2010-11 academic year

Means of Transmission and Electronic Circuits (21302)

Degree/study: Technical Telecommunications Engineering (specialization of Telematics)
Year: 1st year of the degree
Term: 3rd term
Number of ECTS credits: 4 credits
Hours of studi dedication: 100 hours
Teaching language or languages: Catalan / Spanish / English
Teaching Staff: Rafael Pous Andrés, Antonio Ivorra Cano, Ausias Vives Prat

1. Presentation of the subject

Means of Transmission and Electronic Circuits is an introductory, theoretical and practical subject in which the fundamentals of electronic circuits are studied. The studied units are the following: resistive elements and networks, dependent and independent sources, switches and MOS transistors, abstraction, digital amplifiers, energy storage elements, dynamic networks of first and second order, circuit design in the time domain and, optionally, analog and digital circuits and their applications.

This subject also emphasizes that the resolution of basic circuits is fundamental to understanding more complex circuits. For this reason, it is very important that the study of the subject is done gradually and in sync with units developed in the lectures, seminars and laboratories.

2. Competences to be attained

On the one hand, to follow correctly the subject is required to have a solid foundation in mathematics and physics (the same level as the second year in the upper secondary education). On the other hand, it is considered that the student has completed the subject Waves and Electromagnetism (21 296) satisfactorily. In the bibliography section, recommended sources can be found to reinforce some basic knowledge of both mathematics and physics.

The needed previous knowledge and competences are the next:
- Operations with complex numbers: multiplication, division and powers of complex numbers
- Algebra of vectors and matrices
- Calculation of derivatives and integrals.
- Solving equations and systems of linear equations
- Analysis of basic circuits: Ohm's law, calculation of inductive and capacitive reactance and power among other thing.
- Basic concepts of electromagnetism. Electric field and magnetic field
- Know the international system of units (m, kg, s, N, J, W, A, C, V, T) and scientific notation of units (p, n, μ, k, F, G).

3. Competences to be obtained in the subject

Transferable skills	Specific competences
Instrumental 1. Analysis 2. Solving problems	1. Using basic models of the circuits of lumped constants for resistances, sources, inductances, capacitances and transistors. 2. Analyze circuits containing linear lumped elements.

3. Creativity *Interpersonal* 4. Work in team 5. Written communication *Systemic* 6. Capacity of estimate and planning of work 7. Transference of theoretical knowledge in practical ones 8. Responsibility for the quality in tasks carrying out *Others* 9. Motivation for the success and the personal satisfaction	Specifically, the analysis of circuits containing resistors and independent sources using techniques such as method of knots, overlay and Thévenin. 3. Using Boolean algebra to describe the function of logic circuits. 4. Design circuits that represent digital logic expressions. Specifically, design digital circuits at gate-level of abstraction to implement a Boolean function. 5. Check the static specifications of circuits. For example, determine whether the circuit, that represents a logic gate, provides adequate noise margins. 6. Determine the output produced by a circuit for a given set of inputs using the resistive model of a MOSFET. 7. Undertake small signal analysis of an amplifier using a small signal models for all elements of the circuit. 8. Describe analytically the temporal behaviour of first and second order circuits that contain resistors, inductors and capabilities. 9. Building resistive circuits, simple doors and amplifiers in the laboratory. 10. Determine the temporal behaviour of circuits with resistors, inductors and capacities in the laboratory. 11. Using models of operational amplifier in circuits with negative feedback. 12. Design, build and test an audio playback system which includes analog and digital components.

4. Learning aims

In addition to specific skills derived from content, the subject of Means of Transmission and Electronic Circuits is designed to give students some skills that will be very useful throughout the degree. So, in this subject the aims are:

- Understand the basic principles of electrical engineering as well as the abstractions used in the design of electronic systems. These abstractions include lumped circuit models, digital circuits and operational amplifiers.
- Use engineering abstractions to analyze and design basic electronic circuits.
- Formulate and solve differential equations describing the temporal behaviour of circuits that contain energy storage elements.
- Use intuition to describe the temporal behaviour of circuits that contain energy storage elements.
- Understand the concept of using a simple model to represent nonlinear and active elements found in circuits such as MOSFET transistors.
- Build circuits and draw measures of the variables of the circuit using tools such as oscilloscopes, signal generators and multimeters. Compare and analyze the experimental measurements with the behaviour predicted by mathematical models.
- Understand the relationship between the mathematical representation of the behaviour of a circuit and the corresponding real effects.
- Value the practical meaning of electronic systems developed along the subject.

5. Evaluation

General evaluation criteria

There are two possible tracks for the evaluation of the subject, depending on if the student choose continuing assessment or not from the beginning. However, during the subject, the student can also change the type of evaluation.

- Track A (continuing assessment):
  o Laboratory (20%): 9 deliveries will be done (3 for each practical activity: pre-lab, in-lab and post-lab) and 1 per group. In the practical activity number 0, the in-lab session is only needed. Following track A, the minimum mark to pass laboratory section is 4.
  o Problems (20%): 8 deliveries will be done individually. In each delivery, there will be two deliverable problems and one of them will be corrected and marked. Following track A, the minimum mark to pass problems section is 4.
  o Partial examination (30%): Partial examination (19th May). Following track A, the minimum mark to pass the partial examination is 4.
  o Final Exam (30%): Final exam (June). Following track A, the minimum mark to pass the final exam is 4.

The weekly teaching material will be publishing every week in the subject's Aula Global (virtual classroom).

- Track B (no continuing assessment):
  o Laboratory (20%): 9 deliveries will be done (3 for each practical activity: pre-lab, in-lab and post-lab) and 1 per group. Following track B, minimum mark to pass laboratory section is 6.
  o Final Exam (80%): Final exam (June). Following track B, the minimum mark to pass the final exam is 6.

	Track			
	A		B	
	%	Min.	%	Min.
Laboratory	20%	4	20%	6
Problems	20%	4		
Partial examination	30%	4		
Final Exam	30%	4	80%	6

6. Contents

Units

The subject of Means of Transmission and Electronic Circuits considers a range of content that will be worked to achieve the competencies outlined in the previous section. The subject consists of 10 units:

Unit 1. Networks and resistive elements
- Introduction and abstraction of lumped constants
- Method of analysis of circuits
    - Kirchhoff's Laws
    - Overlay
    - Laws of Thévenin and Norton

Unit 2. Digital abstraction and dependent and independent sources
- The digital abstraction
- logic gates
- Incremental analysis
- Dependent sources and amplifiers

Unit 3. Switches, amplifiers and MOS transistors MOS
- Analysis of large signal amplifiers
- Analysis of small signal

Unit 4. Elements of energy storage and dynamics of 1st and 2nd order networks
- 1st order systems and capabilities.
- State and memory
- 2nd order systems

Unit 5. Circuit design in the time domain
- Steady Sinusoidal State

- The impedance model

Unit 6. Analog circuits
- Abstraction of the operational amplifier
- basic circuits with operational amplifiers
- Applications with circuits (optional)

7. Methodology

Methodological focus of the subject
Means of Transmission and Electronic Circuits has 5 credits (or 4 ECTS credits) that are 100 hours of work, 36 of them are face-to-face hours. These 36 hours are divided into: lectures (18 hours), seminars (10 hours) and practical activities in the laboratory (8 hours).

Lectures
- In lectures, the fundamental concepts of the subject will be introduced.
- Lectures will be done in a big group (all groups 1, 2, 3 and4).
- The class attendance is not compulsory.
- Teaching material will be published weekly on the site of the subject in Aula Global (virtual classroom).

Seminars
- The seminars are intended for discussion of problems previously worked by students. The lecturer will act as moderator and resolve the doubts that have arisen.
- The seminar sessions will be separated for groups (1, 2, 3 and 4).
- The class attendance is not compulsory.
- The teaching material is published weekly on the site of the subject in Aula Global (virtual classroom).
- Each week students must deliver two problems to the lecturer (they are announced in Aula Global in previous week). The lecturer will correct randomly and will count only one of two problems.
- The delivery of problems will count as a partial mark of the whole subject (problems mark).

Laboratory
- The practical activities in laboratories are designed to perform practical activities using electronic measuring equipment.
- The laboratory classes will be given separately for groups (1, 2 and 3).
- The class attendance is not compulsory.
- The teaching material is published weekly on the site of the subject in Aula Global (virtual classroom).
- Before each laboratory session, the student will deliver the lecturer preliminary exercises (pre -lab). During the laboratory class, students will follow the questionnaire of the practical activity (in-lab). After each laboratory session, students will do activities to reinforce concepts (post-lab). In-lab and post-lab will be delivered to the lecturer the week after making the practical activity.

Tutorials
- There are available timetables to solve questions or individual interviews of effort

8. Bibliography and didactic resources

8.1. Basic bibliography

- Anant Agarwal and Jeffrey Lang, course materials for 6.002 Circuits and Electron
- Agarwal, Anant, and Jeffrey H. Lang. Foundations of Analog and Digital Electronic

8.2. Reinforcement bibliography

- Tipler, P. A., Física, vol. I i II, Editorial Reverté.
- Giró, A., Canales, M., Rey, R., Sesé, G:, Tullàs, J., Física per a estudiants d':

8.3. Didactic resources. Teaching material of the subject

- Notes (slides), problems and practical activities instructions in the virtual cl