VNIVERSITAT DE VALÈNCIA

Course Guide
34815 High frequency circuits and subsystems

COURSE DATA

Data Subject	
Code	34815
Name	High frequency circuits and subsystems
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1402 - Degree in Telecommunications Electronic Engineering	School of Engineering	4	First term

Subject-matter

Degree	Subject-matter	Character
1402 - Degree in Telecommunications Electronic Engineering	16 - Electronics	Obligatory

Coordination

Name	Department
GONZALEZ MILLAN, VICENTE	242 - Electronic Engineering

SUMMARY

The subject of High Frequency Circutis and Subsystems is studied as the last part of the field of the Degree of Telecommunication Electronics Engineering. It provides the skills needed to understand the functioning of the main communication subsystems present in current equipment. It also introduces the circuits included within those subsystems without going into the details of the design procedure thereof.

The subsystems studied in the course are: RF signal amplifiers, RF oscillators and mixers, PLLs and synthesizers and modulators and demodulators. For each of them, their features and operating principles, important parameters and, where appropriate, examples of circuits are presented. In cases where the complexity of the system is not appropriate for the students, a “black box” model is presented.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

Knowledge of the fundamentals of communications and signal transmission in both guided and unguided media.

OUTCOMES

1402 - Degree in Telecommunications Electronic Engineering

- G3 - Acquisition of the knowledge of the basic and technological subjects that allows students to learn new methods and theories and endows them with the versatility to adapt to new situations.
- G4 - Ability to solve problems with initiative, decision-making and creativity, and to communicate and transmit knowledge, abilities and skills, understanding the ethical and professional responsibility of the activity of a telecommunications technical engineer.
- G5 - Knowledge to carry out measurements, calculations, assessments, evaluations, loss adjustments, studies, reports, task planning, and other analogous work in the specific field of telecommunications.
- G9 - Ability to work in a multidisciplinary environment and in a multilingual group and to communicate, in writing and orally, knowledge, procedures, results and ideas related to telecommunications and electronics.
- G6 - Ability in the handling of specifications, regulations and norms of compulsory compliance.
- TE5 - Ability to design circuits for analog and digital electronics, analog-digital and digital-analog conversion, radio frequency, power and power conversion for telecommunications and computing applications.

LEARNING OUTCOMES

After completing the course, the student should be able to:

LR1: Analyze in detail the behavior of an analog circuit (G3, G4, G5).

LR2: Know the different types of existing devices to address an analogical electronic design (G3, TE5).

LR3: Know how to choose the most appropriate type of circuit according to the needs of a design (G3, TE5).

LR4: Design an electronic system that meets a set of specifications (G5, G6, G9, TE5).

Skills to acquire:

S1: Recognize the building blocks of a communications system

S2: Recognize the integral blocks of an oscillator system and know how to calculate its phase noise.

S3: Recognize the integral blocks of an amplifier and know how to determine the influence on its behavior of the parameters that define them

S4: Know how to calculate the intermodulation products of a mixer.

S5: Know how to design blocks that make up a PLL and a frequency synthesizer.

S6: Know how to select the basic blocks of a transmitter or radiofrequency receiver system to meet specified specifications.

S7: Know how to calculate the global operating parameters of an RF receiver system and know how to obtain those strangers that are needed to meet specifications.

DESCRIPTION OF CONTENTS

1. Introduction to radiofrequency systems

Carrier modulation
Block diagrama of a radiofrequency system
Design parameters
Analogue and digital systems

2. Noise and distortion in RF

Distortion features
Linear distortion
Non-linear distortion
Non-linear distortion in modulated signals
Noise in oscillators

3. Phase-Lock loops and frequency synthesis

Introduction
Study of an ideal PLL
Specifications
Effect of the filter
Phase detectors
Basic synthetizer
Synthetizer configurations

Phase noise in synthetizers
Filtering the reference frequency

4. Mixers

Basic mixer
Specifications of a mixer
Devices used for mixers
Mixer circuits.

5. RF amplifiers

Parameters of a RF amplifier
Tuned amplifiers
Multi-stage tuned amplifiers
Wideband amplifiers
Power amplifiers
Non-linear amplifiers

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	20,00	100
Classroom practices	10,00	100
Study and independent work	24,00	0
Preparation of evaluation activities	32,00	0
Preparing lectures	12,00	0
Preparation of practical classes and problem	22,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The methodology is divided into three types of activities. In all cases, the students will have access to teaching materials in advance related to the contents of the course through Virtual Classroom (e-learning platform of the University of Valencia), to facilitate the preparation of classes.

• **Theory classes**. The lectures will develop the issues by providing a global and inclusive vision, analyzing in detail the key and more complex issues. To encourage student participation, lectures will alternate with examples which resolution will be made jointly by the teacher and students. The teacher can also evaluate the student's prior preparation through questions at the beginning of the classroom based on the homework carried out through Aula Virtual by means of documents, video or audios related to the subject (G3, G5, TE5).

• **Classes of problems**. In the practical classes will be held discussion sessions and resolution of the most significant problems in each section of the course. Sets of problems will be proposed to be developed in groups, and later exposed by the students (G4, TE5).

• **Laboratory classes**. In each laboratory class will be assessed both prior preparation of the practice to be performed by verifying the design and simulation of circuits, as the final results (G6, G9, TE5).

EVALUATION

The evaluation of the course will take place in two ways: first, continuous assessment of student work, both at the classroom and at the laboratory, and, second, by the score on a final exam.

FIRST CALL FOR EXAMINATION

Theory and problems (70% of grade). (G3, G4, TE5).

The continuous evaluation of the theory and problems ($SCORE_{CONT}$), with 60% of the grade corresponding to the scores obtained at one or several of the following items with the weights assigned by the teacher:

- Tests performed at the end of each item or group of items
- Delivery of exercises performed individually or in groups
- Assignments about issues dealing with the subject proposed by the teacher

The remaining 40% will come from the final exam ($SCORE_{EX}$) of the subject. A minimum score of 4/10 will be needed to pass the subject.

Laboratory ($SCORE_{LAB}$, 30% of grade). Recoverable activity. (G5, G6, G9, TE5).

The evaluation of the laboratory shall be by compulsory attendance control all practices and the delivery of a report / questionnaire practice by groups or individually. For reasons of force majeure, duly justified, a maximum of 20% of the sessions may be discontinued. In order to pass the subject the qualification obtained in this part must be equal to or higher than 4.

SECOND CALL FOR EXAMINATION

Theory and problems (70% of grade). (G3, G4, TE5).

The evaluation of the theory and problems of the subject shall be by an examination ($SCORE_{EX}$) of the contents of the subject and those of all the continuous assessment activities carried out during the course. In order to pass the subject the qualification obtained in the examination must be equal to or higher than 4.

Laboratory ($SCORE_{LAB}$, 30% of grade). G5, G6, G9, TE5).

The evaluation of the laboratory in second call shall be by an examination ($SCORE_{LAB}$) of the contents of the subject carried out at the lab. In order to pass the subject the qualification obtained in the examination must be equal to or higher than 4.

FINAL SCORE

First Call

If $SCORE_{LAB}>=4$,

Si $SCORE_{EX}<4$, $SCORE_{FINAL}= SCORE_{EX}$

Si $SCORE_{EX}>=4$,

$SCORE_{FINAL}= 0.3 * SCORE_{LAB}+0.7 * (0.6 * SCORE_{CONT}+0.4 * SCORE_{EX})$

If $SCORE_{LAB}<4$,

$SCORE_{FINAL} = SCORE_{LAB}$

Second call

If $SCORE_{LAB}>=4$,

Si $SCORE_{EX}<4$, $SCORE_{FINAL}= SCORE_{EX}$

Si $SCORE_{EX} >=4$,

$SCORE_{FINAL}= 0.3 * SCORE_{LAB}+0.7 * SCORE_{EX}$

If $SCORE_{LAB}<4$,

$SCORE_{FINAL}= SCORE_{LAB}$

In any case, the evaluation system will be governed by what is established in the “Reglament d’Avaluació i Qualificació de la Universitat de València per a Graus i Màsters (https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?accion=inicio&idEdictoSeleccionado=5639)”.

REFERENCES

Basic

- b1: Electrónica de comunicaciones. M. Sierra. Pearson Education, 2003
- b2: Modern communication circuits. J. Smith. McGraw-Hill, 1989

Additional

- c1: Sistemas electrónicos de comunicaciones I y II. A. Arnau. UPV, 200
- c2: Radio systems engineering: a tutorial approach, H.J. De los Santos. Springer 2014