

Course Syllabus

1. Course number and name: **020CA1ES3 – Switch-mode power converters 1**
2. Credits and contact hours: **3 credits, 52.5 contact hours**
3. Instructor's or course coordinator's name: **Hadi Kanaan**
4. Text book : Francis Labrique, Guy Séguier et Robert Bausière, *Les Convertisseurs de l'Electronique de Puissance : La Conversion Continu-Continu*, Volume 3, Technique et Documentation Lavoisier, 1995
 - a. other supplemental materials: Notes, exercises, lab assignments, PowerPoint presentations
5. Specific course information
 - a. brief description of the content of the course (catalog description)

In this course, different topologies of switch-mode converters are presented. Two categories of converters are studied: the DC-DC converters (choppers, power supplies) and the DC-AC converters (single and three-phase inverters, two and multilevel structures). A detailed analysis starting from the possible configurations, then the establishment of the mathematical equations, the waveforms and the input-output features, and the selection of the semiconductor devices and all other components is elaborated for each topology. Rating criteria based on the evaluation of the voltage and current stresses are elaborated. Simulation sessions using Matlab are carried out to verify the theoretical aspects presented in the course.
 - b. prerequisites or co-requisites: **020ELIES2-Industrial Electronics**
 - c. Required/Elective/Selected Elective: **Required for EE – Industrial Systems option, Selected Elective for EE – Electromechanical option**
6. Specific goals for the course
 - a. specific outcomes of instruction

The students will be able to:

 - ✓ Identify the role and possible configurations of common switch-mode power electronics converters
 - ✓ Establish the operating sequence of a converter in both continuous and discontinuous current modes
 - ✓ Develop the mathematical equations describing the one-cycle behavior of the converter and draw the related waveforms
 - ✓ Analyze the performance of the converter and derive the input-output characteristics
 - ✓ Select the components and devices according to voltage and current ratings

- ✓ Perform a comparative analysis between two or more converters and deduce the benefits and drawback of each topology
- ✓ Simulate a power converter using Matlab, and analyze the numerical results

b. KPIs addressed by the course.

KPI	a2	b1	b2	b3	c1	c2	c3	e3	g1	g2	k2	k3
Covered	x	x	x	x					x	x		x
Assessed	x	x	x	x	x	x	x	x	x	x	x	x
Give Feedback					x	x	x	x		x	x	x

7. Brief list of topics to be covered and approximate lecture hours :

- ✓ Introduction: Basic functions of power electronics, applications, course outcomes and topics (2.5 hours)
- ✓ Choppers: series and parallel structures, operation in case of an ideal or an inductive load, in continuous or discontinuous current mode, two and four-quadrants operation (5 hours)
- ✓ Thyristor-based choppers (3.75 hours)
- ✓ Non-isolated switch-mode power supplies: Classical Buck, Boost and Buck-Boost topologies (5 hours)
- ✓ Isolated power supplies: principles, review of the transformer operation and basic equations (1.25 hour)
- ✓ Forward converter with single or multi outputs: single-switch and asymmetric half-bridge topologies (2.5 hours)
- ✓ Push-Pull converters: parallel, series half-bridge and series full-bridge topologies (3.75 hours)
- ✓ Fly-back converter with single or multi outputs, single-switch and asymmetric half-bridge topologies (3.75 hours)
- ✓ Switch-mode inverters: single-phase basic topologies (5 hours)
- ✓ Three-phase inverter (1.25 hour)
- ✓ Multilevel inverters (2.5 hours)
- ✓ Exercises (8.75 hours)
- ✓ Simulations using Matlab (7.5 hours)