food Engineering Practice*. CRC Press.
- Singh, R. P. *Explore Food Engineering*: http://www.rpaulsingh.com

WINE & BEER TECHNOLOGY (WBTECH)

(7,5h lectures + 12h practical works)

Course instructors: C. Cunault, P. Lallemand, A. Roland

Prerequisite: none

Course span: 7,5 hours of lectures + 12h lab

Course content:

1. **Wine technology: a synthetic presentation of one of the most consumed fermented beverage (6h of lecture +3h lab)**

   Wine technology

   Lecture: Understanding wine technology from harvest to winemaking. Selection of grape variety, "terroir", vineyard management and quality of wine. Process of white, red, sweet and sparkling wine-making, fermentations, aging.

   Wine aroma, sensory analysis and market

   Lecture: Aroma compounds in wines (how they are formed during winemaking and wine aging) and sensory evaluation of wines (methodology and explanation of wine sensory attributes). Presentation of the Mediterranean wines (category, food matching, history, market).

   <u>Assessment</u>: Multiple-choice questions + Sensory methodology

   <u>Reference sources:</u>

   - *Understanding Wine Chemistry*, Andrew L. Waterhouse Gavin L. Sacks David W. Jeffery, Wiley, 2016, doi 10.1002/9781118730720
   - *Handbook of Enology*, Volume 1 The Microbiology of Wine and Vinifications 2nd Edition P. Ribéreau- Gayon, D. Dubourdieu, B. Donèche and A. Lonvaud, 2006 John Wiley & Sons.
   - *Handbook of Enology*, Volume 2 The Chemistry of Wine, Stabilization and Treatments, 2nd Edition P. Ribéreau-Gayon, Y. Glories, A. Maujean and D. Dubourdieu, 2006 John Wiley & Sons.
   - *Wine Flavour Chemistry*, Second edition, Jokie Bakker Ronald J. Clarke, 2012

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- *Wine science*: *principles and applications*. Ronald S. Jackson. Third Edition, 2018, Elsevier.
- *Wine tasting: A professionnal handbook*. Ronald S. Jackson. Third Edition, 2018, Elsevier.
- *Wine Grapes: A Complete Guide to 1,368 Vine Varieties*. J. Robinson, 2012, Penguin books
- *Terroir and Other Myths of Winegrowing*, M. Mathews, 2016, University of California press
- *The Science of Grapevines: Anatomy and Physiology*, M. Keller, Third Edition, 2020, Elsevier

2. Beer Technology (1,5h lectures + 9h lab)

Lecture: beer from history to trends in brewing technology and quality control.

Practical works

Artisanal manufacture of beer and sensory evaluation.

Assessment: multiple-choice questions

Reference sources:

- *Palmer, J. J. (2017). How to brew: everything you need to know to brew great beer every time. Brewers Publications.*

WATER SCIENCE AND TECHNOLOGY (WST)

(22,5 h lecture + practical works + visit)

Course instructors: C. Aliaume, F. Zaviska

Prerequisite: none

Course span: 19,5 hours of lectures + 3 h visit

Course content:

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1. Assuring Clear Water

Lectures + small projects: Conventional and innovative technologies for water treatment and waste water management. Water contamination can be very diverse and can be harmful for both environment and human health. The content of this course will be divided into three main parts. The first part will be dedicated to the presentation of the different type of water contaminants/pollution (anthropogenic or natural pollution) and how it can affect the ecosystem and human health. In a second part, the different water treatment techniques will be presented for both wastewater management and drinking water production. Finally, a presentation of innovative water technology based on membrane processes for specific applications will be details in the last part of this lecture.

Reference sources:

- Vigneswaran S. & Visvanathan C. 1995. *Water treatment processes: Simple option*. CRC Press Published - 224 Pages - ISBN 9780849382833

2. Sustainable aquatic Ecosystems

Lectures and small projects on the ecosystem ecological status and biodiversity preservation. This course aims at introducing ecological basic knowledge of a river system and aquatic organisms, and providing tools to evaluate the ecological status of rivers. Human impacts (such as dam construction) jeopardize ecosystem functioning and biological resources sustainability, and solutions for the ecological continuity restoration are presented. A field trip is scheduled to visit river systems and restoration installations. *Reference sources:*
– Schmutz S. & Sendzimir J. 2018. *Riverine Ecosystem Management. Science for Governing Towards a Sustainable Future*. Aquatic Ecology Series Vol 8. 562 pages
– Baudoin JM et al 2014. Assessing the passage of obstacles by fish. Concepts, design and application. Ed. Knowledge of action. 200p
– Molles M.C. Jr. 2005. Ecology: concepts and applications. Mc Grow Hill Ed. 3rd edition. 622p.
– Townsend C.R., Begon M. & Harper J.L.2003. Essentials of Ecology. Blackwell Publishing 2nd edition. 530p.

WORKSHOPS ON SUSTAINABILITY
12 h

Assessment:

Multiple-choice questions, a small-project prepared by groups with an oral presentation

12h face to face + 4h individual work

This workshop will serve as a forum for debate on key issues related to the ecological transition, including the Anthropocene, resource management, renewable energies, and the 17 Sustainable Development Goals (SDGs) of the United Nations. The discussion will be enriched by contributions from experts, exercises, games, and collaborative work in multidisciplinary and international teams.

<u>Assessment:</u> Multiple-choice question or oral presentation

Reference source:

- https://www.un.org/development/desa/disabilities/envision2030.html

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FRENCH LANGUAGE & CULTURE, INTERCULTURALITY 16h

Your Intensive French Course

Learn French in a superb environment:
in the very heart of Montpellier's historic center,
discover our incredible 19th-century building.

> 5 hours of French culture workshops per week, with 2h30 sessions on Tuesday and Thursday afternoons.

> A fun and high-quality teaching approach; an engaging way to explore the French language and culture. Enjoy being in France to experience a unique full immersion!

> Passionate and dynamic teachers, fun activities and educational outings that will make you love the French language and culture.

> End-of-course certificate recognized by the international network of Alliances Françaises.

Your Cultural Program

Because at Alliance Française Montpellier we are committed to offering you a rich and unique cultural program, the schedule presented below includes all specific requests and interests indicated beforehand by the representatives of your stay.

Date	Activity
Saturday, May 23, 2026	**Full-day excursion: discovery of Roquefort, La Couvertoirade and the Millau Viaduct**
Saturday, June 6, 2026	**Full-day excursion: visit to Nimes and the Pont du Gard**

IF YOU HAVE ANY QUESTION PLEASE CONTACT

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