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	Microsystems

2. Date despre disciplină

2.1 Course name (ro) (en)				Testare si testabilitate			
2.2 Course Lecturer				S.l.dr.ing. ANTONESCU Alexandru			
2.3 Instructor for practical activities				S.l.dr.ing. ANTONESCU Alexandru			
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.03-09		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.					58
Tutoring					10
Examinations					3
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	Design for integrated digital circuits, Electronic devices

4.2 Results of learning	Circuit description and test program implementation using an HDL language, use of a suite of circuit design tools (Simulator and Synthesis Tool/P&R)

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

5.1 Course	Room with approx. 25 seats with monitor for presenting slides and blackboard
5.2 Seminary/ Laboratory/Project	Laborator cu calculatoare cu tool-ul Xilinx ISE/Xilinx Vivado instalat si placute de test cu FPGA si display digital cu 4 digiti

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)*

Knowledge of the basic principles and methods of designing and testing digital integrated circuits, in order to identify the manufacturing defects present in an electronic 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	Students will learn to implement different DFT-type architectures and different algorithms for the automatic generation of test vectors to identify the defects present in a digital circuit
Transversal (General) Competences	Acquiring the basic principles and concrete techniques of Design for Testing and Testability.

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.* It lists the most important stages of the testing and testability process, their limitations and compares different types of similar processes, highlighting the main similarities, differences, as well as their application area. · Defines domain-specific notions, closely related to the analyzed circuit or device or designed layout · Describes/classifies notions/processes/phenomena. It 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).* Select and group relevant information in a given context. · Reasonably uses specific principles in view of abc. · Work productively in a team. · Experimentally verify identified solutions. · Solve practical applications. · Adequately interpret causal relationships. · Analyze and compare the performance of similar circuits, following the testing process. · Identifies solutions and develops solution/project plans. · Formulates conclusions to the experiments carried out. · Argue 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 analyze their veracity. · Respect the principles of academic ethics, correctly citing the bibliographic sources used. · Demonstrates responsiveness to new learning contexts. · Demonstrates collaboration with other colleagues and teaching staff in carrying out teaching activities · Demonstrates autonomy in organizing the learning situation/context or the problem situation to be solved · Demonstrates social responsibility through active involvement in student social life/involvement in academic community events · Promotes/contributes through new solutions related to the specialized field to improve the quality of social life. · Realizes 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). · Apply principles of professional ethics/deontology in the analysis of the technological impact of the proposed solutions in the specialized field on the environment. · Analyzes and capitalizes on business/entrepreneurial development opportunities in the specialty area. Demonstrates real-life situation management skills (collaborative vs. conflict time management).

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.)*

Teaching is based on oral communication (the methods used are the expository method and the problematization method, used face-to-face). Where necessary, the video projector is used (covering the communication and demonstration function).

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Testing importance	2
2	Defect models	2
3	RTL abstractization levels	2

4	DFT techniques overview	3
5	Ad-Hoc DFT	2
6	Controllability and observability	3
7	Scan Architectures	4
8	ATPG vector generation	6
9	Boundary scan	4
	Total:	28

Bibliography:

VLSI Test Principles and Architectures: Design for Testability, editata de Laung-Terng Wang, Cheng-Wen Wu, and Xiaoqing Wen, Elsevier Inc. 2006
Proiectarea Circuitelor Integrate Digitale Folosind Limbajul Verilog, de Mariana Ilas, Ed. MatrixRom, 2011
Digital System Test and Testable Design: Using HDL models and architectures, de Zainalabedin Navabi, Springer 2011
Boundary Scan Tutorial - de Dr. R. G. "Ben" Bennetts, DFT Consultant si Director, ASSET InterTech Inc, 2009

LABORATORY

Crt. no.	Content	No. hours
1	Implementation of a digital alarm clock - defining the design specification - implementation at RTL/Gate level using an HDL - circuit testing using the Xilinx FPGA on the lab demo board - selecting a sub-module from the design (MOD) - synthesis of the sub-module - adding a full-scan chain using muxed-D cells - extraction of the logic scheme at the logic gate level - forcing a stuck-at defect in the circuit - finding the test vector using the D algorithm - identification of the correct output (in the absence of the defect) - writing a testbench for MOD and applying the test vector with the defect present in the circuit - identification of the defect	14
	Total:	

Bibliography:

VLSI Test Principles and Architectures: Design for Testability, editata de Laung-Terng Wang, Cheng-Wen Wu, and Xiaoqing Wen, Elsevier Inc. 2006
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11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course	380 / 5.000 Rezultatele traducerii Rezultatul traducerii • Knowledge of the fundamental theoretical notions of DFT • Knowledge of circuit implementation techniques to be testable (ad-hoc and structured DFT techniques) • Knowledge of various scan architectures (e.g. full-scan, boundary-scan, partial-scan, with various types of cells) • Knowledge of various techniques and algorithms for the automatic generation of test vectors (ATPG)	Written exam	50%
11.5 Seminary/laboratory/project	Implementation at RTL/gate level using an HDL of the circuit proposed in the project topic	Weekly verification of the progress in the implementation of the project theme. Presentation of the project in its final form in week 14	50%
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)

The discipline teaches the basic principles regarding the testability and testing of digital systems, as well as techniques used in the industry for the design of Design for Test (DFT) type structures, offering skills that can be considered assets for the employment of graduates in companies specialized in digital design

Date	Course lecturer	Instructor(s) for practical activities
17.10.2024	S.l.dr.ing. ANTONESCU Alexandru	S.l.dr.ing. ANTONESCU Alexandru

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