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 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)				Fiabilitatea şi mentenabilitatea sistemelor electronice Reliability and maintainability of electronic systems			
2.2 Course Lecturer				Prof. dr. ing. Ioan BACIVAROV			
2.3 Instructor for practical activities				Prof. dr. ing. Ioan BACIVAROV, Dr. ing. Gabriel PETRICĂ			
2.4 Year of studies	1	2.5 Semester	I	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		S	2.9 Course code	2		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	5	Out of which: 3.2 course	3.00	3.3 seminary/laboratory	2
3.4 Total hours in the curricula	70.00	Out of which: 3.5 course	42	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.					51
Tutoring					0
Examinations					4
Other activities (if any):					0

3.7 Total hours of individual study	55.00
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, 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 a video projector and computer
5.2 Seminary/ Laboratory/Project	The applications will take place in a room equipped with computers, 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)*

This course is intended as a deepening and development to a higher level of the knowledge of reliability and maintainability accumulated by the students during their undergraduate studies. The main methods used in evaluating the reliability and maintainability of large systems are presented and deepened. It creates a solid knowledge base necessary for any reliability analyst.

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	Demonstrate basic / advanced knowledge of electronic systems reliability and maintainability. Correlate reliability and maintainability knowledge. Apply domain-specific knowledge in practice. Apply standardized methods and tools to carry out the evaluation and diagnosis process of a situation, depending on the identified/reported problems, and identify solutions. Argue and analyze coherently and correctly the application context of the basic knowledge of the field, using key concepts of the discipline and the specific methodology.
Transversal (General) Competences	Work in a team and communicate effectively, coordinating efforts with others to solve problem situations of medium complexity. Autonomous 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. Put 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. Assume roles / functions of managing the activity of groups, teams or projects.

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.* • Listing the most important stages that marked the development of the field of reliability and maintainability of electronic systems. • Defining notions specific to the field of reliability and maintainability of electronic systems. • Describing/classifying notions/processes/phenomena/structures. • Highlighting 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).* • Selecting and grouping relevant information in a given context. • Reasonably using specific principles in order to analyze the reliability of systems. • Working productively in a team. • Elaborating a scientific text. • Experimentally verifying identified solutions. • Solving practical applications. • Adequately interpreting causal relationships. • Analyzing and comparing reliability tools and indicators. • Identifying solutions and developing solution/project plans. • Formulating conclusions to the experiments carried out. • Arguing the identified solutions/solutions.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* • Selecting appropriate bibliographic sources and analyzing them. • Respecting the principles of academic ethics, correctly citing the bibliographic sources used. • Demonstrating responsiveness to new learning contexts. • Demonstrating collaboration with other colleagues and teaching staff in carrying out teaching activities • Demonstrating autonomy in organizing the learning situation/context or the problem situation to be solved • Demonstrating social responsibility through active involvement in student social life/involvement in academic community events • Promoting/contributing through new solutions related to the specialized field to improve the quality of social life. • Realizing 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). • Applying principles of professional ethics/deontology in the analysis of the technological impact of the proposed solutions in the specialized field on the environment. • Analyzing and capitalizing on business/entrepreneurial development opportunities in the specialized field. • Demonstrating 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.)*

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 and indirect exploration 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 Power Point 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.
The practice of active listening and assertive communication skills, as well as feedback construction mechanisms, will be considered 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	Fundamental concepts in reliability and maintainability engineering - Reliability of systems, definitions, concepts, strategies; - Maintainability, definitions, concepts; - Systems security, definitions, concepts, strategies; - Statistical control of system reliability; - Reliability test design.	8
2	Modeling the influence of certain factors on the reliability of system components - The demand-resistance correlation; - Extrapolation of reliability indicator values for different levels of demand; - The influence of demands and the environment on the failure rate for electronic components; - Selection and run-in tests for systems with electronic components.	4
3	The overall efficiency of the systems - The global efficiency model; - Reliability analysis of a hardware detection system.	2
4	Reliability analysis of two-state systems - Reliability analysis of systems with series and/or parallel structure; - Reliability analysis of systems with non-decomposable series-parallel structure; - Analysis methods based on the sets of minimal links; - Approximate methods for reliability analysis of high reliability systems; - System reliability analysis using the two-dimensional parametric representation of probability; - Computer-assisted reliability analysis using Monte Carlo simulation; - Computer-aided analysis of the reliability of complex systems using pattern recognition theory and training theory.	8

5	Reliability analysis of multi-state systems - Markov models of system reliability; - Reliability analysis of systems without restoration with decomposable structure, containing three-state components.	6
6	Renewal processes - Repair time modeling; - Simple renewal process; - Alternative renewal process; - Availability of systems.	4
7	Analysis of repairable systems with Markov methods - Stochastic processes associated with a renewal process. Markov and semi-Markov process. - Modeling the functioning of repairable systems through homogeneous Markov chains.	5
8	Systems maintenance - Preventive and corrective maintenance; - Methods of predictive evaluation and optimization of maintainability; - Determining the optimal periodicity of maintenance actions; - Maintenance strategies: life cycle optimization, "Total Productive Maintenance" (TPM) strategy, total maintenance, JIT Management; - IT systems maintenance.	5
	Total:	42

Bibliography:

[1]. https://www.euroqual.pub.ro/cursuri/.
[2]. I. Bacivarov, Fiabilitatea sistemelor de telecomunicaţii, Ed. Militară, 1995.
[3]. I. Bacivarov, A.Kobi, Quality and Dependability, Mediarex 21, 2006.
[4]. I. Bacivarov, Angelica Bacivarov, A. Mihalache, Fiabilitatea şi mentenabilitatea sistemelor, Electronica 2000, 2005.
[5]. A. Birolini, Design of Reliability, Concurrent Engineering, Wiley, 2003.
[6]. J. Barlow, Mathematical Theory of Reliability, John Wiley, 1999.
[7]. Moodle course support - https://curs.upb.ro.

LABORATORY

Crt. no.	Content	No. hours
1	Introduction to the use of the STATISTICA program; capabilities and applications in reliability and maintainability.	4
2	Analysis of the main distribution functions used in reliability: exponential, normal, Chi-square, Student and Weibull using the STATISTICA program.	4
3	Statistical processing of experimental data. Estimating the distribution function. Statistical tests (Kolmogorov-Smirnov, Pearson).	4
4	Designing an accelerated reliability test.	4
5	Structural modeling of the reliability of electronic systems. Reliability prediction of electronic systems.	4
6	Reliability, maintainability and availability calculation using Markov models.	4
7	Implementation of optimal predictive maintenance policies.	4

	Total:	28

Bibliography:
[1]. https://www.euroqual.pub.ro/cursuri/.
[2]. I. Bacivarov, Fiabilitatea sistemelor de telecomunicaţii, Ed. Militară, 1995.
[3]. Moodle course support - 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	- verification test - final exam (written)	40%
11.5 Seminary/laboratory/project	Evaluation of laboratory activity	- final individual laboratory test	40%
11.6 Passing conditions			
• Fulfilling the obligations characteristic of laboratory activities: submitting and presenting laboratory reports. • Obtaining 50% of the score related to the activity per semester. • For the student to promote the discipline, they 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 propose ideas to improve the state of the art in the field of reliability and maintainability of electronic 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 RMES 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.

Date	Course lecturer	Instructor(s) for practical activities
22.09.2025	Prof. dr. ing. Ioan BACIVAROV	Prof. dr. ing. Ioan BACIVAROV

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Dr. ing. Gabriel PETRICĂ

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