

## Course guide

# 820752 - GEPFR - Application of Power Electronics for Renewable Generation

**Last modified:** 13/03/2025

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

**Degree:** MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Optional subject).  
MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Optional subject).  
MASTER'S DEGREE IN ELECTRIC POWER SYSTEMS AND DRIVES (Syllabus 2021). (Optional subject).  
MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2022). (Optional subject).

**Academic year:** 2025    **ECTS Credits:** 5.0    **Languages:** Catalan, Spanish, English

### LECTURER

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**Coordinating lecturer:** Cheah Mañé, Marc

**Others:** Cheah Mañé, Marc

### PRIOR SKILLS

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Electrical and Electronic systems, Electric Machines

### REQUIREMENTS

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Models and control implementation

## TEACHING METHODOLOGY

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Teaching methodology:

The course teaching methodologies are as follows:

- Lectures and conferences: presentation of main concepts by lecturers or guest speakers.
- Participatory sessions: collective resolution of exercises with the lecturer and other students in the classroom
- Theoretical/practical supervised work (TD): classroom activity carried out individually or in small groups, with the advice and supervision of the teacher.
- Homework assignment of reduced extension (PR): carry out homework of reduced extension, individually or in groups.
- Homework assignment of broad extension (PA): model implementations and writing a report that should include the approach, results and conclusions.
- Evaluation activities (EV).

Training activities:

The course training activities are as follows:

- Face to face activities

o Lectures and conferences: learning based on understanding and synthesizing the knowledge presented by the teacher or by invited speakers.

o Participatory sessions: learning based on participating in the collective resolution of exercises with the lecturer and other students in the classroom.

o Theoretical/practical supervised work (TD): practical exercises and assignments, individually or in small groups, with the advice of the teacher.

- Study activities

o Homework assignment of reduced extension (PR): Optional activities related to review of concepts that students should know to develop the course without difficulties.

o Homework assignment of broad extension (PA): Assignments that involve implementation of simulation models and writing of related reports

o Self-study (EA): learning based on studying or expanding the contents of the learning material, individually or in groups, understanding, assimilating, analysing and synthesizing knowledge.

## LEARNING OBJECTIVES OF THE SUBJECT

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Electrical aspects of renewable energy will be addressed, from the modelling and control of the required electrical machines to electrical grid integration issues.

1. Introduce the generation principles of the different renewable sources.
2. Introduce the different renewable energy sources focusing on photovoltaic solar and wind systems.
3. Delve into the the electrical aspects of the treated energy sources: induction and synchronous generators, PV panels, etc.
4. Work with energy conversion technologies to integrate renewable energies into the electrical grid or microgrid.
5. Focus on control techniques to maximise generation and control optimally the grid interconnection.
6. Analyse issues related to grid integration: voltage and frequency stability, effect of perturbations into the renewable source generation, etc.
7. Development of simulation-based exercises.

## STUDY LOAD

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

**Total learning time:** 125 h

## CONTENTS

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### Introduction to renewable generation systems

**Description:**

A global introduction to the course will be given covering all the main aspects related to renewable energy generation, specifically photovoltaic and wind systems. Modelling and analysis techniques will be described.

**Specific objectives:**

Introduction and context of the course. Basic modelling aspects.

**Related activities:**

Review basic knowledge in converter and electrical machine modelling

**Full-or-part-time:** 6h

Theory classes: 2h

Self study : 4h

### Photovoltaic generation systems

**Description:**

Review of solar resource and description of main operation and control principles of photovoltaic inverters.

**Specific objectives:**

Understanding of photovoltaic inverters and model implementation.

**Related activities:**

Steady state and dynamic models of PV system

**Full-or-part-time:** 9h

Theory classes: 2h 30m

Self study : 6h 30m

### Wind generation systems

**Description:**

Review of wind resource and description of operation and control of Type 1,2 3 and 4 wind turbines.

**Specific objectives:**

Understanding of wind turbine converters and model implementation.

**Related activities:**

Steady state and dynamic models of wind systems

**Full-or-part-time:** 18h 30m

Theory classes: 4h 30m

Self study : 14h

### Grid integration of renewable generation

**Description:**

Description of power plant controls and grid integration compliance.

**Specific objectives:**

Understand the need of a power plant control and grid requirements.

**Related activities:**

Activity 2

**Full-or-part-time:** 1h 30m

Theory classes: 1h 30m

## GRADING SYSTEM

Written test (PE): 50%

Work performed individually or in groups (TR): 50%

## BIBLIOGRAPHY

**Complementary:**

- Ackermann, Thomas. Wind power in power systems [on line]. 2nd ed. Chichester: Wiley, 2012 [Consultation: 19/06/2025]. Available on: <https://onlinelibrary-wiley-com.recursos.biblioteca.upc.edu/doi/book/10.1002/9781119941842>. ISBN 9780470974162.
- Manwell, J. F. Wind energy explained : theory, design and application [on line]. 2nd ed. Chichester: John Wiley & Sons, 2010 [Consultation: 18/06/2025]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=589269>. ISBN 9780470686287.
- Infield, D. G ; Freris L.L. Renewable energy in power systems. Chichester, U.K.: John Wiley & Sons, 2008. ISBN 9780470017494.
- Anaya-Lara, Olimpo. Wind energy generation : modelling and control [on line]. Chichester: John Wiley & Sons, 2009 [Consultation: 18/06/2025]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=454292>. ISBN 9780470714331.
- Quaschnig, Volker. Understanding renewable energy systems [on line]. 2nd ed. London: Earthscan, 2016 [Consultation: 23/06/2025]. Available on: <https://www-taylorfrancis-com.recursos.biblioteca.upc.edu/books/mono/10.4324/9781315769431/understanding-renewable-energy-systems-volker-quaschnig>. ISBN 9781315769431.