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

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	Micro and Nanoelectronics

2. Date despre disciplină

2.1 Course name (ro) (en)				Proiectarea circuitelor integrate de precizie in tehnologii submicronice Design of precision integrated circuits in submicron technologies			
2.2 Course Lecturer				Colaborator Dr. Cornel Stanescu			
2.3 Instructor for practical activities				Colaborator Dr. Cornel Stanescu			
2.4 Year of studies	1	2.5 Semester	II	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		DA	2.9 Course code	UPB.04.M2.O.05-04		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	3	Out of which: 3.2 course	2.00	3.3 seminary/laboratory	1
3.4 Total hours in the curricula	42.00	Out of which: 3.5 course	28	3.6 seminary/laboratory	14
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.					30
Tutoring					0
Examinations					28
Other activities (if any):					0

3.7 Total hours of individual study	58.00
3.8 Total hours per semester	100
3.9 Number of ECTS credit points	4

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Fundamental Courses of Electronic Devices and Integrated Analog Circuits.

4.2 Results of learning	General knowledge of physics, electronic devices and electrical measurements.

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

5.1 Course	The course will take place in a room equipped with a video projector or on the MSTeams platform
5.2 Seminary/ Laboratory/Project	The laboratory will be conducted in a specific room, which must include: computers, Internet connection, SPICE electronic circuit simulator or MSTeams platform, etc, students with computers with a SPICE simulator installed.

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)*

Presentation of LDO type CMOS integrated circuit design stages (low Dropout voltage stabilizer) .

Highlighting the architecture, electrical performance, and circuit and layout techniques used.- Placement in the context of rapid evolution in the field of CMOS integrated circuit design; short history of electronics as science;

- Presentation of the development stages of an integrated circuit, from project definition to production launch;

- Highlighting and description of the specific parameters of LDO type CMOS integrated circuits;

- Presentation of the role of technology in obtaining the performance of LDO circuits;

- Presentation of the general architecture of LDO-type CMOS integrated circuits;

- Presentation of the main functional blocks, their analysis and advanced design solutions used to achieve the desired performance; alternative solutions are presented where possible;

- Theoretical calculation of some electrical performance specific to functional blocks, such as: current consumption, voltage gain, output resistance;

Presentation of the protection blocks, their role, as well as the circuit techniques used in their implementation;

- Access to patents and published articles detailing the aspects presented at the course;

- Measuring the electrical parameters of the integrated circuits CMOS LDO type with the help of a special platform developed at ON Semiconductor Romania for CAT6243 circuit.

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	C1s. Use of fundamental elements relating to electronic devices, circuits, systems, instrumentation and technology C2's. Design, simulation and testing of devices, integrated circuits and micro and nanoelectronic systems with modern software tools C3's. Modeling and processing of integrated devices and circuits using advanced technologies C4's. Design, simulation and testing of optoelectronic devices, circuits and systems with modern micro and nanoelectronic software tools and technologies
Transversal (General) Competences	**CT**1 Adaptarea la noile tehnologii, dezvoltarea profesională şi personală, prin formare continuă folosind surse de documentare tipărite, software specializat şi resurse electronice în limba română şi, cel puţin, într-o limbă de circulaţie internaţională.

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.* List the stabilizer parameters Defines the characteristic elements of LDO Describe/classify model parameters Highlights the peculiarities of special constructive solutions

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).* Select and group relevant information about the constructive types of stabilisers. Arguably uses specific principles in order to preserve or neglect some model parameters. Work productively in a team to perform laboratory work. Elaborates a scientific text in the drafting of laboratory reports Experimentally check the design solutions within the bleach. Solves practical applications within the laboratory, processing measured data sets. Adequately interprets causal relationships between extracted values. Analyzes and compares the measured values. Identifies measurement solutions in the laboratory. Conclusions on the experiments carried out. Arguing the solutions identified .
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* Select appropriate bibliographic sources and analyze them. Respect the principles of academic ethics, correctly quoting the used bibliographic sources. Demonstrate responsiveness for new learning contexts. Demonstrates collaboration with other colleagues and teachers in carrying out teaching activities Demonstrates autonomy in organizing the learning situation/context or problem-solving situation Promotes/contributes through new solutions, related to the specialty field. Awareness of the value of its contribution to the field of engineering in identifying viable/sustainable solutions Apply ethical principles

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.)*

Building on the analysis of students' learning characteristics and their specific needs, the teaching process will explore teaching methods both expository (lecture, exposure) and conversational-interactive, based on learning by discovery models facilitated by direct and indirect exploration of reality (experiment, demonstration, modeling), but also on action-based methods such as exercise, exercise, and, practical activities and problem solving.

Lectures will be used in the teaching activity, based on PowerPoint presentations or different Internet pages that will be made available to students. Each course will start with the recapitulation of the chapters already covered, with an emphasis on the notions taken at the last course.

The presentations use images and schemes so that the information presented is easily understood and assimilated.

This discipline covers information and practical activities designed to support students in their learning efforts and to develop optimal relationships of collaboration and communication in a climate conducive to learning through discovery.

The practice of active listening and assertive communication skills, as well as feedback building mechanisms, will be considered, as ways of behavioral regulation in various situations and of adapting the pedagogical approach to the learning needs of the students.

The ability to work in teams to solve different learning tasks will be practiced.

The attention of students will be checked by rapid tests (quizz) during or at the end of the course at certain courses.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	1. Introduction 1.1 "s. Course theme 1.2. Brief history of electronics with important data 1.3. Stages of precision integrated circuits design	2
2	2. Integrated LDO type CMOS circuit 2.1. Concept description 2.2. Electrical parameters 2.3. Architecture of an LDO type CI	2
3	3. The main functional blocks in the LDO circuit 3.1. The error amplifier 3.2. The buffer 3.3. Transistor series 3.4. Resistive divisor 3.5.Reference of tension	8
4	4. Frequency compensation of LDO circuit 4.1. Compensation at exit 4.2. Miller cascoda type compensation	4
5	5. LDO circuit protection 5.1. Protection that limits the output current 5.2. Thermal protection 5.3. Over-voltage protection on the output	6
6	6. Noise in LDO circuits	6
	Total:	28

Bibliography:
1. C.Stanescu, PCIPTS, https://curs.upb.ro/2021/course/view.php?id=9477
2. C. Stanescu, „Proiectarea circuitelor integrate de precizie in tehnologii submicronice”, Manuscrisul scanat al notelor de curs, 2016.
3. C. Stanescu, "A New 150mA LDO in 0.8µm CMOS Process", Proceedings of the Romanian International Conference on Semiconductors (CAS), 2000.
4. C. Stanescu, "Buffer stage for fast response LDO", Proceedings of the Romanian International Conference on Semiconductors (CAS), p.357-360, 2003.
5. C. Stanescu et al., U.S. Patent No.: 6,518,737/February 11, 2003 - “Low dropout voltage regulator with non-Miller frequency compensation”
6. C. Stanescu et al., U.S. Patent No.: 6,710,583/Mar.23, 2004 - “Low dropout voltage regulator with non-Miller frequency compensation”;
7. C. Stanescu, C. Caracas, G. Aungurencei, A. Russell, "Quick-start CMOS voltage reference for positive LDOs", Proceedings of the Romanian International Conference on Semiconductors (CAS), p.379-382, 2005.
8. O. Profirescu, C. Dinca, C. Stanescu, "Noise in CMOS LDOs", Proceedings of the Romanian International Conference on Semiconductors (CAS), p.563-566, 2007.
9. C. Stanescu, R. Iacob, C. Dinca, C. Caracas, O. Profirescu, "0.5A Fast CMOS LDO", Proceedings of the Romanian International Conference on Semiconductors (CAS), p.473-476, 2009
10. C. Stanescu, R. Iacob, C. Dinca, O. Profirescu, "External Control Technique for Current Limit in LDOs", Proceedings of the Romanian International Conference on Semiconductors (CAS), p.413-416, 2011.

LABORATORY

Crt. no.	Content	No. hours
1	Laboratory presentation/work protection	1
2	Measurement of the electrical parameters of the integrated circuits CMOS type LDO with the help of a special platform developed at ON Semiconductor Romania for CAT6243 circuit.	7
3	Evaluation by theoretical calculation of some electrical parameters of the CAT6243 circuit.	7
	Total:	14

Bibliography:
1. C. Stanescu, "Platforma de Laborator pentru Cursul Proiectarea circuitelor integrate de precizie in tehnologii submicronice”, 2016, documentatie in format pdf.
CAT6243, ON Semiconductor, Data Sheet, documentatie in format pdf.

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade

11.4 Course	basic knowledge of calculating the electrical parameters of functional blocks in integrated circuits CMOS type LDO.	The evaluation grid test is done by written test examination of sustained verification at a fixed date during the exam session.	40%
	knowledge of basic theoretical notions related to the design of integrated circuits CMOS type LDO;	The evaluation is made by written test of verification sustained at a fixed date during the semester.	40%
11.5 Seminary/laboratory/project	Measurement of the electrical parameters of the integrated circuits CMOS type LDO with the help of a special platform developed at ON Semiconductor for CAT6243 circuit.	The evaluation shall be made at a final deadline for the laboratory report and shall include: 1. checking the measurements in the report: if they are complete and correct; 2. the degree of understanding of the significance of the results obtained.-	20%
11.6 Passing conditions			
Highlighting and description of specific parameters of LDO type CMOS integrated circuits. Obtaining 50% of the laboratory score in the semester time. Compliance with the UNSTPB regulation on promotion conditions			

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)

The increasing complexity of electronic circuits and systems and the need to reduce costs and research-design-manufacture cycles have imposed the development of computer-aided simulation, design and optimization techniques, in the form of various software tools.

The discipline provides graduates with adequate skills with the needs of current qualifications and modern, quality and competitive scientific and technical training.

Thus, the graduates are provided with a modern, quality and competitive scientific and technical training that will allow them to be hired quickly after graduation, being perfectly framed in the politics of the Polytechnic University of Bucharest, both in terms of content and structure, and in terms of international skills and openness offered to students.

Date Course lecturer Instructor(s) for practical activities

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01.09.2024	Colaborator Dr. Cornel Stanescu	Colaborator Dr. Cornel Stanescu
Date of department approval	Head of department	
31.10.2024	Prof. Dr. Claudius DAN	
Date of approval in the Faculty Council	Dean	
01.11.2024	Prof. Dr. Mihnea Udrea	