Course guide
240761 - 240761 - Electrotechnics

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 709 - DEE - Department of Electrical Engineering.
Degree: BACHELOR’S DEGREE IN INDUSTRIAL TECHNOLOGIES AND ECONOMIC ANALYSIS (Syllabus 2018).
(Compulsory subject).
Academic year: 2022  ECTS Credits: 6.0  Languages: English

LECTURER
Coordinating lecturer: Arnau Dòria Cerezo
Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEGTI 9. (ENG) Coneixement d’electrònica, electricitat, teoria de circuits i màquines elèctriques.

TEACHING METHODOLOGY

The total teaching load of the subject is 59 hours: 49 hours are taught in slate classrooms (30 theory hours and 19 practical hours) and 10 hours dedicated to lab practices. The weekly distribution is:

- Two weekly work sessions in a class (with a duration between one hour and a half and two hours, until the total load of 50 hours), which outlines the basic theory aspects with the support of teaching material and many practical examples.
- Five practical lab sessions of two hours each session (approximately, one session every two weeks).

An additional dedication of one hour and a half for every hour of class is expected from the student, with a slight increase in the last themes.

LEARNING OBJECTIVES OF THE SUBJECT

The overall objective of the subject is providing students with the basic skills which are necessary for the electrical circuit analysis in sinusoidal steady-state.

The specific objectives are:

- knowledge of the models for the active and passive components of the electrical circuits,
- Kirchhoff's laws,
- electrical circuits general solution,
- ability of analysis and solution of electrical circuits in direct current and sinusoidal steady-state, the latter using the phasor domain technique,
- learn the notion of instantaneous, active, reactive and apparent power associated with electrical circuits in sinusoidal steady-state,
- use the Node Analysis (NA) for electrical circuit analysis,
- (grounded and isolated) wye and delta connections,
- power measurement in three phase systems,
- choose the capacitor to improve the installation power factor,
- analyze the distribution system configurations more common (radial and meshed), and
- model transformers as components of the distribution networks, with preferable use of pu values.
STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>50,0</td>
<td>33.33</td>
</tr>
<tr>
<td>Hours small group</td>
<td>10,0</td>
<td>6.67</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

Analysis of electrical circuits

Description:
1.1. Kirchhoff's laws
1.2. Active and passive elements
1.3. Analysis of electrical circuits
1.4. Equivalent circuits: definition, Thévenin and Norton Theorems
1.2 Circuit analysis
   Analysis of circuits containing voltage and current sources

1.3 Circuits in sinusoidal steady-state

1.4 Power in sinusoidal steady-state circuits
   Instantaneous power absorbed and delivered by an active or passive two-terminal element. Active, reactive, and apparent power in AC circuits. Additivity of active, reactive and apparent complex powers. Power factor. Wattmeters. Reactive power consumption. Power factor correction.

1.5 Thévenin and Norton equivalent circuits
   Thévenin and Norton theorems. Short circuit power. Thévenin-load problems.

Full-or-part-time: 8h
Theory classes: 8h
Alternating current circuits

Description:
2.1. AC current justification
2.2. Periodic signals
2.3. Circuits in permanent sinusoidal regime
2.4. Magnetic coupling

1.2 Circuit analysis
Analysis of circuits containing voltage and current sources

1.3 Circuits in sinusoidal steady-state

1.4 Power in sinusoidal steady-state circuits
Instantaneous power absorbed and delivered by an active or passive two-terminal element. Active, reactive, and apparent power in AC circuits. Additivity of active, reactive and apparent complex powers. Power factor. Wattmeters. Reactive power consumption. Power factor correction.

1.5 Thévenin and Norton equivalent circuits
Thévenin and Norton theorems. Short circuit power. Thévenin-load problems.

**Full-or-part-time:** 9h
Practical classes: 9h

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Electric power in alternating current circuits

Description:
3.1. Instant power
3.2. Powers in alternating current circuits
3.3. Power factor improvement

**Full-or-part-time:** 9h
Theory classes: 9h

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Three-phase systems

Description:
4.1. Justification of three-phase systems
4.2. Definitions of symmetrical and balanced voltage / current systems
4.3. Three-phase loads
4.4. Electrical power in three-phase systems: powers per phase, total powers

**Full-or-part-time:** 9h
Theory classes: 9h
**Electrical transformers**

**Description:**
- 5.1. Ideal single phase transformer
- 5.2. Non-ideal single-phase transformer: equivalent circuits
- 5.3. Reduced models: pu model, reduction to primary / secondary
- 5.4. Three-phase transformer
- 5.5. Plate features of a transformer
- 5.6. Cascading and parallel transformers

**Full-or-part-time:** 8h

Theory classes: 8h

**Analysis of distribution lines**

**Description:**
- 6.1. Neutral phase equivalent
- 6.2. Calculation of voltage drops, losses / performance and conductor cross section
- 6.3. Study of networks with P-Q loads

**Full-or-part-time:** 7h

Theory classes: 7h

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**GRADING SYSTEM**

In the case of ordinary assessment, the grade of the subject will be

\[ N_{FINAL} = 0.15*N_{L} + 0.85*N_{E} \]

\[ N_{E} = \text{MAX} (0.35*N_{P} + 0.65*N_{F}, N_{F}) \]

where \( N_{L} \) is the lab grade, \( N_{E} \) is the exam grade, \( N_{P} \) is the midterm grade, and \( N_{F} \) is the final exam grade.

In order to be able to have an evaluation of the subject, it will be a necessary condition to have attended, carried out and delivered the reports of all the laboratory sessions. If this necessary condition is not met, the grade will be NP (Not Presented).

There will be an act of re-evaluation of the subject to which all students who, having enrolled in one or both semesters, have suspended the subject will be able to present themselves. In this case, the grade for the subject will be

\[ N_{FINAL} = 0.15*N_{L} + \text{MAX}(N_{R}, N_{E}) \]

where \( N_{R} \) is the grade for the reassessment exam.

It is not necessary to take the partial and final exams to be entitled to the reassessment exam, it is only necessary to have a grade of laboratory practice (\( N_{L} \)).

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**BIBLIOGRAPHY**

**Basic:**