

[MGF101] ELECTRICAL MACHINES DESIGN

GENERAL INFORMATION

Studies	UNIVERSITY MASTER IN ENERGY AND POWER ELECTRONICS		Subject	ELECTRICAL MACHINERY DESIGN, MODELLING AND ANALYSIS
Semester	1	Course	1	Mention / Field of specialisation
Character	COMPULSORY		Language	ENGLISH
Plan	2015	Modality	Adapted Face-to-face	Total hours
Credits	6	Hours/week	4.28	77 class hours + 73 non-class hours = 150 total hours

PROFESSORS

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REQUIRED PREVIOUS KNOWLEDGE

Subjects	Knowledge
(No specific previous subjects required)	(No previous knowledge required)

SKILLS

VERIFICA SKILLS

SPECIFIC

MGC06 - Developing machine designs that are adjusted to the specific requirements of each application, with optimal electromagnetic and thermal performance.

MGC07 - Acquiring knowledge of new electric machine design and manufacturing trends in terms of manufacturing processes, high-performance materials, and design tools.

MGC08 - Acquiring knowledge and skills for the use of design tools and the analysis of electric machines.

MGC09 - Acquiring knowledge of electric machine design methods.

CROSS

MGTR10 - To share knowledge, reasoning and conclusions with specialist and non-specialist audiences in clear, unambiguous ways.

MGTR12 - To analyse complex information and situations in the field of study, considering several solutions for each problem and making the right decision in a given context, taking social and ethical implications into account.

MGTR13 - To identify product or business development opportunities, managing the human and material resources adequately.

BASIC

M_CB9 - To share knowledge, conclusions and their rationale with specialised and lay audiences in a clear, unambiguous manner

MGTR11 - To lead work teams effectively and efficiently in order to achieve common goals.

LEARNING RESULTS

RMG127 Analyze and size the different elements optimizing the resources (number of windings, magnetic materials, dimensions...)

LEARNING ACTIVITIES

	CH	NCH	TH
Individual study and work, tests and evaluations and check points		14 h.	14 h.
Presentation of the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects	30 h.		30 h.
Individual and team exercises		20 h.	20 h.

EVALUATION SYSTEM

	W
Individual written and oral tests to assess technical skills of the subject	80%
Reports of solving exercises, case studies, computer practices, simulation practices and laboratory practices	20%

MAKE-UP MECHANISMS

Individual written and oral tests to assess technical skills of the subject

Comments: Although it will be tried to carry out the activities and the evaluation in person, it is possible that due to COVID-19 it will have to be switched to an online or blended model.

CH - Class hours: 30 h.

NCH - Non-class hours: 34 h.

TH - Total hours: 64 h.

RMG128 Optimize electromagnetically the machine design with finite elements, including the simulation in the design loop in coherent way

LEARNING ACTIVITIES		CH	NCH	TH
Individual study and work, tests and evaluations and check points			10 h.	10 h.
Presentation of the teacher in the classroom, in participatory classes, of concepts and procedures associated with the subjects		20 h.		20 h.
Individual and team exercises			18 h.	18 h.

EVALUATION SYSTEM	W	MAKE-UP MECHANISMS
Individual written and oral tests to assess technical skills of the subject	20%	Individual written and oral tests to assess technical skills of the subject
Reports of solving exercises, case studies, computer practices, simulation practices and laboratory practices	80%	

Comments: Although it will be tried to carry out the activities and the evaluation in person, it is possible that due to COVID-19 it will have to be switched to an online or blended model.

CH - Class hours: 20 h.
NCH - Non-class hours: 28 h.
TH - Total hours: 48 h.

RMG129 Apply electrical machine skills in real or simulated environment with POPBL methodology

LEARNING ACTIVITIES		CH	NCH	TH
Development, writing and presentation of memorandums, reports, audiovisual material, etc. Relating to projects/POPBLs carried out individually or in teams		27 h.	11 h.	38 h.

EVALUATION SYSTEM	W	MAKE-UP MECHANISMS
Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence	100%	Technical skills, involvement in the project, finished work, obtained results, handed documentation, presentation and technical defence

Comments: Although it will be tried to carry out the activities and the evaluation in person, it is possible that due to COVID-19 it will have to be switched to an online or blended model.

CH - Class hours: 27 h.
NCH - Non-class hours: 11 h.
TH - Total hours: 38 h.

CONTENTS

0.- FUNDAMENTAL OF ELECTRICAL MACHINES

- 0.1.- Electromagnetism Laws for Magnetic Circuit Resolution
- 0.2.- Electro-Mechanical Energy Conversion Principles
- 0.3.- Brushless AC Motor Fundamentals
- 0.4.- Analysis of Brushless AC Motors

1.- DESIGN OF MAGNETIC CIRCUITS

- 1.1.- Air Gap Magnetic Field
- 1.2.- Air Gap Magnetic Flux
- 1.3.- Design of Rotor and Stator Magnetic Circuits

Coursework 1: Analytical and FEM Computation of Magnetic Field in PMSM

2.- DESIGN OF WINDINGS

- 2.1.- Three Phase Integral Slot Stator Windings
- 2.2.- Computation of the Winding Factor
- 2.3.- Computation of Electrical Parameters. Coil Resistance and Coil Inductances

Coursework 2. Definition of a three phase winding and computation of electrical parameters

3.- MATERIALS FOR ELECTRICAL MACHINE CONSTRUCTION

- 3.1.- Permanent Magnets
- 3.2.- Silicon Steels
- 3.3.- Soft Magnetic Composites
- 3.4.- Materials for electrical Insulation

4.- FEM ANALYSIS OF BRUSHLESS AC MACHINES

- 4.1.- Fundamentals of Finite Element Method
- 4.2.- Open Circuit Analysis and Load Analysis
- 4.2.- Characterization of AC Brushless Machines

Coursework 3. Characterization of AC Brushless machines

5.- THERMAL EVALUATION OF ELECTRICAL MACHINES

LEARNING RESOURCES AND BIBLIOGRAPHY

Learning resources	Bibliography
Class presentations	Transducteurs électromécaniques / Marcel Jufer, Presses polytechniques et universitaires romandes ,1985,ISBN: 2880740495 Design of Brushless Permanent Magnet Motors : Monographs in Electrical and Electronic Engineering J.R. Hendershot, TJE Miller A Oxford University Press 1995 ISBN: 9780198593898 (paper)