IPL Summer School 2019

Science & Engineering program

A multidisciplinary approach to the subject of Energy and Sustainability.

Most of the largest challenges we will face in the future (global warming, increasing scarcity of fossil fuels, the impact of production methods and materials, etc.) are related to how we produce and use energy and the consequences of those actions. The course aims to teach future engineers the industrial and regulatory context, the technical concepts and tools needed to comprehend these challenges, and explore the solutions of tomorrow.

Drawing from ECAM Lyon's expertise in the areas of energy, electrical and mechanical engineering, as well as materials science, this program is composed of a series of lectures and practical courses that will include case studies, labs and individual work on the themes covered. Students will also be asked to work on a team project that will be presented at the end of the course.

For program and application details, go to: http://www.iplsummerschool.com/index.php

Total credits: 6 ECTS[1], European Transfer System

Hours: 54

	Session - Course content [2]	Instructor	Hours
1	**Regulatory context of sustainable energies**	Dominique Seguy, Consultant in Operational Management in the energy sector	4
- Laws and regulations: European and National regulatory context; post COP 21-COP22 - Institutional support to promote and encourage sustainable energies - Industrial sector of HVAC in France and Europe - Perspectives for bioenergy and biomass in France			
2	**Circular Economy and the energy sector**	Dominique Seguy, Consultant in Operational Management	4
- Circular economy: what is it and how does it apply to the sector of sustainable energies? - Wood industry - Biogas plants and industry; waste energy - Bioenergy & Biomass: organization of the sector - Focus on District Heating			
3	**Visit of boiler plant in district heating with double energy production**	Dominique Seguy, Consultant in Operational Management	4
4	**Production of Electrical Energy 1: Nuclear power plant & Power grid**	Prof. Thierry Bailles &, Professor-Researcher in the Energy Department	3
- Operating principle of a nuclear reactor, fission chain reaction, schematic diagram of a nuclear power plant with electro-mechanic-thermal conversion, performances - Three-phase and one-phase power grid, currents and power calculation - Electrical test with a transformer and some receivers			
5	**Production of Electrical Energy 2: Photovoltaic, Wind turbine**	Prof. Thierry Bailles, Professor-Researcher in the Energy Department	3
- Operating principle of a photovoltaic cell, main characteristics, performance of a solar panel installation, examples of applications - Test of a solar panel - Operating principle of a wind turbine, main characteristics, conversion of mechanical energy to electrical energy with or without coupling network, with synchronous or induction generator, schemes of associated electronic convertor, installation examples. - Test bench of the coupling network of a synchronous alternator			

[1] Equivalent to 3 or 4 US credits, depending on your program and university.

2 The school reserves the right to modify the course modules and/or their content for updating or improvement purposes.

6	**Production of Electrical Energy 3: Fuel Cells**	Prof. Christophe Jouve, Head of the Automation & IT Department	3
- Operating principle of a fuel cell, main characteristics, performance, hydrogen generation and stocking means, applications examples (e.g. electric vehicles) - Test bench of a 500W fuel cell			
7	**Efficiency and Control System**	Prof. Christophe Jouve	3
- Presentation of an industrial programmable logic controller PLC, performances and industrial applications. Drivers & controllers of actuators. Rules of regulation. - Test bench of a device with on-off inputs and outputs and of a small process control, small controller programming and analysis of the system response.			
8	**Energy: From primary sources to sustainability I**	Prof. Alexandre Vaudrey, Professor-Researcher in the Energy Department	3
- A short reminder of the two laws of thermodynamics and their consequences on the management of energy and environment: why we must take energy from somewhere, but it cannot come from anywhere. - What we need and what we have: what are the primary energy sources (PES), energy carriers (EC) and final energy (FE)? Why do we always need to convert, to transport and to store energy? - How to assess all energy systems: is it better to talk about efficiency or effectiveness? What are the other typical performance criteria and when are they used? How should the environment be taken into account in our calculations?			
9	**Energy: From primary sources to sustainability II**	Prof. Alexandre Vaudrey	3
- Current state of our world: what are our actual primary sources and how are we using them? - The problem: what is the Energy Transition and why must we care about sustainability? - The future: what are the possible solutions for tomorrow? What are the critical parameters to take into account before adopting a new technology? How to stay hopeful.			
10	**Heat Ventilation and Air Conditioning (HVAC) systems and energy consumption of buildings**	Prof. Alexandre Vaudrey	3
- Thermal comfort and acceptable indoor air quality in buildings. - The concept of humid air: importance of temperature and humidity. - How does an HVAC system works. - Energy balance and efficiency of HVAC systems. - Laboratory work: practical use of a real HVAC equipment with case studies.			
11	**Materials for sustainable energy**	Prof. Aurélien Etiemble, Professor-Researcher, Materials and Structures Department	3
- Introduction to materials science: classification of materials and common properties. - Materials in energy conversion and storage devices. - Laboratory work: Characterization of materials for photovoltaic solar cell and Li-ion batteries.			
12	**Group Project**	ECAM Lyon instructors	5 x 3h sessions
- Research project related to one of the subjects covered during the course - Students work in teams; regular contact with supervising professors			
13	**Final evaluation + oral presentation**	ECAM Lyon instructors	3
- Final exam covering the taught classes and laboratory work - 20-minute oral presentation of the group project followed by questions from the panel of professors			