

## IPL Summer School 2017 Science & Engineering program

### A multidisciplinary approach to the subject of **Energy and Sustainability**.

Most of the biggest challenges we will have to face in the future (global warming, increasing scarcity of fossil fuels, the impact of production methods and materials, etc.) are related to the production of energy, its use and consequences. The goal of this course is 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, European Transfer System

	Course content – Sessions <sup>1</sup>	Instructor	Hours
1	<b>Orientation meeting + campus visit</b> What is a “Grande Ecole” in the French tradition of engineering schools? <b>Intro. to energy management and sustainability</b>	Lisa Vergara, International Coordinator; Prof. Alexandre Vaudrey, Professor-Researcher in the Energy Department	2
2	<b>Regulatory context of sustainable energies</b>  - Laws and regulations: European and National regulatory context; 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	Dominique Seguy, Consultant in Operational Management in the energy sector	3
3	<b>Circular Economy and the energy sector</b>  - 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	Dominique Seguy, Consultant in Operational Management	3
4	<b>Visit of boiler plant in district heating with double energy production</b>	Dominique Seguy, Consultant in Operational Management	3

<sup>1</sup> The school reserves the right to modify the course modules and/or their content for updating or improvement purposes.

<b>5</b>	<b>Production of Electrical Energy 1: Nuclear power plant &amp; Power grid</b>	Prof. Olivia Petillot, Professor- Researcher in the Energy Department	3
<ul style="list-style-type: none"> <li>- Operating principle of a nuclear reactor, fission chain reaction, schematic diagram of a nuclear power plant with electro-mechanic-thermal conversion, performances</li> <li>- Three-phase and one-phase power grid, currents and power calculation</li> <li>- Electrical test with a transformer and some receivers</li> </ul>			
<b>6</b>	<b>Production of Electrical Energy 2: Photovoltaic, Wind turbine &amp; Fuel Cells</b>	Prof. Olivia Petillot, Professor- Researcher in the Energy Department	3
<ul style="list-style-type: none"> <li>- Operating principle of a photovoltaic cell, main characteristics, performance of a solar panel installation, examples of applications</li> <li>- Test of a solar panel</li> <li>- 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.</li> <li>- Test bench of the coupling network of a synchronous alternator</li> </ul>			
<b>7</b>	<b>Efficiency and Control System</b>	Prof. Christophe Jouve, Head of the Automation & IT Department	3
<ul style="list-style-type: none"> <li>- Presentation of an industrial programmable logic controller PLC, performances and industrial applications. Rules of regulation.</li> <li>- 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.</li> <li>- Operating principle of a fuel cell, main characteristics, performance, hydrogen generation and stocking means, applications examples (e.g. electric vehicles)</li> </ul> <p>Test bench of a 500W fuel cell</p>			
<b>8</b>	<b>Energy: From primary sources to sustainability I</b>	Prof. Alexandre Vaudrey, Professor- Researcher in the Energy Department	3
<ul style="list-style-type: none"> <li>- 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.</li> <li>- 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?</li> <li>- 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?</li> </ul>			
<b>9</b>	<b>Energy: From primary sources to sustainability II</b>	Prof. Alexandre Vaudrey, Professor- Researcher in the Energy Department	3
<ul style="list-style-type: none"> <li>- Current state of our world: what are our actual primary sources and how are we using them?</li> <li>- The problem: what is the Energy Transition and why must we care about sustainability?</li> <li>- 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.</li> </ul>			

10	<b>Applying sustainable operational excellence to the carbon black industry</b>	Gilles Moninot Global Director of Sustainability Birla Carbon, Aditya Birla Group	3
<ul style="list-style-type: none"> <li>- Main principles of sustainable development in the carbon black industry</li> <li>- What sustainability means at Birla Carbon, a leader in the carbon black industry</li> <li>- Workshop: Life Cycle Assessment; energy and carbon mass balance analysis</li> </ul>			
11	<b>Structures I: Materials</b>	Prof. Soledad Commisso, Prof. Atilla Atli, Prof. Philippe Jacquet, Professor-Researchers, Materials and Structures Department	3
<ul style="list-style-type: none"> <li>- Description of the methodology for materials selection. Linking material properties to application.</li> <li>- Material selection for energy-efficient systems. How does material selection influence the energy consumption?</li> <li>- Environmentally-responsible options</li> <li>- Examples of materials for energy storage. Which properties do we require?</li> <li>- Laboratory work: experimental testing to obtain the mechanical properties of two steels. Comparison between their mechanical performance.</li> </ul>			
12	<b>Structures II: Technological analysis of a starter engine</b>	Prof. Christine Billon-Lanfray, Professor in the Materials and Structures Department	3
<ul style="list-style-type: none"> <li>- Dismantling and examination of the components of the mechanism</li> <li>- Understanding the kinematics of the mechanism</li> <li>- Study of a selection of parts: choice of materials and manufacturing process</li> </ul>			
13	<b>Group Project</b>	ECAM Lyon instructors	5 x 3h sessions
<ul style="list-style-type: none"> <li>- Research project related to one of the subjects covered during the course</li> <li>- Students work in teams; regular contact with supervising professors.</li> </ul>			
<b>Final evaluation + oral presentation</b>		ECAM Lyon instructors	3
<ul style="list-style-type: none"> <li>- Final exam covering the taught classes and laboratory work 20 minute oral presentation of the group</li> <li>- Project followed by questions from the panel of professors</li> </ul>			

Total hours: 53