Program	59EC – Communications Electronic Engineering B. Eng. 59SC – Telecommunications Systems Engineering B. Eng. 59SO – Sound and Image Engineering B.Eng. 59TL – Telematics Engineering B. Eng.

Course code and name	
Code	595000008, 595000307, 595000107, 595000207
Name	Circuit Analysis II
Semester	S2 [(February-June)]

Credits and contact hours	
ECTS Credits	6
Contact hours	60

Coordinator's name	García Lampérez, Alejandro [alejandro.garcia.lamperez@upm.es]

Specific course information	
Tuition language	Spanish

Description of course content

This course is a continuation of 'Circuit Analysis I' where the students have worked in detail the steady and alternating states. Now they will study in-depth the transient state, that is, what happens in the inductors and capacitors when the source is turned on or a change is applied to the circuit. In addition, they will learn to analyze circuits where the inductors are so close that magnetic coupling will occur. They will also analyze the behavior of the circuits when the frequency varies. Finally the students will learn to work with the circuit as a two-port or quadrupole network.

List of topics to be covered

1. Magnetic coupling and transformers.
    - 1.1. Coupled inductors
    - 1.2. Ideal and linear transformer
    - 1.3. Ideal autotransformer
2. Transient state
    - 2.1. Time-domain analysis of first and second order circuits
    - 2.2. Free and forced regimes
    - 2.3. Typical excitation functions
    - 2.4. Laplace transform: definition and properties
    - 2.5. Application of the Laplace transform to solving circuits
3. Frequency response
    - 3.1. Introduction to filtering
        - 3.1.1. Frequency response

3.1.2. Filter types
3.1.3. Characterization of the frequency response of first and second order filters: maximum value and cutoff frequency
3.2. Introduction to resonance
3.2.1. Quality factor
3.2.2. Series resonant circuit
3.2.3. Parallel resonant circuit
4. Two port networks
4.1. Parameter families
4.2. Quadrupole association

Lab sessions:
1. Introduction to circuit simulation
2. Thevenin, Norton and superposition theorems
3. Maximum power transfer and impedance matching theorem
4. Magnetic coupling
5. Observation of the transient regime
6. Frequency response
7. Case study I
8. Case study II

Prerequisites or co-requisites

- Workshops on Introductory Engineering
- Circuit Analysis I
- Calculus I
- Linear Algebra

Course category in the program

☑ **R (required)**	☐ **E (elective)** *(elective courses may not be offered every year)*

Specific goals for the course

Specific outcomes of instruction

- RA37 – To know the interconnection ways for the most common quadrupoles and the parameter family more appropriate for the association.
- RA1027 – To observe the transient behavior of some circuits through the circuit simulation.
- RA38 – To define the complete response from a circuit excited by several functions.
- RA42 – To know the resonance as a physical phenome and its implication in the reception process.
- RA43 – To establish the main parameters linked to the resonant circuits, as the resonance frequency, quality factor and bandwidth.
- RA41 – To study the behavior of circuits in frequency domain.
- RA40 – To know the application of the Laplace transform to the circuits solution.
- RA36 – To typify the out terminal quadrupole through the different parameters families.
- RA1025 – To analyze circuits with magnetic coupling, transformers and autotransformers.

- RA1026 – To know the basic characteristics of circuit simulation.
- RA1125 – To solve the differential equations in first and second order circuits, linked the mathematical terms in the solution with their physical interpretation.
- RA1127 – To know the assembly or the simulation of the four basic types of filters: low-pass, high-pass, band pass and band-stop.
- RA1126 – To experiment some phenomes such as the load and unload of a capacitor, or the main theorems of the circuit theory.

Further reading and supplementary materials
– Fundamentos de circuitos eléctricos. C. K. Alexander, M. N. O. Sadiku. 5th ed. McGraw Hill Educación, 2013. – Circuitos eléctricos. J.W. Nilsson, S.A. Riedel. 7th ed. Pearson Prentice Hall, 2005. – Análisis de circuitos en ingeniería. W. H. Hayt, Jr; J. E. Kemmerly, S. M. Durbin. 7th ed. McGraw Hill Interamericana, 2007. – Moodle. – PC, oscilloscope, function generator, power supply, circuit board.