



Course guide

230905 - AC - Circuit Analysis

Last modified: 25/06/2024

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.

Degree: BACHELOR'S DEGREE IN ELECTRONIC ENGINEERING AND TELECOMMUNICATION (Syllabus 2018).
(Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: MANUEL MARIA DOMINGUEZ PUMAR

Others: Segon quadrimestre:
ALEXANDRA BERMEJO BROTO - 10
MANUEL MARIA DOMINGUEZ PUMAR - 10

PRIOR SKILLS

- Complex variable. (complex numbers: real part and imaginary part, module and phase, basic operations)
- ODEs
- Laplace transform

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CE1. (ENG) GREELEC: Capacitat per a la resolució dels problemes matemàtics que puguin plantejar-se a l'enginyeria. Aptitud per aplicar els coneixements sobre àlgebra lineal, geometria, geometria diferencial, càlcul diferencial i integral, equacions diferencial i en derivades parcials, mètodes numèrics, algorítmica numèrica, estadística i optimització. (Mòdul de formació bàsica).

Generical:

CG3. (ENG) GREELEC: Coneixement de matèries bàsiques i tecnològies que el capacitin per a l'aprenentatge de nous mètodes i tecnologies, així com que el dotin d'una gran versatilitat per adaptar-se a noves situacions.

Transversal:

CT6. (ENG) GREELEC: APRENENTATGE AUTÒNOM: Detectar deficiències en el propi coneixement i superarles mitjançant la reflexió crítica i l'elecció de la millor actuació per ampliar coneixements.

Basic:

CB5. (ENG) GREELEC: Que els estudiants pugin desenvolupar habilitats d'aprenentatge per emprendre estudis superiors amb un alt grau d'autonomia.

TEACHING METHODOLOGY

Master lesson
Participative expository class
Autonomous work

LEARNING OBJECTIVES OF THE SUBJECT

In the Circuit Analysis course, we will re-learn the knowledge of the Basic Foundations of electronics, and we will add the variations of the signals over time. We will analyze the circuits with condensers and coils in the temporal domain and we will also learn to do so in what we call a transformed domain of Laplace that will allow us to find the dynamics of the circuits, just solving simple algebraic equations. We will see how circuit responses vary according to the initial conditions and what it means forced response from a system. In fact, since we are interested in knowing how the circuits modify the signals according to the frequencies that make up them, we will learn to perform and interpret Bode diagrams. All of this knowledge will help us to understand how circuits work for different signals of audio, video, radio frequency communications, etc ...

STUDY LOAD

Type	Hours	Percentage
Hours large group	65,0	43.33
Self study	85,0	56.67

Total learning time: 150 h

CONTENTS

1. Electronic components Models

Description:

- 1.1. From characteristics to the model.
 - 1.1.1. Equivalent linear model. Model validity: approximations and margins.
 - 1.1.1.1. Quiescent point concept
 - 1.1.2. Incremental circuit, small signal.
- 1.2. Equivalent models.
 - 1.2.1. Diode models
 - 1.2.2. BJT transistor models
 - 1.2.3. MOS transistor models
- 1.3. Amp equivalent model: Gain and equivalent input and output resistors.
 - 1.3.1. Examples of amplifiers with transistors. Different configurations.

Full-or-part-time: 37h

Theory classes: 19h

Self study : 18h

2. Elemental analysis of circuits in the temporal domain

Description:

- 2.1. Analysis of first order circuits with capacitors or coils. (Loading and unloading)
- 2.2. Analysis of circuits with capacitors or coils and nonlinear elements (loads and discharges through diodes)

Full-or-part-time: 24h

Theory classes: 12h

Self study : 12h

3. Laplace Transformed Circuit

Description:

- 3.3.1. Transformation of variables, elements and laws of interconnection.
- 3.3.2. Treatment of the initial conditions.
- 3.3.3. Impedance and admittance concepts.

Full-or-part-time: 18h

Theory classes: 6h

Self study : 12h

Midterm Exam

Description:

Midterm Exam and class

Full-or-part-time: 13h

Theory classes: 3h

Self study : 10h

4. Study of the Dynamics of Linear Circuits.

Description:

- 4.1. Temporary response of linear circuits.
 - 4.1.1. Components of the response. Response to null entry and response to null initial conditions. Free response and forced response.
- 4.2. Concept of network function.
 - 4.2.1. Definition and type. Properties.
 - 4.2.2. Forms of the free answer associated with the poles.
- 4.3. Initial and impulsional responses. Convolution.
- 4.4. Stability

Full-or-part-time: 29h

Theory classes: 11h

Self study : 18h

5. Frequency response of linear circuits.

Description:

- 5.1. The circuit as a signal processor in the frequency field.
 - 5.1.1. Networks in permanent sinusoidal regime (RPS). Amplification and drift.
 - 5.1.2. Representation of the signals in the frequency domain.
 - 5.1.3. Fourier Series and Fourier Transform. Discontinuous and continuous spectra.
 - 5.1.4. Filter concept.
- 5.2. Fasorial Transformed Circuit.
- 5.3. Graphic representation of the frequency response. Amplification and phase curves. Obtained from the diagram of poles and zeros.
- 5.4. Diagrams of Bode. Asymptotes and corrections.
- 5.5. Design of filters with Operational Amplifiers.

Full-or-part-time: 29h

Theory classes: 14h

Self study : 15h

GRADING SYSTEM

The qualification will consist of a final exam (EF) and a mid-term mid-term exam (EP). The final grade will be defined by $\max \{EF, 0.7 * EF + 0.3 * EP\}$

BIBLIOGRAPHY

Basic:

- Thomas, R.E.; Rosa, A.J.; Toussaint, G.J. The analysis and design of linear circuits. 7th ed. Hoboken, NJ: John Wiley & Sons, 2012. ISBN 9781118065587.