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 Technology and Reliability**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Masters
1.6 Programme of studies	Quality and Safety Engineering in Electronics and Telecommunications

2. Date despre disciplină

2.1 Course name (ro) (en)				Diagnoza defectelor şi proiectarea pentru testabilitate Fault diagnosis and design for testability			
2.2 Course Lecturer				Prof. dr. ing. Angelica BACIVAROV			
2.3 Instructor for practical activities				Prof. dr. ing. Angelica BACIVAROV			
2.4 Year of studies	2	2.5 Semester	I	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		DA	2.9 Course code	UPB.04.M3.O.14-09		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.					81
Tutoring					0
Examinations					2
Other activities (if any):					0

3.7 Total hours of individual study	83.00
3.8 Total hours per semester	125
3.9 Number of ECTS credit points	5

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Not applicable.

4.2 Results of learning	Accumulation of basic knowledge in the fields: quality / reliability / maintainability, statistics.

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 video projector and computer.
5.2 Seminary/ Laboratory/Project	The applications will take place in a room equipped with computer systems, the necessary software, Internet access. Attendance at laboratory sessions is mandatory (according to POLITEHNICA Bucharest regulations).

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 general objective of the discipline "Fault diagnosis and design for testability" consists in the study of the basic concepts regarding system diagnosis and system architectures to be easily testable / maintainable. The issue of automatic generation of test vectors for both electronic circuits and large systems is being developed. The manner of presentation of general notions gives students the opportunity to later approach any concrete system architecture.
The discipline develops the ability to design and run synthesis algorithms for diagnostic tests for systems with electronic circuits, to design easily testable systems, to carry out research in order to highlight different types of defects.

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	Demonstrates basic / advanced knowledge of fault diagnosis and design of testable systems. It correlates knowledge in the field of testability of complex systems. Apply in practice the knowledge related to the construction of easily testable / maintainable systems. It applies standardized methods and tools, specific to the field, to carry out the evaluation and diagnosis process of a situation, depending on the identified / reported problems, and identifies solutions. It argues and analyzes coherently and correctly the context of application of the basic knowledge of the field, using key concepts of the discipline and the specific methodology. Uses the scientific vocabulary specific to the field, in order to communicate effectively, in writing and orally.

Transversal (General) Competences	Works in a team and communicates effectively, coordinating efforts with others to solve problem situations of medium complexity. Autonomy and critical thinking: the ability to think in scientific terms, search and analyze data independently, and draw and present conclusions / identify solutions. Ability to analyze and synthesize: presents the acquired knowledge in a synthetic way, as a result of a process of systematic analysis. Respect the principles of academic ethics: correctly cite the bibliographic sources used in the documentation activity. Puts elements of emotional intelligence into practice in the appropriate social-emotional management of real-life/academic/professional situations, demonstrating self-control and objectivity in decision-making or 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.* • Lists the most important stages that marked the development of the field of testable systems. • Defines specific notions of system testability and fault diagnosis. • Describes/classifies notions/processes/phenomena/structures. • 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. • Reasonably uses specific principles in order to diagnose defects and ensure the testability of systems. • Work productively in a team. • Elaborate a scientific text. • Experimentally verifies identified solutions for fault diagnosis. • Solve practical applications. • Adequately interpret causal relationships. • Analyze and compare characteristics of testable systems. • 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 them. • 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 specialized field.

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.)*

Starting from the analysis of students' learning characteristics and their specific needs, the teaching process will explore both expository (lecture, exposition) and conversational-interactive teaching methods, based on discovery learning models facilitated by direct exploration and indirect of reality (experiment, demonstration, modelling), but also on action-based methods, such as exercise, practical activities and problem solving.
In the teaching activity, lectures will be used, based on PowerPoint presentations or different videos that will be made available to the students. Each course will start with a recap of the chapters already covered, with an emphasis on the concepts covered in the last course.
Presentations use images and diagrams so that the information presented is easy to understand and assimilate.
This discipline covers information and practical activities designed to support students in their learning efforts and the development of optimal collaborative and communicative relationships in a climate conducive to discovery learning.
It will be considered the practice of active listening and assertive communication skills, as well as feedback construction mechanisms, as ways of regulating behavior in various situations and adapting the pedagogical approach to the students' learning needs.
Teamwork skills will be practiced to solve different learning tasks.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Basic concepts. - Failure mechanisms and modes. - Fault detection. - Fault diagnosis, - Testability.	4

2	Methods of generating test sequences at the systems level. - Fault modeling. - Simulation of faults. - Test vector generation methods. - Techniques for running tests.	4
3	Generation of test sequences at the level of integrated circuits. - Deterministic tests. - Random tests. - Parametric tests. - Non-parametric tests.	4
4	Equipment for testing systems with electronic circuits. - Non-contact testing of integrated circuits. - Electron beam testing. The scanning electron microscope. - Generating the test stimuli. - The logic analyzer. Signature Analyzer.	4
5	Circuit design for testability. - Principles. - LSSD techniques, - Scan Path, Cell Boundary Scan. - IEEE 1149.x standards	4
6	The design of self-testing systems. - Principles of realization. - Totally self-testable systems with separable redundant structure. - Totally self-testable systems with non-separable redundant structure. - Structure of control circuits.	4
7	Generating test sequences at the software level. - Test specifications and verification protocols. - Diagnosis of system-level faults in PVM (Parallel Virtual Machine). - Manual testing. Automatic testing.	4
	Total:	28

Bibliography:

[1]. https://www.euroqual.pub.ro/cursuri/.
[2]. V. Cătuneanu, Angelica Bacivarov, Structuri electronice de înaltă fiabilitate. Toleranţa la defectări, Editura Militară, Bucureşti, 1999.
[3]. M. Abramovici, M.A. Breuer and A.D. Friedman. Digital Systems Testing and Testable Design. Computer Science Press, New York, NY, 1996.
[4]. E. Dustin, J. Rashka, J. Paul, Automated Software Testing, Addison Wesley, 1999.
[5]. D. Pitică, Mihaela Radu, Elemente de testare pentru sisteme electronice, Ed. Albastră, Cluj-Napoca, 2001.
[6]. H. Cârstea, Testarea echipamentelor electronice, Editura Politehnica, 1997.
[7]. Suport în platforma Moodle - https://curs.upb.ro.

LABORATORY

Crt. no.	**Content**	**No. hours**
1	Generation of test vectors for combinational logic circuits by the sensitive path method. Generating test sequences by algebraic methods.	2

2	Designing a test experiment for sequential logic schemes.	2
3	Generating test sequences by statistical methods.	2
4	Testing of complex electronic equipment with logic analyzers and signature analyzers.	2
5	Tools for testing the software performance of a system.	2
6	Functional testing of a software system. Android operating system case study.	2
7	Studies on the design of preventive maintenance activities	2
	Total:	14

Bibliography:
[1]. https://www.euroqual.pub.ro/cursuri/.
[2]. V. Cătuneanu, Angelica Bacivarov, Structuri electronice de înaltă fiabilitate. Toleranţa la defectări, Editura Militară, Bucureşti, 1999.
[3]. Suport în platforma Moodle - https://curs.upb.ro.

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course	Knowing how to apply the theory to specific problems	- homework	20%
	Knowledge of fundamental theoretical notions	- test - final exam (written)	40%
11.5 Seminary/laboratory/project	Evaluation of laboratory activity	- final laboratory test	40%
11.6 Passing conditions			
• Fulfilling the obligations characteristic of laboratory activity: teaching and supporting laboratory reports. • Obtaining 50% of the score related to the activity during the semester. To promote the discipline, the student must obtain at least 50% of the total score, in compliance with all the requirements specified in the POLITEHNICA Bucharest / ETTI Regulations.			

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)

• Through the activities carried out, students develop skills to offer solutions to problems and to propose ideas for improving the existing situation in the field of fault diagnosis and the design of easily testable systems
• Knowledge / aspects / phenomena described by specialized literature / own research published / presented in journals and scientific conferences were taken into account in the development of the content of the discipline
• Through the practical activities in the DDPT laboratory, the development of the student's skills to manage practical situations that he may face in real life is considered in order to increase his contribution to the improvement of the socio-economic environment.

Universitatea Națională de Știință și Tehnologie Politehnica București

Facultatea de Electronică, Telecomunicații și Tehnologia Informației

Date	Course lecturer	Instructor(s) for practical activities
24.09.2025	Prof. dr. ing. Angelica BACIVAROV	Prof. dr. ing. Angelica BACIVAROV
Date of department approval	Head of department	
	Conf. dr. ing. Marian VLĂDESCU	
Date of approval in the Faculty Council	Dean	
	Prof. dr. ing. Radu Mihnea UDREA	