Industrial Electronics

1. **Course number and name:** 020ELIES2 Industrial Electronics

2. **Credits and contact hours:** 6 ECTS credits, 3x1:15 contact hours per week.

3. **Instructor's or course coordinator's name:** Flavia KHATOUNIAN RAJJI (el) and Ragi GHOSN

4. **Instructional materials:**
   a. **Textbook**
      - Hervé LABORNE, "Convertisseurs assistés par un réseau alternatif", Tome 1, Editions Eyrolles, 1992.
      - Hervé LABORNE, "Convertisseurs assistés par un réseau alternatif", Tome 2, Editions Eyrolles, 1992.
   b. **Other supplemental materials:** PowerPoint presentation, Exercises, Lab experiments instructions

5. **Specific course information**
   a. **Catalog description:**
      This course introduces students to the expanding field of power electronics in the domain of industrial applications. It is articulated around three main topics: first, the characteristics of power semiconductor devices (ideal vs practical), which are used as switches to perform the power conversions from ac-dc, dc-dc, dc-ac and ac-ac, then an in-depth study of the operation, analysis, and design of single-phase and three-phase thyristor-based power rectifiers. This main part is validated by workshops using MATLAB/Simulink, as well as a set of lab experiments. Finally, an application related to variable speed systems, and based on power-rectifiers is developed.

   b. **prerequisites or co-requisites:** None

   c. **Required** for EE students.

6. **Educational objectives for the course:**
   a. **Specific outcomes of instruction:**
      - Classify power semiconductor devices based on their static and dynamic switching characteristics.
      - Explain the switch mode in a group of semiconductor devices and calculate snubber circuits to protect a thyristor from a large *di/dt* during turn-on and a large *dv/dt* during turn off.
      - Describe and analyze the operation of single-phase and three-phase thyristor-based power rectifiers.
      - Design a simple system based on power conversion from ac-dc.

- Use MATLAB and MATLAB/Simulink to simulate the studied thyristor-based power rectifiers.

b. PIs addressed by the course:

PI	1.1.	1.2.	1.3.	2.1.	2.2.	2.4.	6.1.	6.2.	6.3.	6.4.
Covered	x	x	x	x	x	x	x	x	x	x
Assessed			x				x	x	x	x

7. Brief list of topics to be covered:

- Course introduction (1.25 hours)
- Characteristics of ideal versus practical power switches (1.25 hours)
- The power diode (1.25 hours)
- Thyristors (1.25 hours)
- Thyristors natural and forced commutation techniques (2.5 hours)
- Fully controlled power switches: power bipolar transistors, GTO, MOSFET, IGBT (2.5 hours)
- Switch mode and snubber circuits (5 hours)
- Single-phase thyristor-based power rectifiers (5 hours)
- Three-phase thyristor-based power rectifiers (7.5 hours)
- Power factor improvement: Mixed topologies (5 hours)
- Case study: Design of a simple system based on power conversion from ac-dc (5 hours)
- Workshops using MATLAB/Simulink (3 3-hour labs)
- Laboratory experimental validation of the main rectifiers' topologies (3 3-hour labs)