COURSE DESCRIPTION

1. Program identification information

1.1 Higher education institution	**National University of Science and Technology Politehnica Bucharest**
1.2 Faculty	**Electronics, Telecommunications and Information Technology**
1.3 Department	**Electronic Devices, Circuits and Architectures**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Masters
1.6 Programme of studies	Microsystems

2. Date despre disciplină

2.1 Course name (ro) (en)				Proiectarea circuitelor pentru comanda şi alimentarea microsistemelor si senzorilor inteligenti			
2.2 Course Lecturer							
2.3 Instructor for practical activities				Conf. Dr. Ing. Gheorghe Pristavu			
2.4 Year of studies	1	2.5 Semester	II	2.6. Evaluation type	V	2.7 Course regime	Ob
2.8 Course type	DA	2.9 Course code		UPB.04.M2.O.03-11		2.10 Tipul de notare	Nota

3. Total estimated time (hours per semester for academic activities)

3.1 Number of hours per week	2	Out of which: 3.2 course	0.00	3.3 seminary/laboratory	2
3.4 Total hours in the curricula	28.00	Out of which: 3.5 course	0	3.6 seminary/laboratory	28
Distribution of time:					hours
Study according to the manual, course support, bibliography and hand notes Supplemental documentation (library, electronic access resources, in the field, etc) Preparation for practical activities, homework, essays, portfolios, etc.					44
Tutoring					0
Examinations					3
Other activities (if any):					0

3.7 Total hours of individual study	47.00
3.8 Total hours per semester	75
3.9 Number of ECTS credit points	3

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	· Electronic Devices · Fundamental Electronic Circuits · Analog Integrated Circuits · Digital Integrated Circuits, · Microelectronic Technology Fundamentals Low Voltage Low Power Integrated Circuits
4.2 Results of learning	· Knowledge of electronic devices and circuits · Electronic circuit analysis · Microelectronics technology

5. Necessary conditions for the optimal development of teaching activities (where applicable)

5.1 Course	Not applicable.
5.2 Seminary/ Laboratory/Project	Rooms for the laboratory with video-projectors and internet connection. A minimum of 15 computer workstations with dedicated electronic circuit simulation software.

6. General objective *(Reffering to the teachers' intentions for students and to what the students will be thought during the course. It offers an idea on the position of course in the scientific domain, as well as the role it has for the study programme. The course topics, the justification of including the course in the currcula of the study programme, etc. will be described in a general manner)*

The project aims to familiarize students with the design and simulation process of complex analog electronic circuits, in professional analysis and simulation environments, used in the commercial field (Mentor Graphics, Cadence, etc.)

7. Competences *(Proven capacity to use knowledge, aptitudes and personal, social and/or methodological abilities in work or study situations and for personal and proffesional growth. They refflect the empolyers requirements.)*

Specific Competences	• The design of a relaxation oscillator fully integrated in CMOS technology • Operation of the MOS transistor in switching mode • CMOS inverter design. Mode of operation. Component sizing. • The design of low current sources. Mode of operation. Component sizing. • Design of a CMOS comparator. Mode of operation. Component sizing.
Transversal (General) Competences	· Teamwork for coordinating efforts with the others in order to solve special situations, with varying degrees of difficulty. · Autonomy and critical thinking: the abilty to think in engineering terms, to seek and analyze data independently, as well as identify and present new solutions. · Capacity to analyze and synthesize: Capacitate de analiză și sinteză: presents the acquired knowledge in a synthetic way, as a result of systematic analysis. · Respecting the principles of academic ethics. Correct citations of bibliographic sources used as references in own works.

8. Learning outcomes *(Synthetic descriptions for what a student will be capable of doing or showing at the completion of a course. The learning outcomes reflect the student's acomplishments and to a lesser extent the teachers' intentions. The learning outcomes inform the students of what is expected from them with respect to performance and to obtain the desired grades and ECTS points. They are defined in concise terms, using verbs similar to the examples below and indicate what will be required for evaluation. The learning outcomes will be formulated so that the correlation with the competences defined in section 7 is highlighted.)*

Knowledge	*The result of knowledge aquisition through learning. The knowledge represents the totality of facts, priciples, theories and practices for a given work or study field. They can be theoretical and/or factual.* Knowledge about professional simulation programs Use of models for weak inversion MOS transistors in circuit design. Behavioral model development for electronic circuits used in various applications. Describes complex circuit techniques. · Practical schematic design for microelectronic circuits in CMOS technology: switches, current/voltage sources, comparators, oscillators.
Skills	*The capacity to apply the knowledge and use the know-how for completing tasks and solving problems. The skills are described as being cognitive (requiring the use of logical, intuitive and creative thinking) or practical (implying manual dexterity and the use of methods, materials, tools and intrumentation).* Team work Solve practical problems using theoretical knowledge · Analysis and simulation of complex circuit and building blocks · Identifies practical applications for the studied electronic circuits · Identifies the limitations imposed by circuit architecture and the behavior of electronic devices · Identifies the importance of model parameters in the electrical operation of devices and circuits
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* · Selection and analysis of appropriate bibliographic sources. · Respect for the principles of academic ethics, correctly citing the bibliographic sources used. · Demonstrates responsiveness towards new circuit architectures. Collaborates with other colleagues and teaching staff in undertaking didactic tasks. Demonstrates autonomy in organizing the learning situation/context or the problem-solving situation. Contributes, through new solutions related to electronic circuits, to improving the quality of social life. Realizes the value of personal contributions in the field of engineering for identifying viable/sustainable solutions to solve problems in social and economic life (social responsibility). · Applies principles of professional ethics/deontology in analyzing the technological impact of proposed solutions on the environment. · Analyzes and exploits opportunities for entrepreneurial development in the specialized field. · Demonstrates management skills in real-life situations.

9. Teaching techniques *(Student centric techniques will be considered. The means for students to participate in defining their own study path, the identification of eventual fallbacks and the remedial measures that will be adopted in those cases will be described.)*

Demonstration, exposition, exercise and problem solving are used at the project meetings. Concrete situations of design, simulation and testing of integrated circuits (relaxation oscillator) are presented. The students' direct involvement in solving problems and their creativity in designing the block schematics that make up the complex circuit are stimulated.

10. Contents

PROJECT		
Crt. no.	**Content**	**No. hours**
1	Stage 1 – Task Assignment - Design of a relaxation oscillator, fully integrated in CMOS technology. The role and operation of the oscillator. Main parameters.	4
2	Stage 2 – CAD – configuration of the design program and device models used in the simulation.	4
3	Stage 3 - The MOS switch and inverter- Presentation of switch-mode operation for the MOS transistor. Selection and sizing criteria for obtaining switches and inverters with the desired specifications. Simulations.	4
4	Stage 4 – Current and voltage sources – Types of power sources. Design of oscillator bias blocks according to design data. Simulations.	4
5	Stage 5 – The Comparator – Role and operation. Comparator design in CMOS technology. Simulations.	4
6	Stage 6 – Testing the relaxation oscillator – Assembling the component blocks in order to obtain the final schematic. Simulations. Performance validation.	4
7	Stage 7 – Final evaluation – Presentation and grading of the projects.	4
	Total:	28

Bibliography:

1. G. Brezeanu, F. Draghici, Circuite electronice fundamentale, Ed. Niculescu, București, 2013
2. P. R. Gray, P. J. Hurst, S. H. Lewis, R. G. Meyer, Analysis and Design of Analog IC's, editia 4, J. Whiley&Sons, 2001.
3. B. Razavi, Design of Analog CMOS Integrated Circuits , McGrawHill, 2001.
4. G. Brezeanu, F. Draghici, F. Mitu, G. Dilimot Circuite electronice fundamentale- probleme Ed. Rosetti Educational, București, 2008.
5. IEEE Journal of Solid State Circuits, collection during 2000-2022.

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course			0%

11.5 Seminary/laboratory/project	Design, simulation and testing skills of oscillator building blocks: - The MOS switch - The CMOS inverter - Power supplies - The comparator	Grading based on degree of fulfillment of each individual task.	80%
	Design, simulation and testing skills of the functional fully-CMOS relaxation oscillator.	Final project evaluation of the complete relaxation oscillator.	20%
11.6 Passing conditions			
Obtaining 50% of the total score related to the activity during the semester.			

12. Corroborate the content of the course with the expectations of representatives of employers and representative professional associations in the field of the program, as well as with the current state of knowledge in the scientific field approached and practices in higher education institutions in the European Higher Education Area (EHEA)

Analog integrated circuits represent a key, fast-growing, branch of microelectronics. Multinational microelectronics companies, well-known producers of analog and mixed signal circuits and systems (Infineon, Microchip, ONSEMI), as well as the expansion to analog design of telecommunications and consumer electronics equipment companies, have considerably increased the demand for qualified engineers, with solid knowledge and competences in the field of integrated circuits. The PCCAMSI project provides its graduates with analog and mixed signal circuit analysis, design and simulation competences, culminating with the ability to optimize performances. Thus, the strategy of "Politehnica" University of Bucharest, of promoting subjects strongly correlated with both the requirements of present top industry such as microelectronics and the demands of the innovation and design process, is followed.

Date	Course lecturer	Instructor(s) for practical activities
15.10.2024		Conf. Dr. Ing. Gheorghe Pristavu

Date of department approval	Head of department
31.10.2024	Prof. Dr. Claudius DAN
Date of approval in the Faculty Council	Dean

Universitatea Națională de Știință și Tehnologie Politehnica București
Facultatea de Electronică, Telecomunicații și
Tehnologia Informației

01.11.2024 Prof. Dr. Mihnea Udrea