SUBJECT TEACHING GUIDE

G993 - Analogue Electronics

Degree in Industrial Electronic Engineering and Automatic Control Systems

Academic year 2019-2020

1. IDENTIFYING DATA					
Degree	Degree in Industrial Electronic Engineering and Automatic Control Systems		Type and Year	Compulsory. Year 3	
Faculty	School of Industrial Engineering and Telecommunications				
Discipline	Subject Area: Electronics and Automation Module in Common with the Industrial Branch				
Course unit title and code	G993 - Analogue Electronics				
Number of ECTS credits allocated	6	Term		Semester based (1)	
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. TECNOLOGIA ELECTRONICA E INGENIERIA DE SISTEMAS Y AUTOMATICA
Name of lecturer	YOLANDA LECHUGA SOLAEGUI
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Office	E.T.S. de Ingenieros Industriales y de Telecomunicación. Planta: - 3. DESPACHO PROFESOR (S3082)
Other lecturers	MARIA DEL MAR MARTINEZ SOLORZANO

3.1 LEARNING OUTCOMES

- Ability to analyze and to design basic analog circuits
  Knowledge and identification of the most representative circuits and the most extended applications related to Analog Electronics.
  Ability to design and to develop experiments as well as analyzing and reading results

4. OBJECTIVES

Study of the operational amplifier and its use as basic building block in linear and non-linear applications
Analysis of the frequency response of the most common configurations of amplifiers
Study of the feedback effect on amplifiers and understanding of the stability problems and its application to oscillators
Analysis of output stage topologies for power amplifiers
Acquiring experience in the design, analysis and implementation of simple analog circuits, checking, by experimental measurements done in the laboratory, the specifications of the circuits that have been previously calculated theoretically and also by using a SPICE-based electrical simulator.

6. COURSE ORGANIZATION

CONTENTS	
1	The operational amplifier
1.1	The operational amplifier: Introduction. The ideal and non-ideal opamp. Inverting and non-inverting amplifier. Finite-gain effect on the opamp performances. Offset voltage and current. Summer and difference amplifiers. Integrator and differentiator circuits
1.2	Linear applications: Difference amplifiers. Instrumentation amplifiers. Current-to-voltage converter. Voltage-to-current converter. Reference voltages. Current amplifiers. Programmable gain amplifiers
1.3	Non-linear applications: Comparators with opamps and monolithic comparators. Precision clamping circuits. Logarithmic and antilogarithmic amplifiers. Multipliers. Analog dividers and square-root calculation. Half-wave and full-wave precision rectifiers. Analog switches. Sample-and-hold circuits.
1.4	Operational amplifier parameters: Saturation output voltage. Offset input voltage. Bias current and offset input current. Output current limit. Slew-Rate. Open-loop and close-loop frequency response
2	Output stages and power amplifiers
2.1	Classification of output stages. Class A, class B, class AB and modified class AB. Transfer characteristics. Circuit operation. Power dissipation. Power amplifiers with BJT transistors. Power amplifiers with MOS transistors. Integrated power amplifiers
3	Frequency response of amplifiers
3.1	Introduction. Transfer function. Bode Plot. Internal capacitances and high-frequency model for MOS and BJT transistors
3.2	Low-frequency response of the CS MOS amplifier. High-frequency response of the CS MOS amplifier. Miller's Theorem. Approximation using the open circuit and short circuit time constant methods. High-frequency response of the CG and cascode MOS amplifiers. High-frequency response of the CD MOS amplifier. High-frequency response of the differential MOS amplifier. Frequency response of multistage amplifiers.
3.3	Analysis of the low, medium and high-frequency response of bipolar amplifiers.
4	Feedback and stability of amplifiers
4.1	Feedback fundamentals: Advantages of negative feedback. Types of feedback amplifiers. Series-shunt feedback amplifiers. Ideal and real cases. Feedback amplifiers: series-series, shunt-shunt and shunt-series
4.2	Stability of feedback amplifiers. Poles of the feedback amplifier: Root locus. Analysis of first and second-order systems. Gain and phase margins. Compensated and non-compensated opamps. Frequency compensation techniques
4.3	Oscillators. Basic principles of sinusoidal oscillators. Oscillators with opamps and RC networks. LC oscillators and quartz crystal oscillators. Astable multivibrators
5	The CMOS operational amplifier
5.1	Two-stage topologies. Voltage gain. Frequency response and compensation. Slew-rate concept. Alternative configurations for CMOS amplifiers

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Laboratory assessment	Laboratory evaluation	No	Yes	30,00
Ongoing assessment	Others	No	No	30,00
Final written exam	Written exam	Yes	Yes	40,00
TOTAL				100,00

Observations

Attendance to lab sessions is mandatory.
In order to pass the course, it is essential to pass the lab program.

Observations for part-time students

For those students who have difficulties to attend lab classes regularly for justifiably reasons , it is possible to pass the lab program through a practical exam that will take place at the September sitting.

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

A.S. Sedra, K.C. Smith, Microelectrónics Circuits, 6ª ed., Edt. Oxford University Press, 2011
B. Razavi, Fundamentals of Microelectronics, 1ª ed., Edt. Wiley, 2008
G.W. Roberts, A.S. Sedra, SPICE, 2ª ed. Edt. Oxford University Press, 1997