

820749 - DSCMEM - Design, Simulation and Control of Electrical Machinery

Coordinating unit:	240 - ETSEIB - Barcelona School of Industrial Engineering
Teaching unit:	709 - EE - Department of Electrical Engineering
Academic year:	2019
Degree:	MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Teaching unit Optional) MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits:	5
Teaching languages:	Catalan, Spanish

Teaching staff

Coordinator:	Córcoles López, Felipe
Others:	Córcoles López, Felipe Pedra Durán, Joaquín Monjo i Mur, Lluís

Prior skills

The students should domain the Electrical Engineering fundamentals.

Requirements

Adequate mathematical and computer skills are required to address the subject contents.

Degree competences to which the subject contributes

Specific:

CEMT-4. Efficiently collect data on renewable energy resources and their statistical treatment and apply knowledge and endpoint criteria in the design and evaluation of technology solutions for using renewable energy resources, for both isolated systems and those connected to networks. They will also be able to recognise and evaluate the newest technological applications in the use of renewable energy resources.

CEMT-6. Employ technical and economic criteria to select the most appropriate electrical equipment for a given application, dimension thermal equipment and facilities, and recognise and evaluate the newest technology applications in the field of production, transport, distribution, storage and use of electric energy.

CEMT-7. Analyse the performance of equipment and facilities in operation to carry out a diagnostic assessment of the use system and establish measures to improve their energy efficiency.

CEMT-9. Undertake projects related to energy management in production and service sectors, recognise and value advances and developments in the field and contribute innovative ideas.

Teaching methodology

The course development includes the following teaching methods:

- Master class (EXP): knowledge exposition and exercises solution by the teacher through master classes.
- Oriented individual works (TD): individual works of reduced complexity or extensión. The acquired knowledge will be applied in these works, and the results will be presented. Their elaboration will start in the classroom (with the teacher guidance) and will end out of the classroom.
- Evaluation activities (EV).

Learning objectives of the subject

To provide the student with a global point of view of the electrical machines and drives, as well as their control, making



820749 - DSCMEM - Design, Simulation and Control of Electrical Machinery

special emphasis in their transient modelling and simulation.

Study load

Total learning time: 125h	Hours small group:	30h	24.00%
	Guided activities:	15h	12.00%
	Self study:	80h	64.00%

820749 - DSCMEM - Design, Simulation and Control of Electrical Machinery

Content

<p>1. Electrical machines design and simulation</p>	<p>Learning time: 100h Laboratory classes: 20h Guided activities: 60h Self study : 20h</p>
<p>Description:</p> <ul style="list-style-type: none"> 1.1. Introduction to the electrical machines. Electromechanical conversion. 1.2. Magnetic field in uniform air-gap machines. Winding induced voltage and self- and mutual-inductance calculation. 1.3. Electrical equations and electromagnetic torque in uniform air-gap machines. <p>Related activities:</p> <ul style="list-style-type: none"> A1. Squirrel-cage induction motor (or wound-rotor induction motor with short-circuited slip rings) simulation . A2. Squirrel-cage induction generator (or wound-rotor induction generator with short-circuited slip rings) simulation. Doubly-fed induction generator simulation. <p>Specific objectives:</p> <p>The student must be capable of calculate the air-gap magnetic field, the electromagnetic torque (electromechanical conversion) and the voltage-current relationships in order to derive the dynamic and steady-state equations (without variables transformation) of the analyzed electrical machines. The dynamic and steady-state simulation require a brief introduction to their implementation in commercial software like PSpice, Matlab or Simulink.</p>	
<p>2. Electrical machines control</p>	<p>Learning time: 26h Laboratory classes: 10h Guided activities: 6h Self study : 10h</p>
<p>Description:</p> <ul style="list-style-type: none"> 2.1. Variables transformation: Park, Ku and symmetrical components. 2.2. Steady-state and dynamic equations for the electrical machines. 2.3. Stator- or rotor-flux oriented vector control. 2.4. Electrical machines control. <p>Related activities:</p> <ul style="list-style-type: none"> A3. Laboratory measurement of the magnitudes of a frequency converter fed induction motor. <p>Specific objectives:</p> <p>The student gets a global view of the electric machines state equations and the variables transformation required to simulate their dynamic and steady-state behaviors, as well as the most common control algorithms.</p>	

820749 - DSCMEM - Design, Simulation and Control of Electrical Machinery

Planning of activities

<p>A1. Squirrel-cage induction motor (or wound-rotor induction motor with short-circuited slip rings) simulation</p>	<p>Hours: 30h Guided activities: 30h</p>
<p>Description: The aim of this work is the dynamic behavior simulation of the squirrel-cage induction motor in Simulink, as well as the equivalent circuit parameters determination (by means of Matlab) and other steady-state behaviors calculation.</p>	
<p>A2. Squirrel-cage induction generator (or wound-rotor induction generator with short-circuited slip rings) simulation. Doubly-fed induction generator simulation</p>	<p>Hours: 30h Guided activities: 30h</p>
<p>Description: The aim of this work is the dynamic behavior simulation of the squirrel-cage induction generator in Simulink, as well as the equivalent circuit parameters determination (by means of Matlab) and other steady-state behaviors calculation. Optionally, the students may choose the doubly-fed induction generator simulation (instead of the squirrel-cage generator), which should lead to a higher score.</p>	
<p>A3. Laboratory measurement of an induction motor fed by a frequency converter</p>	<p>Hours: 6h Guided activities: 6h</p>
<p>Description: The aim of this work is the laboratory measurement (and subsequent data processing) of the voltage, current, torque and speed of a frequency converter fed induction motor when the speed and torque references are modified and when supply network perturbations are produced.</p>	

Qualification system

Written test (final examination) (PE): 60 %
Oriented individual works (TD): 40 %

Regulations for carrying out activities

The final examination (PE) will have two parts: (1) exercises on the theoretical and practical course content, weighting the 30% of the final course mark, (2) validation of the oriented individual works (TD), weighting the 30% of the final course mark.



820749 - DSCMEM - Design, Simulation and Control of Electrical Machinery

Bibliography

Basic:

Krause, Paul C. Analysis of electric machinery. 3rd ed. New York: Wiley, 2013. ISBN 9781118024294.

Novotny, D. W.; Lipo, T. A. Vector control and dynamics of AC drives. New York: Oxford University Press, 1996. ISBN 0198564392.

Lesenne, J.; Notelet, Francis; Séguier, Guy. Introduction a l'electrotechnique approfondie. Paris: Technique et Documentation, cop. 1981. ISBN 2852060892.