NAME:

HIGH FREQUENCY AND OPTOELECTRONIC DEVICES

LECTURER COORDINATOR: **Juan M. López González**

LECTURERS TEAM: **Juan M. López González y Pablo Ortega**

LANGUAGE OF INSTRUCTION: **English/Catalan/Spanish**

CONTACT HOURS: **3 hours (2 h concepts + 1 h application)**

LAB HOURS: **1 hour**

WEB

In preparation

KNOWLEDGE PREREQUISITES

Electronic and Photonic Devices I and Electronic and Photonic Devices II (DEF1 and DEF2)

AIM

The main objectives are:

1) Electronic semiconductor devices for radio frequency and microwaves

2) Optoelectronic semiconductor devices

BASIC CONTENTS

Transmission lines. Microwaves. RLC Circuits. Lineal two-ports. Gain of an amplifier. Matching. Stability. Noise. Linearity. Stability. Low Noise Amplifiers (LNA). Power Amplifiers (PA). Passive structures. Diodes. Field Effect Transistors. Bipolar Transistors. Characterization of RF and Microwave devices. MMICs. Emitters and detectors of light semiconductor devices: photodiodes, phototransistors, solar cells, LEDs and lasers

ASSESSMENT METHOD

Proves or controls (40 %)

Exercices or directed works (35 %)

Simulation and Characterization Laboratory (25 %)

SYLLABUS (Recordeu que en els punts principals s'ha de posar la durada en hores)

4 hours x 15 weeks = 60 hours

• 28 hours concepts

• 14 hours application

• 14 hours laboratory

• 4 hours tests

THEORY

NOTE: for each topic there are 1 hour of concepts and 0.5 hours of application

1. **Transmission lines and Microwaves**
2. **RLC Circuits**
3. **Lineal two-ports**
4. **Power gain**
5. **Materials and components for hybrid circuits of High Frequency, HF, - RF and Microwaves -**
6. **Materials and components for MMIC circuits**
7. **Models for passive structures**
8. **Models for HF diodes**
9. **Compact models for HF effect field devices of HF: BSIM**
10. **Compact models for HF bipolar devices of HF: SGP, VBIC, HICUM**

11. **Matching and stability of the HF amplifiers**
12. **Noise**
13. **Noise in HF transistors and amplifiers**
14. **Distortion and linearity**
15. **Power Amplifiers**
16. **Power Transistors**
17. **Measurements**
18. **Parameters extraction with IC-CAP**
19. **Low Noise Amplifier design**
20. **Power amplifier design**
21. **Introduction to Optoelectronics**
22. **Basics of the light detection devices**
23. **Photodiodes, phototransistors and detection noise**
24. **Solar cells and photovoltaic modules**
25. **The diode LED**
26. **The diode laser**
27. **Optical coupler and other optoelectronic devices**

LABORATORY

The simulation and laboratory activities will be developed of agreement with the available of the resources for their realization.

The following tools were used for the simulation and characterization of devices and electric circuits: IC-CAP-Agilent and ADS-Agilent. For the simulation and characterization of optoelectronic devices was used a commercial simulator of semiconductor devices.

The total number of hours of laboratory is of 14

1. **Extraction of parameters and modelling of devices using IC-CAP**
2. **Modelling of bipolar transistor using IC-CAP**
3. **Extraction of parameters of high frequency (parameters S, noise and power) of a bipolar transistor**
4. **Description of RF or microwave circuit using ADS**
5. **Analysis of low noise amplifier, LNA, for 1.9 GHz in hybrid technology using ADS**
6. **Analysis of power amplifier, PA, for 2.4 GHz in MMIC technology using ADS**
7. **Simulation of a photodiode PIN**

BIBLIOGRAPHY

BASIC:

1. **Professor notes**
2. **U.L. Rohde and D.P. Newkirk, "RF/Microwave Circuit Design for Wireless Applications", John Wiley and Sons, 2000**
3. **G. Gonzalez, "Microwave Transistors Amplifiers", Prentice Hall, 1984**
4. **Juan M. López-González, *El transistor bipolar de heterounión: Física, Electrónica y Microond*as, capitulos 3-7, Edicions UPC, 2002, capítulos 7-10**
5. **D. Wood, "Optoelectronics Semiconductor Devices", Ed. Prentice Hall, Inter. Series in Optoelectroncis, 1994**
6. **Franz Sischka, IC-CAP Characterization Handbook , 2002**
7. **http://eesof.tm.agilent.com/docs/adsdoc2005A/manuals.htm**

ADVANCED:

8. **L. Besser and R. Gilmore, "Practical RF Circuit Design for Modern Wireless Systems, vol. I, passive circuits and systems" ed. Artech House, 2003**

9. **L. Besser and R. Gilmore, "Practical RF Circuit Design for Modern Wireless Systems, vol. II, active circuits and systems" ed. Artech House, 2003**

10. **T.H. Lee "Planar Microwave Engineering: A Practical Guide to Theory, Measurements and Circuits", Cambridge University Press, 2004**

11. **S.A. Maas, "Nonlinear Microwave and RF Circuits", 2ª ed., Artech House, 2003**

12. **Compact Modelling Council: http://www.eigroup.org/cmc/**

13. **W. J. Mooney, "Optoelectronic Devices and Principles", Prentice Hall,**

14. **http://eesof.tm.agilent.com/docs/IC-CAP2002/IC-CAP_mdl_handbook.html**

OTHER EDUCATIONAL MATERIALS

OBSERVATIONS