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	
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Bachelor/Undergraduate
1.6 Programme of studies	Applied Electronics

2. Date despre disciplină

2.1 Course name (ro) (en)				Verificare în proiectarea circuitelor Verification in Circuit Design			
2.2 Course Lecturer				As. Costin Vasile			
2.3 Instructor for practical activities				As. Costin Vasile			
2.4 Year of studies	3	2.5 Semester	I	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	1.00	3.3 seminary/laboratory	2
3.4 Total hours in the curricula	42.00	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.					54
Tutoring					14
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, Integrated digital 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 discipline is studied within the field of Electronic Engineering, Telecommunications, and Information Technology, in the specialization of 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. Alongside these, the functional verification metrics used in the 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, quantification of progress using relevant metrics, verification of all specifications, and identification of all bugs.

Students will be familiarized with the UVM framework implemented in SystemVerilog and currently used by the entire industry for verifying the most modern and complex chips. 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 its implementation - Programming in SystemVerilog - Analyzing verification results - Debugging techniques
Transversal (General) Competences	- Demonstrates analytical and synthesis skills: presents concisely and clearly the knowledge acquired through rigorous analysis of information. - Demonstrates teamwork and effective communication skills, collaborating with others to solve problems of medium complexity. - Exhibits autonomy and critical thinking: capable of independently analyzing and interpreting data, identifying solutions, and formulating relevant conclusions. - Respects principles of academic ethics: accurately and appropriately cites bibliographic sources used in documentation activities. - Applies aspects of emotional intelligence for effective management of socio-emotional aspects in the academic environment, demonstrating 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.* - Define the specific notions and concepts of functional verification, closely related to the specifics of the UVM methodology. - Properly describe the analysis and verification techniques used for testing digital modules depending on the analyzed integration level. - Understand and describe the functioning of system component blocks and their impact at the chip level. - List the most important characteristics of a robust verification environment, highlighting their limitations, advantages, disadvantages, and practical applicability. - Understand and accurately describe the main phases of simulation according to the organization, requirements, and working methods used in the 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 organizes relevant information in a given context, thus being able to appropriately describe various theoretical or practical aspects relevant to functional verification. - Uses rational arguments based on specific concepts and principles of functional verification to establish the degree of compliance with chip specifications. - Experimentally validates the identified solutions for the practical implementation and verification in project assignments. - Identifies and interprets causal relationships correctly in the system's operation. - Formulates accurate conclusions regarding the simulation results obtained.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* - Selects appropriate bibliographic sources and analyzes them. - Respects principles of academic ethics, correctly citing the bibliographic sources used. - Demonstrates receptiveness 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 this discipline is centered around oral communication, with a focus on interactive and demonstrative methods, as well as using the problematization method, all applied in a frontal manner. The video projector is used to communicate and illustrate content, combined with interactive means based on questions and active student feedback.

During the teaching process, students are presented with methodologies for analyzing 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 concepts covered in the previous session. The presentations contain numerous sections of source code and diagrams to facilitate understanding and assimilation of the information.

In addition to theoretical concepts, this discipline integrates complex practical activities, consisting of elaborating a project, designed to support students' learning process and develop essential skills for functional verification of digital systems.

Skills promoted include active listening and assertive communication, along with understanding and applying concepts of constructive feedback, thus adapting the teaching process to the individual needs of students.

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 - The importance of hardware verification - Verification levels - Languages and methodologies - Verification tools and technologies	1
2	Functional verification process - Challenges of verification - Verification planning - Verification environment - Test execution - Debugging process - Progress measurement	2
3	Stimulus generation - Reset - Random generation - Test sequences - Test modules - Simulation and regression	2
4	Monitoring and evaluation - Importance of self-assessment - What is a reference model? - Events, temporal checks - Data recovery	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	Finalizing verification - Coverage analysis - Test success rate	1
8	Verification models - Registers - FIFO - Arbiters - Translators - Algorithmic blocks - Processors	2
9	Other topics - System-level verification - Mixed-signal verification - Low-power system verification	1
	Total:	14

Bibliography:
Bibliography
- 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	Applications of SystemVerilog	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

Bibliography:
Bibliography
- 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	written	25%
	Final exam	written	25%
11.5 Seminary/laboratory/project	Project completion and performance.	Recurring project presentations.	50%
11.6 Passing conditions			
- Achieving 50% of the score related to the activity throughout the semester. - Achieving 50% of the score from the final exam. - Completion of the project.			

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 put into verification. For these reasons, in the electronic systems industry, up to 60% of the total effort for product development is dedicated to verification. Similarly, the demand for capable verification engineers is very high, both domestically and internationally. The course provides students with the opportunity to accumulate knowledge that allows them to approach the verification of medium complexity systems, enabling them to be quickly integrated into an engineering team without requiring additional training upon employment.

Date	Course lecturer	Instructor(s) for practical activities
25.09.2025	As. Costin Vasile	As. Costin Vasile

Date of department approval	Head of department

Date of approval in the Faculty Council	Dean
26.09.2025	Prof. Dr. Mihnea Udrea