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820128 - ME2EE - Electrical Machines II

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering

Teaching unit: 709 - EE - Department of Electrical Engineering

Academic year: 2018

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
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ECTS credits: 6 Teaching languages: Catalan

Teaching staff

Coordinator: Ramon Bargalló Perpiñà

Others: Ramon Bargalló Perpiñà, Altres.

Prior skills

Differential and Integral calculus
Matrix calculus
Numerical resolution of ODE
Complex number algebra
Electromagnetics
DC and AC circuit analysis
Transient circuit analysis (1st and 2n order)
Scientific calculator use (HP 50G and CFX-9950)
SOme knowledge of MATLAB/OCTAVE

Requirements

Electrical machines 1.

Degree competences to which the subject contributes

Specific:

1. Carry out calculations for the design of electrical machines.

CEELE-20. Understand machine control and electric drives and their applications.

Transversal:

2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

Teaching methodology

Expositive methodology for theory classes.
PBL for exercices classes.
Normalized test on laboratory classes.

Learning objectives of the subject

Electrical machines analysis feeds with industrial grid or ideal electronic converter.
Non conventional machines analysis

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Transient analysis of AC machines
Introduction to design of electrical machines

Study load

Total learning time: 150h	Hours large group:	45h	30.00%
	Hours medium group:	0h	0.00%
	Hours small group:	15h	10.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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Content

Synchronous machines: Generator operation

Learning time: 31h

Theory classes: 10h
Laboratory classes: 2h
Self study : 19h

Description:
Synchronous machine. Construction. Field excitation. Stator Winding. No load operation. Liakage. Influence of power factor on resultant field. Saturation. Equivalent circuit.Synchronous reactance. Short circuit test. Power and torque. Limits. Salient pole machine. Torque and power equation.

Related activities:
Test of generator. No load test. Short circuit test.

Synchronous machine: motor operation

Learning time: 26h

Theory classes: 8h
Laboratory classes: 2h
Self study : 16h

Description:
Synchronous motor. Voltage operation. Limits. Starting. Salient pole motors. Power and torque expressions. Characteristics. Current operation. Characteristics. Synchronous reluctance motor. Self-commutated synchronous machine.

Related activities:
Grid Syncronization of synchronous generator. Working as a motor. COnstant power characteristics.

Non conventional machines

Learning time: 36h

Theory classes: 12h
Laboratory classes: 3h
Self study : 21h

Description:
Electromechanical energy conversion principles.Study of lineal and rotating systems. Multiple excitation systems. Torque. Switched reluctance machines. Step motors. Linear motors. Other.

Related activities:
Step motor test.
Asynchronous linear motor test

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Direct current machines	Learning time: 16h Theory classes: 5h Laboratory classes: 2h Self study : 9h

Description:
Introduction. Constructional features. Armature voltage. Armature reaction. Commutation. MAgnetization curve. Generators. Motors. Excitation methods. Mechanical characteristics. Universal motors.

Related activities:
DC generator test
DC motor test.

Trnasients and Dynamics of electrical machines	Learning time: 17h Theory classes: 5h Laboratory classes: 2h Self study : 10h

Description:
3-2 transformations. Rotating references. FLux, voltage, power and torque expressions. Equivalent circuits for transient analysis. Case study.

Related activities:
Starting of induction machine. Simulation. Experimental test.

Design of electrical machines	Learning time: 24h Theory classes: 5h Laboratory classes: 4h Self study : 15h

Description:
General expressions for torque. Standards. Scale laws. FE applications for analysis and design of electrical machines

Related activities:
FE analysis of electrical machine

Qualification system

Final test: 20%
Laboratory:20%
Homework exercicis+classe exercises: 15%
Middle term exam: 20+20%

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Regulations for carrying out activities

Scientific calculator
1 sheet with expressions. No reexam.

Bibliography

Basic:

Zorbas, Dino. Electric machines : principles, applications and control schematics. 2nd ed. Montreal: McGill University, 2015. ISBN 9781133628514.

Boldea, I.; Tutelea, Lucian. Electric machines : steady state, transients and design with MATLAB. Boca Raton [etc.]: CRC Press / Taylor & Francis Group, cop. 2010. ISBN 9781420055726.

Pyrhönen, Juha; Jokinen, Tapani; Hrabovcová, Valéria. Design of rotating electrical machines. Chichester: John Wiley & Sons, 2008. ISBN 9780470695166.

Fraile Mora, Jesús. Máquinas eléctricas. 7a ed. Madrid [etc.]: Garceta, 2015. ISBN 8416228132.

Complementary:

Gieras, Jacek F.; Wing, Mitchell. Permanent magnet motor technology: design and applications. 2nd ed. New York: Marcel Dekker, cop. 2002. ISBN 0824707397.