GENERAL INFORMATION

Course information	
Name	Fundamentals on electrical engineering and optimization techniques
Code	MEPI-513
Degree	Official Master's Degree in the Electric Power Industry (MEPI)
Year	
Semester	Fall
ECTS credits	3 ECTS
Type	Extra training
Department	Electrical Engineering
Area	
Coordinator	Damián Laloux

Instructor	
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DETAILED INFORMATION

Contextualization of the course
Contribution to the professional profile of the master's degree
The overall objective of the course is to provide students who have no training in electrical engineering or operations research with the basic concepts necessary to successfully address the study of other mandatory courses where these topics are assumed to be known.
Prerequisites
Students willing to take this course should be familiar with basic mathematics, linear algebra and complex numbers. Some background in scientific or technical subjects is also desired although not strictly required.

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Competences and Learning Outcomes

Competences

General Competences

Basic Competences

CB4. Ser capaces de predecir y controlar la evolución de situaciones complejas mediante el desarrollo de nuevas e innovadoras metodologías de trabajo adaptadas al ámbito científico/investigador, tecnológico o profesional concreto, en general multidisciplinar, en el que se desarrolle su actividad.

Specific Competences

CE22. Para aquellos alumnos sin formación previa en ingeniería eléctrica ni en técnicas de optimización, comprender los fundamentos de ambas materias que les capacite para ser capaces de asimilar los contenidos presentados en el resto de asignaturas del Título.

Learning outcomes

By the end of the course students should be able to:

LO1. Understand the fundamental concepts of electricity.

LO2. Know and understand the terms used in this area.

LO3. Predict the value of the most relevant magnitudes in electric circuits, and to control the decision variables in complex optimization problems.

LO4. Solve basic problems of electric circuits (Kirchhoff's laws, Ohm's Law, Thévenin-Norton equivalences, circuit theorems, etc.) both in direct current, and in alternating current (in single phase systems).

LO5. Formulate an optimization problem (using linear and/or mixed-integer linear mathematical programming) from a statement, encoded in a programming language designed to optimize and analyze the results.

TEACHING METHODOLOGY

General methodological aspects
This is an intensive course during only three weeks in order to provide the students with basic concepts and tools they will require in the following courses. To obtain a good understanding of the different concepts, it is necessary to combine theory and practice. As the students will have to assimilate a wide range of knowledge in a short period of time, their commitment will be essential as well.
In-class activities
Lectures and problem-solving sessions (16 hours): The lecturer will introduce the fundamental concepts of each chapter, along with some practical recommendations, and will go through worked examples to support the explanation. Active participation will be encouraged by raising open questions to foster discussion and by proposing short application exercises to be solved in class either on paper or using a software package.
Lab sessions (13 hours): Under the instructor's supervision, students, divided in small groups, will apply the concepts and techniques covered in the lectures to real problems: On the one hand they will connect electrical devices and machines and measure electrical quantities and on the other hand they will become familiar with widespread optimization software tools.
Evaluation for the electrical part will consist in a test **(1 hour)** whereas for the optimization part the exam will be a practical case study implemented during the last lab session.
Out-of-class activities
▪ Personal study of the course material and resolution of the proposed exercises: individual activity by the students, in which they will read, analyze and question the readings provided as background material, and that will be discussed with other students and lecturers in the classroom (30 hours).
▪ Learning activity that will be carried out individually, outside of the classroom, and that will require personal research or analysis of different materials (30 hours).

GRADING AND COURSE RULES

Grading

Regular assessment

- **Electrical engineering** will account for 60%
- **Optimization techniques** will account for the remaining 40%

In order to pass the course, the global mark must be greater or equal to 5 out of 10 points, but the mark of each part must be greater or equal to 3 as well. Otherwise, the final grade will be the lower of the two marks.

Retakes

If one part has a passing grade, its mark will be preserved, and only the failed part will be subject to a retake exam. Otherwise, the student will retake both exams. The resulting grade will be computed following the same rule as before:

- Electrical engineering: 60%
- Optimization techniques: 40%

As in the regular assessment period, in order to pass the course, the global mark must be greater or equal to 5 and the mark of each part must be greater or equal to 3.

Retake exams are reserved to students who have failed the course exclusively.

Course rules

- Class attendance is mandatory according to Article 93 of the General Regulations (*Reglamento General*) of Comillas Pontifical University and Article 6 of the Academic Rules (*Normas Académicas*) of the ICAI School of Engineering. Not complying with this requirement may have the following consequences:
  - Students who fail to attend more than 15% of the lectures may be denied the right to take the final exam during the regular assessment period.
  - Regarding laboratory, absence to more than 15% of the sessions can result in losing the right to take the final exam of the regular assessment period and the retake.
  - Students who commit an irregularity in any graded activity will receive a mark of zero in the activity and disciplinary procedure will follow [cf. Article 168 of the General Regulations (*Reglamento General*) of Comillas Pontifical University].

WORK PLAN AND SCHEDULE[1]

In and out-of-class activities
Electrical engineering lectures
Electrical engineering Lab sessions
Optimization techniques Lectures
Optimization techniques Lab sessions
Review and self-study of the concepts covered in the lectures
Problem-solving
Electrical engineering exam
Optimization techniques practical session and evaluation

STUDENT WORK-TIME SUMMARY			
IN-CLASS HOURS			
Lectures	**Problem-solving**	**Lab sessions**	**Assessment**
13	3	12	2
OUT-OF-CLASS HOURS			
Self-study		**Individual term papers**	
30		30	
		ECTS credits:	**3 (90 hours)**

BIBLIOGRAPHY

Bibliography

- J.W. Nilsson, S.A. Riedel. *Electric Circuits (8th Edition).* Pearson Prentice Hall, 2008. (Or any other book on Electric Circuits).
- J.L. Kirtley Jr. *Introduction to Power Systems.* MIT Course 6061 Class Notes, chapters 1 and 2. MIT OpenCourseWare, 2003
- Nash, S.G., and Sofer, A. *Linear and Nonlinear Programming*. McGraw-Hill 1996

[1] A detailed course schedule can be found in the course moodle portal. Nevertheless, this schedule is tentative and may vary to accommodate the pace of the class.