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340030 - SIEL-N9O09 - Electrical Systems

Coordinating unit: 340 - EPSEVG - Vilanova i la Geltrú School of Engineering

Teaching unit: 709 - EE - Department of Electrical Engineering

Academic year: 2017

Degree: BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)

ECTS credits: 6 Teaching languages: Catalan

Teaching staff

Coordinator: JOSE IGNACIO PERAT BENAVIDES
MARCEL TORRENT BURGUÉS
JOSEP FONT MATEU

Font Mateu, Josep

Others: JOSE IGNACIO PERAT BENAVIDES - MARCEL TORRENT BURGUES - RAMON CAUMONS SANGRA - JOSEP FONT i MATEU

Prior skills

It is recommended to have completed the subjects of mathematics and physics.

Degree competences to which the subject contributes

Specific:

1 Industri. CE10. Theoretical knowledge and use of circuits and electrical machines.

1 Disseny. D11. Knowledge of beginning of electric and electronic systems and its application to resolve engineering problems.
2 Disseny. D12. Knowledge of parts and function of basic electric power systems and its application to resolve engineering problems.
3 Disseny. D13. Knowledge of elements, laws and basic methods of electric circuit analysis and its application to resolve engineering problems.
4 Disseny. D14. Knowledge of electric machines constitutions and function and its application to resolve engineering problems.
5 Disseny. D15. Knowledge of constitution of electric installations and LUMINOTECNICAS

Transversal:

T1. EFFECTIVE USE OF INFORMATION RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.
T2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

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Teaching methodology

- In the theory classes, the basic theory of the programmed subjects will be exposed and developed. They will consist of theoretical explanations complemented by activities designed to stimulate participation, discussion and critical analysis by students.
- In the classes of problems will arise and solve exercises corresponding to the subjects treated. Students must solve, individually or in a group, the problems that are indicated.
- Within the laboratory hours students will perform the required practices and deliver the corresponding report of the activity along with the calculations and appropriate criticism.
- A group work will be carried out during the course related to a specific subject.

Learning objectives of the subject

INDUSTRIAL:
- Familiarize the student with the components, devices, machines and systems of Electrical Engineering.
- Present the basic components that are part of the electrical circuits.
- Use the equations that relate voltage and current in the different basic components.
- Solve electrical circuits in direct current.
- Calculate the basic parameters in periodic functions.
- Solve circuits in periodic sinusoidal steady state.
- Solve symmetrical three-phase circuits, in star connection and in triangle connection.
- Correctly use the concept of an equivalent diagram per phase in symmetrical three-phase circuits.
- Identify the different components in an electrical installation.
- Select the basic elements for an electrical installation.
- Know the main industrial applications of the different electrical machines.
- Provide the basic fundamentals and the main technological aspects of electrical machines.
- Identify the construction parts of the different electrical machines.
- Understand the principle of operation of the different electrical machines.
- Familiarize the student in the practice of electrical measurements.

DESIGN:
- To familiarize the student with the components, devices and electrical machines applied to industrial design.
- Present the basic components that are part of the electrical circuits.
- Use the equations that relate voltage and current in the different basic components.
- Solve electrical circuits in direct current and alternating sinusoidal current.
- Solve symmetrical three-phase circuits, in star connection and in triangle connection.
- Select the necessary protections in devices that work with electric power.
- Introduce the basic aspects of electrical and lighting installations.
- Know the main industrial applications of the different electrical machines.
- Provide the basic fundamentals of electric machines.
- Identify the constituent parts of the different electrical machines.
- Understand the principle of operation of the different electrical machines.
- Provide the basic technological aspects and the selection criteria of the applied electrical systems.
- Introduce the practice of electrical measurements.

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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

-1 (Industrial): Electric Power System. -1 (Design): Electricity applied to the product.	Learning time: 4h Theory classes: 2h Self study : 2h

Description:
INDUSTRIAL:
1.1.- Energy and Society.
1.2.- Electric power.
1.3.- The electrical power system.
1.4.- Use of electric power.

DESIGN:
1.1.- Introduction to Electric Power Systems.
1.2.- DC devices.
1.3.- Devices in alternating current.

Related activities:
Theory class 1.

Specific objectives:
- Identify the diffenent parts of the electrical systems in particular and the electrical power system in general.

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-2 (Industrial and Design): Fundamentals of electrical circuits analysis.	Learning time: 30h Theory classes: 6h Practical classes: 4h Laboratory classes: 2h Self study : 18h

Description:
INDUSTRIAL:
2.1.- Basic concepts.
2.2.- Constituent elements of electrical circuits.
2.3.- Kirchhoff.
2.4.- Resistive circuits.
2.5.- Theorems in the resolution of electrical circuits.
2.6.- Forms of periodic waves. Average value and effective value.

Practice 1.- DC circuits.

DESIGN:
2.1.- Basic concepts.
2.2.- Constituent elements of electrical circuits.
2.3.- Kirchhoff.
2.4.-Resistive circuits.
2.5.- Forms of periodic waves. Average value and effective value.

Practice 1.- Electical Measures.

Related activities:
Theory classes 2, 3, 4.
Classes of problems 1, 2.
Laboratory Practice 1.

Specific objectives:
INDUSTRIAL:
- Identify the constituent elements of electrical circuits.
- Apply the relationships between voltage and current in the different elements.
- Calculate the average value and the effective value in the periodic signals.
- Formulate the Kirchhoff laws in electrical circuits.
- Solve electrical circuits in direct current with resistors.
- Apply different theorems and methods of analysis of electrical circuits.

DESIGN:
- Identify the constituent elements of electrical circuits.
- Apply the relationships between voltage and current in the different elements.
- Calculate the average value and the effective value in the periodic signals.
- Formulate the Kirchhoff laws in electrical circuits.
- Solve electrical circuits in direct current with resistors.

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-3 (Industrial and Design): Single-phase and three-phase alternating current circuits.	Learning time: 30h Theory classes: 6h Practical classes: 4h Laboratory classes: 2h Self study : 18h

Description:
INDUSTRIAL AND DESIGN:
3.1.- Sinusoidal waveforms.
3.2.- Representation of sinusoidal magnitudes.
3.3.- Circuits in permanent sinusoidal regime.
3.4.- Power in sinusoidal permanent regime.
3.5.- Symmetrical and balanced three-phase circuits.
3.6.- Power in symmetrical and balanced three-phase circuits.
3.7.- Analysis of symmetrical and balanced three-phase circuits.

Practice 2 (Industrial) .- Electical Measures. Measures in single-phase and three-phase circuits.

Practice 2 (Design) .- Measures in electrical devices. Measures in three-phase circuits.

Practice 2.- Measures in electrical devices. Three-phase circuits with symmetric loads.

Related activities:
Theory classes 5, 6, 7.
Classes of problems 3, 4.
Laboratory Practice 2.

Specific objectives:
- Identify and represent the monophasic and three-phase sinusoidal magnitudes.
- Solve single-phase and three-phase alternating current circuits.
- Apply the Kirchhoff laws in permanent sinusoidal regime.
- Calculate the power in single-phase and three-phase circuits.
- Improve the power factor in single-phase and three-phase systems.
- Identify polyphase circuits.
- Measure voltages, currents and powers in single-phase and three-phase circuits.
- Perform star-triangle transformations.

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-4 (Industrial): Basic concepts of electrical installations. -4 (Design): Electrical protections in devices and electrical installations.	Learning time: 26h Theory classes: 4h Laboratory classes: 2h Guided activities: 6h Self study : 14h

Description:

INDUSTRIAL:
4.1.- General ideas.
4.2.- Basic parts in an electrical installation.
4.3.- Protections: of the elements of the installation and of the people.
4.4.- Calculation of the section of the conductors.

Practice 3.- Electrical Instalacions: Test of magnetothermic and differential switches.

DESIGN:
4.1.- Introduction to electrical installations.
4.2.- Protections for devices.
4.3.- Protections for people.
4.4.- Calculation of the section of the conductors.
4.5.- Introduction to lighting technology.

Practice 3.- Test of protection devices. Lighting technology

Related activities:

Theory classes 8, 9.
Work in a group.
Laboratory Practice 3.

Specific objectives:

INDUSTRIAL:
- Know the basic concept of electrical installation in BT (IEBT).
- Recognize the applicable legal regulations and how to find it.
- Identify the basic elements of an IEBT, know its purpose and choose them in each application.
- Calculate the forecast of loads of an IEBT.
- Know, identify and select the protection elements of an IEBT.
- Perform calculations of conductor sections and basic calculations in electrical installations.

DESIGN:
- Know the basic concept of electrical installation in BT (IEBT).
- Recognize the applicable legal regulations and how to find it.
- Know, identify and select the protection elements.
- Carry out calculations of conductor sections.
- Identify the basic elements in a lighting system.

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-5 (Industrial): Main energy circuits and transformers. -5 (Design): Electrical machines.	Learning time: 29h Theory classes: 6h Practical classes: 3h Laboratory classes: 2h Self study : 18h

Description:

INDUSTRIAL:

5.1.- Main energy circuits.
5.2.- Analysis of magnetic circuits.
5.3.- The ideal and real transformer.
5.4.- The single-phase transformer.
5.5.- The three-phase transformer.
5.6.- Autotransformer. Measuring transformers.

Practice 4.- Electromagnetic induction. Electric machines.

DESIGN:

5.1.- Main energy circuits.
5.2.- Transformers and autotransformers.
5.3.- Rotating electrical machines. Definition, constitution and classification.
5.4.- Losses. Torque. Performance.
5.5.- Rotating magnetic fields.
5.6.- Three-phase asynchronous motor.
5.7.- DC motor.

Practice 4.- The transformer.

Related activities:

Theory classes 10, 11, 12.
Classes of problems 5, 6.
Laboratory Practice 4.

Specific objectives:

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INDUSTRIAL:
- Identify the main energy circuits in an electric machine.
- Solve magnetic circuits.
- Know the different types of permanent magnets.
- Identify the different constituent parts of the transformer.
- List the main applications of the transformers.
- Analyze the ideal and real transformer.
- Different types of losses in the transformer.
- Identify the three-phase transformer.
- Carry out measurements with measurement transformers.

DESIGN:
- Identify the main energy circuits in an electric machine.
- Identify the different constituent parts of the transformer.
- List the main applications of the transformers.
- Identify the ideal and real transformer.
- Different types of losses in electrical machines.
- Identify the autotransformer.
- Know the main industrial applications of the different rotating electrical machines.
- Provide the basic fundamentals of rotating electrical machines.
- Identify the constituent parts of the different rotating electrical machines.
- Understand the principle of operation of the different electrical machines.
- Calculate torque and performance in AC and DC motors.

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-6: Fundamentals of rotating electrical machines. -6 (Design): Applied electrical systems.	Learning time: 31h Theory classes: 6h Practical classes: 3h Laboratory classes: 4h Self study : 18h

Description:
INDUSTRIAL:
6.1.- Rotating electrical machines. Definition, constitution and classification.
6.2.- Losses. Torque. Performance.
6.3.- Rotating magnetic fields.
6.4.- Three-phase asynchronous motor. Constitution and operating principle.
6.5.- Balance of powers and characteristic curves of the three-phase asynchronous motor.
6.6.- Speed ¿¿variation of the three-phase asynchronous motor.
6.7.- DC motor. Constitution and operating principle.
6.8.- Balance of powers and characteristic curves of the DC motor.
6.9.- Speed ¿¿variation of the DC motor.

Practice 5.- Asynchronous three-phase motor.

DESIGN:
6.1.- Criteria for the selection of motors and electrical devices.
6.2.- Calculation of the necessary power in machines.
6.3.- Transformer selection criteria.
6.4.- Batteries.
6.5.- Luminaires.
6.6.- Drivers.

Practice 5.- Rotating magnetic fields. Three-phase asynchronous motor.

Practice 5.- Conversion of energy: generation and utilization of electrical energy.
Practice 6.- Asynchronous machine.

Related activities:
Theory classes 13, 14, 15.
Classes of problems 6, 7.
Laboratory Practice 5.

Specific objectives:

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INDUSTRIAL:
- Identify the different constituent parts of rotating electrical machines.
- List the main applications of the different types of rotating electrical machines.
-Different types of losses in rotating electrical machines.
- Describe how a rotating magnetic field is generated.
- Operation of the induction motor.
- Explain how the speed regulation of the induction motor is carried out.
-Operation of the DC motor.
- Explain how the DC motor speed regulation is carried out.

DESIGN:
- Provide the basic technological aspects of electrical machines and devices.
- Provide the basic selection criteria of the elements that make up the applied electrical systems.

Qualification system

- Exams during the course (65%).
- Realization of problems and work, in groups or individuals (15%).
- Laboratory practices (20%).

Re-evaluation: the re-evaluation of the part corresponding to the exams will be carried out, according to the re-evaluation criteria established in the EPSEVG regulations.

Regulations for carrying out activities

- The written tests are face-to-face and individual.
- In the classes of problems and/or in the laboratory practices, the previous work will be valued, if it is the case, together with the presentation of the results of the activity.

Bibliography

Basic:

Nilsson, James W.; Riedel, Susan A. Circuitos eléctricos. 7a ed. México [etc.]: Pearson Educación, 2005. ISBN 8420544582.

Serway, Raymond A.; Jewett, John W. Electricidad y magnetismo. 6a ed. Publicación México [etc.]: McGraw-Hill, 2005. ISBN 9706865381.

Chapman, Stephen J. Máquinas eléctricas. 5a ed. México DF [etc.]: McGraw-Hill, 2012. ISBN 9786071507242.

Complementary:

Cogdell, J. R. Foundations of electrical engineering. 2nd ed. New Jersey: Prentice Hall, 1996. ISBN 0130927015.

Sanjurjo Navarro, Rafael. Máquinas eléctricas. Madrid: García-Maroto, 2011. ISBN 9788415214144.