Universitatea Naţională de Ştiinţă şi Tehnologie Politehnica Bucureşti
Facultatea de Electronică, Telecomunicaţii şi
Tehnologia Informaţiei

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)				Verificare în proiectarea circuitelor Verification in circuit design			
2.2 Course Lecturer				Teaching Assistant Costin Vasile			
2.3 Instructor for practical activities				Teaching Assistant Costin Vasile			
2.4 Year of studies	3	2.5 Semester	1	2.6. Evaluation type	V	2.7 Course regime	F
2.8 Course type		S	2.9 Course code	04.S.05.L.027		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	1	3.3 seminary/laboratory	2
3.4 Total hours in the curricula	42	Out of which: 3.5 course	14	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.					56
Tutoring					12
Examinations					4
Other activities (if any):					0

3.7 Total hours of individual study	33.00
3.8 Total hours per semester	75
3.9 Number of ECTS credit points	3

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Object-oriented programming, Digital integrated circuits
4.2 Results of learning	Verilog programming, Linux scripting

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

5.1 Course	Projector, white screen and Internet access

5.2 Seminary/ Laboratory/Project	Laboratory with Internet access for students, projector and white screen

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)*

This subject is studied within the field of Electronic Engineering, Telecommunications and Information Technologies, in the specialization Advanced Computing in Embedded Systems, and presents the concept of functional verification, the use of the SystemVerilog language in the context of functional verification, the UVM framework, and the application of object-oriented programming concepts. In addition, functional verification metrics used in industry are presented.

The aim is to understand the characteristics of a robust and efficient verification environment: automation, source code reuse, ease of writing and maintaining code, quantifying progress using relevant metrics, verifying all specifications, and identifying all bugs.

Students will become familiar with the UVM framework implemented in SystemVerilog and currently used across the industry to verify the most modern and complex chips. The standard verification components within UVM and the execution phases of a simulation will be discussed.

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	At the end of this course, students will have theoretical and practical knowledge of: - Designing a verification plan and implementing it - Programming in SystemVerilog - Analysis of verification results - Debugging techniques
Transversal (General) Competences	- Has the ability to analyze and synthesize: presents concisely and clearly the knowledge acquired through rigorous analysis of information. - Demonstrates teamwork skills and communicates effectively, collaborating with others to solve problems of medium complexity. - Demonstrates autonomy and critical thinking: is able to analyze and interpret data independently, identify solutions, and formulate relevant conclusions. - Respects the principles of academic ethics: correctly and appropriately cites the bibliographic sources used in documentation activities. - Applies aspects of emotional intelligence to efficiently manage socio-emotional aspects in the academic environment, showing control and objectivity in decision-making or tense 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.* - Defines the notions and concepts specific to functional verification, in close relation to the particularities of the UVM methodology. - Properly describes analysis and verification techniques used to test digital modules depending on the level of integration analyzed. - Understands and describes the operation of system component blocks and their impact at chip level. - Lists the most important characteristics of a robust verification environment, highlighting their limitations, advantages, disadvantages, and practical applicability. - Understands and properly describes the main simulation phases according to the organization, requirements, and working methods used in industry.
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, thus being able to properly describe various theoretical or practical aspects relevant to functional verification. – Uses, with justification, concepts and principles specific to functional verification to establish the degree of fulfillment of chip specifications. – Experimentally validates the solutions identified for the practical resolution of the project topic. – Correctly identifies and interprets causal relationships in system operation. – Formulates correct conclusions on the obtained simulation results.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* – Selects appropriate bibliographic sources and analyzes them. – Respects the principles of academic ethics, correctly citing the bibliographic sources used. – Demonstrates openness to new learning contexts. – Demonstrates autonomy in organizing the learning context and the problems to be solved.

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.)*

The teaching of the subject is built around oral communication, focusing on interactive and demonstrative methods, as well as using problem-based learning, all applied to the whole class. A video projector is used to communicate and illustrate content, combined with interactive means based on questions and active student feedback.

Within the teaching process, students are presented with methodologies for analyzing the specifications of complex digital modules and for developing test suites to verify their functionality.

Teaching methods include lectures supported by PowerPoint presentations and the use of relevant video materials, which will be made available to students. Each lesson begins with a recap of the material presented previously, focusing on the essential notions covered in the previous class. The presentations contain numerous source code sections and diagrams to facilitate understanding and assimilation of the information.

Alongside theoretical notions, this subject integrates complex practical activities, consisting of the development of a project, intended to support the students' learning process and to develop essential skills for the functional verification of digital systems.

Active listening and assertive communication skills are promoted, together with the understanding and application of constructive feedback concepts, thus adapting the teaching process to students' individual needs.

All course materials are available electronically on the faculty's Moodle platform for easy and convenient access and consultation.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Introduction - Importance of hardware verification - Verification levels - Languages and methodologies - Verification tools and technologies	1
2	Functional verification process - The verification challenge - Verification planning - Verification environment - Running tests - Debugging process - Measuring progress	2
3	Stimulus generation - Reset - Random generation - Test sequences - Test modules - Simulation and regression	2
4	Monitors and evaluation - Importance of self-checking - What is a reference model? - Events, temporal checks - Data collection	2
5	Debugging - Defect analysis - Management of known defects	1

6	Defining and collecting progress metrics - Code coverage - Functional coverage - Temporal and assertion coverage - Unified metrics	2
7	Verification closure - Coverage analysis - Test pass rate	1
8	Verification models - Registers - FIFOs - Arbiters - Translators - Algorithmic blocks - Processors	2
9	Other topics - System-level verification - Mixed-signal verification - Low-power system verification	1
	Total:	14

Bibliography:
Bibliografie
- Bruce Wile, John Goss, Wolfgang Roesner, Comprehensive Functional Verification: The Complete Industry Cycle, Morgan Kaufmann; 1st edition (June 9, 2005)
-Andreas Meyer, Principles of functional verification, Newnes; 1st edition (November 5, 2003)

LABORATORY

Crt. no.	Content	No. hours
1	SystemVerilog applications	2
2	Test modules and simulation	2
3	Building the verification environment	2
4	Metrics and test coverage	2
5	Regression tests	2
6	Assertions	2
7	Assessment	2
	Total:	14

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- Bruce Wile, John Goss, Wolfgang Roesner, Comprehensive Functional Verification: The Complete Industry Cycle, Morgan Kaufmann; 1st edition (June 9, 2005)
-Andreas Meyer, Principles of functional verification, Newnes; 1st edition (November 5, 2003)

11. Evaluation

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

11.4 Course	Midterm test	written	25%
	Final exam	written	25%
11.5 Seminary/laboratory/project	Project completion and performance.	Recurring project presentations.	50%
11.6 Passing conditions			
btaining 50% of the score for activities during the semester. btaining 50% of the final exam score. roject completion.			

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 quality of an electronic system largely depends on the quality of the verification methodology applied to that system and the effort invested in verification. For these reasons, in the electronic systems industry, up to 60% of the total effort to deliver a product is dedicated to verification. For the same reasons, the demand for capable verification engineers is very high, both domestically and abroad. The course offers students the opportunity to acquire knowledge that enables them to approach the verification of systems of medium complexity, allowing them to be quickly integrated into an engineering team without requiring additional training upon hiring.

Date	Course lecturer	Instructor(s) for practical activities
25.09.2025	Teaching Assistant Costin Vasile	Teaching Assistant Costin Vasile

Date of department approval	Head of department
26.09.2025	Prof. Dr. Claudius Dan
Date of approval in the Faculty Council	Dean
26.09.2025	Prof. Dr. Mihnea Udrea

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