Course guide
240257 - 240EN39 - Electric Energy Conversion

Last modified: 16/05/2023

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 709 - DEE - Department of Electrical Engineering.

Degree: MASTER'S DEGREE IN ELECTRIC POWER SYSTEMS AND DRIVES (Syllabus 2021). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: Montesinos Miracle, Daniel

Others:

PRIOR SKILLS

Basic knowledge on electricity, electronics and automation

REQUIREMENTS

None

TEACHING METHODOLOGY

Masterclasses for main concepts, but combining theoretical concepts, exercises and problems.

LEARNING OBJECTIVES OF THE SUBJECT

- Understand the working principles of power electronic systems
- Know the basic topologies and their relations
- Size and select the main components of a power converter

STUDY LOAD

Type	Hours	Percentage
Hours large group	45,0	36.00
Self study	80,0	64.00

Total learning time: 125 h

CONTENTS

Introduction to power electroncis and its elements

Description:
Module 1 Introduction
Definition and Applications of power electronics. Commutation.
Module 2 Basic concepts
Components in power electronics: sources. Basic rules of sources connection. Basic components in power electronics: ideal switch. Source interconnection: direct converters and indirect converters. Converter synthesis. Hard and soft switching (ZCS and ZVS)
Module 3 Real switches
Diode. Thyristor. MOSFET. IGBT. Other types. Losses and drivers
Module 3 Auxiliary elements
Resistor, capacitors, inductors and transformers.

Full-or-part-time: 39h
Theory classes: 39h

Power converters

Description:
Module 1 DC/DC converters
Introduction and Applications of DC/DC converters. Buck converter. Boost converter. 2 quadrant converter. H-bridge: 4 quadrant converter. Three-level switching.
Module 2 AC/DC converters: current converters
Introduction and applications of AC/DC converters. Synthesis of AC/DC converters. Single and three phase rectifiers.
Module 3 DC/AC converters: inverters
Introduction and applications of AC/DC converters. Synthesis of DC/AC converters. Single phase inverter. Three phase inverters. SVPWM.
Module 4 Applications of power electronics
Renewable Energy applications: wind, PV, microgrids
Motor control applications: industrial VFD, EV powertrain, railway, ships
Power supplies: Uninterruptible Power Supplies, power supplies
Transport and distribution of Energy: HVDC, FACTS, STATCOM, active filters and reactive power compensation
Other applications: induction heating, soldering, electrolysis, lighting

Full-or-part-time: 7h
Theory classes: 7h

Converter control

Description:
Module 1 Auxiliary control elements
Voltage and current sensors. Analog and digital control. PWM modulation. Analog tot digital conversion.
Module 2 Model and converter control
Modelling of converter: average model and switched model. Control tuning. Digital implementation.

Full-or-part-time: 7h
Theory classes: 7h

GRADING SYSTEM

Final mark = 0,5 final exam + 0,4 lab report + 0,1 lab activities
Those who will not do the final exam or the lab report will be qualified with an NP
In case the reevaluation exam is necessary for you, the same methodology for computing the final mark will be used, but substituting the final exam mark by the mark in the reevaluation exam.

EXAMINATION RULES.

The final exam will be on the dates fixed by the school. The final exam and reevaluation exam consist of theoretical aspects, but also the aspects seen in the lab.

BIBLIOGRAPHY

Basic:

- Buso, Simone ; Mattavelli, Paolo. Digital control in power electronics [on line]. [San Rafael, Calif.]: Morgan & Claypool Publishers, cop. 2006 [Consultation: 14/09/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=881367. ISBN 9781598291124.
- Barrade, Philippe. Électronique de puissance : méthodologie et convertisseurs élémentaires. Lausanne: Presses polytechniques et universitaires romandes, cop. 2006. ISBN 9782880745660.
- Mohan, Ned; Robbins, William P; Undeland, Tore M. Power electronics : converters, applications, and design. 3rd ed. New York [etc.]: John Wiley & Sons, cop. 2003. ISBN 9780471226932.
- Blaabjerg, Frede; Kazmierkowski, Marian P; Krishnan, Ramu. Control in power electronics : selected problems [on line]. Amsterdam [etc.]: Academic Press, cop. 2002 [Consultation: 14/09/2022]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9780124027725/control-in-power-electronics. ISBN 0124027725.