Electronic circuit design for communication

Academic Year: (2019 / 2020) **Review date: 15-10-2019**

Department assigned to the subject: Department of Electronic Technology

Coordinating teacher: HERNANDEZ CORPORALES, LUIS

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 1

STUDENTS ARE EXPECTED TO HAVE COMPLETED

(Bachelor) Electronic Systems, Digital electronics, Linear Systems, Communication Theory

COMPETENCES AND SKILLS THAT WILL BE ACQUIRED AND LEARNING RESULTS.

The student should acquire the following competences:

CE2 Ability to develop communication systems: Antenna design, subsystems and equipments, channel modelling, link budget calculation and planning.
CE3 Ability to implement wireline , optic fiber , radio and satellite systems on mobile and landline communication services.
CE10 Ability to design and fabricate integrated circuits.
CE11 Knowledge about Hardware Description Languages
CE12 Ability to use programmable logic devices and to design digital and analog advanced electronics systems.
CE13 Ability to design communications components such as routers, switches and hubs , emmiters and receivers of different frequency bands.
CE14 Ability to apply advanced knowledges about fotonics and optoelectronics as well as high frequency electronics

DESCRIPTION OF CONTENTS: PROGRAMME

Block I

Lesson 1. C ommunications systems circuit design
- Processing chain in a communications system
- Introduction to microelectronics in communications systems. System on Chip (SoC). Design flow of a SoC
- Design Tools for SoC: hardware specification languages ¿¿(Verilog, VHDL, analog simulation tools)
- Microelectornic technologies for communications SoC.

Lesson 2. Active filters in continuous time
-Review of filter synthesis theory
- Biquadratic filters
- Sallen Key Filters and its derivatives
- State variables filtes wir RC-Opamp circuits
- Filters with gyrators
- Gm-C Filters

Lesson 3. sample and hold circuits
- The CMOS switch
- Sampling circuits and basic sample&hold circuits
- Charge injection phenomenon
- Sampling uncertainty phenomenon
- Integrated Sample & Hold Circuits

Lesson 4. Switched capacitor circuits
- Elements of a switched capacitor circuit
- Basic Integrator
- Discrete Integrator insensitive to parasitic capacitances with delay
- Discrete Integrator insensitive to parasitic capacitances without delay
- Adder and gain stages
- Discrete time Filters of first and second order

Block II:

Lesson 5. Special Communications Amplifiers: hybrid circuits, tuned amplifiers, mixers, AGC
- Single-ended and differential LC tuned amplifiers. Integrated inductances.
- Active mixers of 2 and 4 quadrants
- Definition of IP3 point
- Variable gain amplifiers VGA
- Amplifiers with Automatic Gain Control (AGC). Logarithmic control law

Lesson 6. Noise in electronic systems
- Review of statistical definitions of electrical noise. Noise spectral density
- Equivalent noise bandwidth of a circuit
- Types of circuit noises. Small-signal noise models of semiconductor devices
- Noise in discrete systems. Maximum SNR of an ideal sampler.
- Noise Factor and Friis formula.
- Concept phase noise of an oscillator. Relationship to jitter of a digital clock.

Lesson 7. Principles of A/D and D/A. D/A converters
- Noise a uniform quantizer
- Static parameters of an A/D and D/A, static errors, INL and DNL.
- Dynamic parameters. SNR, SNDR, SFDR, ENOB and dynamic range.
- D / A converters with resistance networks
- D / A converters with current sources
- D / A converters with switched capacitors
- Converter with R-2R network

Lesson 8. A/D converters
- Integrating A/D Converters (ramp, dual ramp)
- Succesiva approximation A/D converters (SAR)
- Pipe-line A/D converters
- FLash A/D converters

Block III:

Lesson 9: Oversampled Circuits
- Concept of oversampled systems
- Principle of noise shaping (Noise Shaping)
- Sigma-delta modulators of 1st and 2nd order
- Implementation of oversampled A/D
- Implementation of oversampled D/A converters

Lesson 10: Frequency Synthesis
- Types of Frequency Synthesizers
- Dynamic Equations of a phase control loop (PLL)
- Elements of a PLL: phase comparators, LC VCO, programmable dividers
- Phase noise in a digital divider
- Double modulus synthesizers
- Synthesizers controlled by sigma-delta modulation
- DDS Synthesizers
- Ring Oscillators. Time to Digital Converters
- Digital PLL Synthesizers

LEARNING ACTIVITIES AND METHODOLOGY

The training activities include:
* Lectures, classes resolve doubts in small groups, student presentations, individual tutorials and personal work, including studies, tests and examinations; aimed at the acquisition of theoretical knowledge.
* Classes of problems in small groups, individual tutorials and personal work, including studies, tests and examinations; aimed at the acquisition of practical skills related to the program for each subject
* Four practical sessions, two lab-sessions and two computer sessions

ASSESSMENT SYSTEM

The course is divided into three thematic blocks. During the course, there will be three written tests for Block I, Block II and Block III together with all the topic contents. The final grade is composed of: the average of the three written tests (85%), the practical sessions averaged mark (15%).

At the end of the course there will be a final exam for students who fail the grade of the written tests, or for those students wishing a reappraisal of his work. For these students the final grade will be composed of the final exam (85%) and the practical sessions averaged mark (15%).
The extraordinary final exam will be done with a weight of 100%.

% end-of-term-examination:	45
% of continuous assessment (assigments, laboratory, practicals…):	55

BASIC BIBLIOGRAPHY

- A. Sedra Microelectronic Circuits, Oxford Publishing, 1991
- B Razavi RF Microelectronics, Prentice Hall, 1998
- D. Johns Analog Integrated Circuit Design, J. Willey & Sons, 1997
- J. Smith Modern Communication Circuits, McGraw-Hill Science, 1997