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	Bachelor/Undergraduate
1.6 Programme of studies	Microelectronics, Optoelectronics and Nanotechnologies

2. Date despre disciplină

2.1 Course name (ro) (en)				Bazele tehnologice ale microelectronicii			
2.2 Course Lecturer				Conf. Dr. Alexandru Antonescu			
2.3 Instructor for practical activities				Conf. Dr. Alexandru Antonescu			
2.4 Year of studies	4	2.5 Semester	1	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		S	2.9 Course code	04.S.07.O.403		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	4.5	Out of which: 3.2 course	3	3.3 seminary/laboratory	1.5
3.4 Total hours in the curricula	63	Out of which: 3.5 course	42	3.6 seminary/laboratory	21
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.					62
Tutoring					11
Examinations					3
Other activities (if any):					0

3.7 Total hours of individual study	62.00
3.8 Total hours per semester	125
3.9 Number of ECTS credit points	5

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum · · A	Completing and / or promoting the following disciplines: Electronic Materials Electronic Devices Electronic Components Models for SPICE Analog ICs

4.2 Results of learning	Accumulate the following knowledge: • Determining the main parameters, elements and photolithographic processes associated to the basic semiconductor devices • Analysis oh the main technological process limitations in conjunction with the evolution of semiconductor devices and integrated circuits. • Identification of the main structures of a integrated circuit layout, elaboration of cross-sections, and circuit schematic identification

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 and computer
5.2 Seminary/ Laboratory/Project	The laboratory will take place in a room with specific equipment, which must include: access to CADENCE design suite, PCs with necessary software installed, two monitors and projection system

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 microelectronic system design and manufacturing is nowadays a mature domain characterized by the separation of main activity types (each group having its own metabolism):Design, Manufacturing, and Testing.

To this regard the course main goals are to offer the basic microelectronics knowledge needed for both (1) understanding and efficient use of the resources provided by modern microelectronic processes and (2) to ensure the appropriate solution of the unavoidable issues specific to the designer, process engineer and testing engineer.

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	C4.1. Understanding of the modern CMOS, BiCMOS and bipolar processes: the students will be able to evaluate theirs specific resources and limitations taking into account the design requirements, and C4.2. Getting the knowledge level that guarantee his/her further professional development as analog, digital and mixed signals microcircuits designer
Transversal (General) Competences	Work in a team and communicate effectively, coordinating efforts with others to solve situations of medium complexity. Autonomy and critical thinking: the ability to think scientifically, to look for and analyze data independently, as well as to draw and present conclusions / identify solutions. Ability to analyze and synthesize: summarizes the knowledge gained as a result of a systematic analysis process. Respects the principles of academic ethics: in the documentation activity he correctly cites the bibliographic sources used. Put into practice elements of emotional intelligence in the proper socio-emotional management of real life / academic / professional situations, demonstrating self-control and objectivity in making decisions or in stressful situations.

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 most important stages of technological process, it's limitations, and compares similar processes showing the main similarities, differences, and applicability area. • Defines field-specific notions, in close relation to the analysed circuit or designed layout • Describe / classify notions / processes / phenomena. • Highlights consequences and relationships.
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).* • Selects and groups relevant information in a given context. • Arguably uses specific principles for abc. • Work productively in a team. • Experimentally verify identified solutions. • Solves practical applications. • Properly interprets causal relationships. • Analyses and compares the performance of similar circuits, following the testing process. • Identifies solutions and develops solution plans / projects. • Formulates conclusions from the experiments performed. • Argues the identified solutions / solutions.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* • Select appropriate bibliographic sources and analyse their veracity. • Respects the principles of academic ethics, correctly citing the bibliographic sources used. • Demonstrates receptivity to new learning contexts. • Shows collaboration with other colleagues and teachers in carrying out teaching activities • Demonstrates autonomy in organizing the learning situation / context or problem situation to be solved • Demonstrates social responsibility through active involvement in student social life / involvement in events in the academic community • Promotes / contributes through new solutions, related to the specialized field in order to improve the quality of social life. • Awareness of the value of his contribution in the field of engineering to the identification of viable / sustainable solutions to solve problems in social and economic life (social responsibility). • Applies principles of professional ethics / deontology in the analysis of the technological impact of the solutions proposed in the specialized field on the environment. • Analyses and capitalizes on business opportunities / entrepreneurial development in the specialized field. • Demonstrates skills in managing real-life situations (time management, collaboration vs. conflict).

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.)*

Oral communication supported (if it is necessary) by slides. The support mate¬rials are handouts available either HW or SW.

During the laboratory activity the student will perform, both

(1) the analysis and/or electrical design, and

(2) the layout of a small / medium complexity CMOS circuit implemented by a submicron process using a standard design environment

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	An overview of the monolithic microsystem domain evolution 6	6
2	Semiconductor materials and material properties	8
3	Si-SiO2 system	6
4	Silicon wafers fabrication	1
5	Epitaxy. Dielectric, semiconductors and conductive layers deposition	1
6	Native layers	1
7	Diffusion. Ion implantation	2
8	Packaging	1
9	Monolithic silicon microsystems manufacturing	16
	Total:	42

Bibliography:

1. Alexandru Mihai Antonescu, Bazele Tehnologice ale Microelectronicii, suport de curs electronic, https://curs.upb.ro/2021/course/view.php?id=9164
2. R.J. Baker, “CMOS: Circuit Design, Layout, and Simulation”, 3rd ed. IEEE Press, Wiley 2010.
3. T.C. Carusone, D.A. Johns, and K. Martin, “Analog Integrated Circuits Design”, 2nd ed., John Wiley & Sons, New York, 2011.
4. P.R. Gray, P.J. Hurst, S.H. Lewis, R.G. Meyer, “Analysis and Design of Analog Integrated Circuit”, 5th ed., John Wiley & Sons, New York, 2009.
5. P.R. Gray, R.G. Meyer, “Circuite integrate analogice, Analiză şi proiectare”, Editura tehnică, 1997.
6. A.S. Grove, “Fizica şi tehnologia dispozitivelor semiconductoare”, Editura Tehnică, Bucureşti, 1973.
7. G.S. May, S.M. Sze, “Fundamentals of Semiconductor Fabrication”, Wiley, 2003.
8. S.M. Sze, “Semiconductor Devices:Physics and Technology”, 2nd ed., Wiley, 2001.

LABORATORY		
Crt. no.	**Content**	**No. hours**

1	Students' acquaintance with the submicron process and circuit performances specifications. Critical process parameters analysis. Electrical and layout specifications of the small to medium complexity circuit to be designed	3
2	Spice analysis of the circuit. LVS. Interaction between electrical parameters and process parameters.	6
3	Layout design. Design rules. DRC. Interdependence between electrical parameters and layout. Component matching	6
4	Completion of the electrical and physical design	3
5	Laboratory activity evaluation	3
	Total:	21

Bibliography:

Alexandru Mihai Antonescu, Bazele Tehnologice ale Microelectronicii, suport de curs electronic, https://curs.upb.ro/2021/course/view.php?id=9164
A. Hastings, "The Art of Analog Layout", 2nd ed., Prentice Hall, 2005
R.J. Baker, "CMOS: Circuit Design, Layout, and Simulation", 3rd ed. IEEE Press, Wiley 2010.M. Burns, G.W. Roberts, An Introduction to Mixed-Signal Ic test and Measurement
M. Bushnell, V.D. Agarwal, Essentials of Electronics Testing

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course	- knowledge of fundamental theoretical notions; - knowing how to apply the theory to specific problems.	A written verification test (midterm) during the semester, held on a date set by the dean's office. Topics cover 50% of the subject matter consisting of exercises and modeling issues presented in the course.	30%
	- knowledge of fundamental theoretical notions; - knowing how to apply the theory to specific problems.	Final exam in session with the possibility to repeat the midterm	40%
11.5 Seminary/laboratory/project	- knowledge of how to apply theoretical knowledge on specific circuit	A practical verification test scheduled at the last laboratory session, which aims to assess the degree of assimilation of knowledge specific to the laboratory activity	30%
11.6 Passing conditions			
Obtaining 50% of the total score. Obtaining 50% of the 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)

In the labor market this course targets the consolidated segment of the microelectronic design and implementation well represented on the national and international scale. The significant employers are represented by both national and multinational companies and small and medium design centers focused on the microelectronic system design and implementation.

The course syllabus meets the requirements of the actual level of the microelectronic systems development taking into account the aggressive rise of the resources provided by the global development of the electronic technologies.

This way the students will acquire the competitive level of knowledge in the field of microelectronic systems design required by the competitive employers. This is also a part of the POLITEHNICA University of Bucharest policy to adapt the curricula and syllabus of the courses to comply to the global perspective of durable development.

Date	Course lecturer	Instructor(s) for practical activities
16.09.2025	Conf. Dr. Alexandru Antonescu	Conf. Dr. Alexandru Antonescu
Date of department approval	Head of department	
22.10.2025	Prof. Dr. Claudius Dan	
Date of approval in the Faculty Council	Dean	
	Prof. Dr. Mihnea Udrea	