Course guide
240761 - 240761 - Electrotechnics

Last modified: 15/06/2023

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: 2023 **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 60 hours: 46 hours are taught in slate classrooms, and 14 hours are dedicated to lab practices. The weekly distribution is as follows:

- 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.
- Six practical lab sessions of two hours each session (approximately, one session every two weeks), and a laboratory exam.

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,
- Kirchoff'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

Type	Hours	Percentage
Hours small group	10,0	6.67
Hours large group	50,0	33.33
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

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
Introduction of the phasors. Voltage-current relationships in passive and active two-terminal elements. Series-parallel association of impedances. Ammeters and voltmeters. Passive four-terminal elements (magnetic coupling): overview and characterization 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
Practical classes: 8h

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
Introduction of the phasors. Voltage-current relationships in passive and active two-terminal elements. Series-parallel association of impedances. Ammeters and voltmeters. Passive four-terminal elements (magnetic coupling): overview and characterization 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

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: 8h
Theory classes: 8h

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: 8h
Theory classes: 8h

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: 6h
Theory classes: 6h

GRADING SYSTEM

In the case of ordinary assessment, the grade of the subject will be
N_FINAL=0,1*N_Lab+0,1*N_ExLab+0,8*N_E
N_E = MAX (0.35*N_P + 0.65*N_F, N_F)
where N_Lab is the lab grade, N_ExLab is the grade of the laboratory exam, N_E is the exam grade, N_P is the midterm grade, and N_F is the final exam grade.

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 = 01*N_Lab+0.1*N_ExLab + 0.8*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).

BIBLIOGRAPHY

Basic:

- Hayt, W.H. ; J.E. Kemmerly ; S.M. Durbin. Engineering Circuit Analysis. 8th ed. New York: McGraw-Hill, 2012. ISBN 9780071317061.
- Irwin, J.D.. Basic engineering circuit analysis. 12th ed. Singapore: Wiley, 2022. ISBN 9781119667964.