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220209 - Power Generation, Transmission and Distribution

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 709 - EE - Department of Electrical Engineering
Academic year: 2019
Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2013). (Teaching unit Compulsory)
ECTS credits: 5 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: Santiago Bogarra Rodríguez

Others: Ricard Horta Bernús

Prior skills

It is important that students have achieved the previous competences developed in Advanced Physics and Circuit Theory and Electrotechnics and Electrical Machines related to electromagnetism, electricity, electrical circuit analysis and knowledge and use of electrical machines.

Degree competences to which the subject contributes

Specific:

1. Knowledge and capacity for analysis and systems design for the generation, transmission and distribution of electricity.

Teaching methodology

Teaching methodology is divided into three parts:
- In the theory classes, teachers introduce the theoretical concepts with examples to illustrate their understanding. Teachers guide students in the data analysis and exercise solution by applying techniques and theoretical concepts.
- In the practical classes, students work on the exercises in the laboratory, and teachers guide students in applying theoretical concepts.
- Self-study for doing exercises and activities. Students, independently, need to work on the materials provided by teachers and the outcomes of the sessions of exercises/problems, in order to fix and assimilate the concepts.

Learning objectives of the subject

To know the power system operation: generation, transmission and distribution.
To study the sustainable use of natural resources for power generation.
Students are instructed in the principles of calculating the electrical parameters required in the design of an electrical installation.
To calculate the operating conditions of electrical installations as well as its design and protection, taking into account not only technical criteria based on the boundaries of the different components, but also energy efficiency criteria.
Using commercial catalogs.

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Study load

Total learning time: 125h	Hours large group:	30h	24.00%
	Hours medium group:	0h	0.00%
	Hours small group:	15h	12.00%
	Guided activities:	0h	0.00%
	Self study:	80h	64.00%

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Content

1. Generation of electrical energy

Learning time: 44h

Theory classes: 8h
Laboratory classes: 6h
Self study : 30h

Description:
1.1. Power system.
1.2. Asynchronous generator.
1.3. Synchronous generator.
1.4. Power plants.

Related activities:
1, 2, 3 ,4

Specific objectives:
The developed concepts should enable students to:
- know the power system components.
- know the different possibilities of electrical energy generation from other kinds of energy.
- know the power plant operation (hydro, thermal, solar, wind, ...)
- know the basics of electrical machines used in power generation.
- know and solve exercises for power calculation and energy balance.

2. Transmission of electrical energy

Learning time: 34h

Theory classes: 10h
Laboratory classes: 4h
Self study : 20h

Description:
2.1. Power transformers.
2.2. Power lines.
2.3. Power transmission system analysis in steady state.
2.4. Power transmission system design.

Related activities:
1, 2, 3 ,4

Specific objectives:
Students should be able to:
- know transformer operation for several types of electrical transformers.
- know power lines components.
- know equivalent circuits for power transmission components.
- know power transmission system controls.
- know and solve exercises for power transmission system operation.
- know cable selection for power transmission systems.

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3. Distribution of electrical energy	Learning time: 47h Theory classes: 12h Laboratory classes: 5h Self study : 30h

Description:
3.1. Power distribution system analysis in steady state.
3.2. Fault currents.
3.3. Electrical Protection.
3.4. Grounding system.
3.5. Power distribution system design.

Related activities:
1, 2, 3 ,4

Specific objectives:
Students should be able to:
- know equivalent circuits for power distribution components.
- know and solve exercises for power distribution system operation.
- know overcurrent causes and effects.
- know protection and switchgear in distribution systems.
- know and solve exercises for calculating the overcurrents in distribution systems.
- know and solve exercises for grounding system design.
- know and solve exercises for distribution system design.

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Planning of activities

ACTIVITY 1. THEORY CLASSES

Hours: 91h
Theory classes: 26h
Self study: 65h

Description:
Preparation of theory classes and development of exercises.

Support materials:
Tutorials and slides in ATENEA virtual campus.
Recommended reading in the literature of the subject.

Descriptions of the assignments due and their relation to the assessment:
Practical exercises will be delivered through ATENEA. The evaluation of this activity is included in the exercise grade with a weight of 10% of the total subject grade.

Specific objectives:
To transfer the necessary know-how in applying theoretical concepts developed in theory classes.
To learn the skills needed for a correct interpretation and solution of the exercises.
To prepare for the exams.

ACTIVITY 2. LABORATORI CLASSES

Hours: 30h
Laboratory classes: 15h
Self study: 15h

Description:
Labs are performed in the laboratory of Electrical Machines, in groups, with a duration of two hours. Students should read the laboratory tutorial before the class. In the laboratory each group will perform the measurements requested and interpreting the results. The report will be completed in class.

Support materials:
The laboratory tutorial are available in ATENEA, and the equipment is in the laboratory. The student must pick and return the equipment from the appropriate shelf.

Descriptions of the assignments due and their relation to the assessment:
Reports completed in class and laboratory exam. The grade of the activity is obtained from the reports with a 10% of the final grade and the laboratory exam with a 5% of the final grade.

Specific objectives:
At the end of the class, the student should be able to:
1. know the aim of the laboratory class and the practical application of the theoretical concepts.
2. know the use of metering instruments.
3. know the interpretation of experimental results.
4. encourage teamwork, planning tasks, safety and responsibility at work.

ACTIVITY 3. MIDTERM EXAM

Hours: 2h
Theory classes: 2h

Description:
Individual exam in class, consisting of written exercises relating to modules 1 and 2.

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Support materials:
Statement of the midterm exam, formulae and calculator.

Descriptions of the assignments due and their relation to the assessment:
Solution to the exam.
It represents 30% of the final grade.

Specific objectives:
The exam allows determine that the student has achieved the basic concepts related to modules 1 and 2.

ACTIVITY 4. FINAL EXAM	Hours: 2h Theory classes: 2h

Description:
Individual exam in class, consisting of written exercises relating to modules 1, 2 and 3.

Support materials:
Statement of the final exam, formulae and calculator.

Descriptions of the assignments due and their relation to the assessment:
Solution to the exam.
It represents 45% of the final grade.

Specific objectives:
The exam allows determine that the student has achieved the basic concepts related to modules 1, 2 and 3.

Qualification system

The final grade depends on the following assessment criteria:
- First: Exercises. Weight: 10%
- Second: Laboratory exercises and laboratory examination. Weight: 15%
- Third: Midterm Exam. Weight 30%
- Fourth: Final Exam. Weight: 45%.

The unsatisfactory results of the midterm exam can be make up with written exercises that can be done the day set for the final exam.
The exercises are done by all the enrolled students. The initial grade is replaced by the new grade (between 0 and 10) if it is higher than the previous.

Regulations for carrying out activities

- Exercises are done individually or in groups, in writing.
- Laboratory exercises are done in groups, in writing.
- The laboratory, midterm and final examination are done individually, in writing

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Grainger, John J.; Stevenson, William D. Análisis de sistemas de potencia. México [etc.]: McGraw-Hill, 1996. ISBN 9789701009086.

Guirado Torres, R. [et al.]. Tecnología eléctrica. Madrid: McGraw-Hill, cop. 2006. ISBN 844814807X.

García Trasancos, J. Instalaciones eléctricas en media y baja tensión. 6ª ed. Madrid: Paraninfo, cop. 2011. ISBN 9788428331906.

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Complementary:

Cortés Cherta, M. Curso moderno de máquinas eléctricas rotativas. Barcelona: Editores Técnicos Asociados, 1970-1989. ISBN 9788471460219.

Gómez Expósito, A. Análisis y operación de sistemas de energía eléctrica. Madrid, [etc.]: McGraw Hill Interamericana, 2002. ISBN 9788448135928.

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Others resources:

Audiovisual material

Generació, transport i distribució d'energia. Arxius excel i matlab.