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	**Telecommunications**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Bachelor/Undergraduate
1.6 Programme of studies	Networks and Telecommunications Software

2. Date despre disciplină

2.1 Course name (ro) (en)				Măsurări în electronică şi telecomunicaţii Measurements in electronics and telecommunications			
2.2 Course Lecturer				Prof. dr. ing. Octavian Fratu			
2.3 Instructor for practical activities				As. drd. ing. Teodora Cristiana Stoian			
2.4 Year of studies	1	2.5 Semester	II	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		D	2.9 Course code	04.D.02.O.013		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	3.5	Out of which: 3.2 course	2.00	3.3 seminary/laboratory	1.5
3.4 Total hours in the curricula	49.00	Out of which: 3.5 course	28	3.6 seminary/laboratory	21
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.					47
Tutoring					0
Examinations					4
Other activities (if any):					0

3.7 Total hours of individual study	51.00
3.8 Total hours per semester	100
3.9 Number of ECTS credit points	4

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Completion and graduation of the following courses: Basics of Electrotechnics part I

4.2 Results of learning	Not applicable

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

5.1 Course	The course takes place in a class with a video projector that facilitates the transmission of information from the laptop. Also, the room must be equipped with a blackboard as certain demonstrations and numerical examples are solved with chalk. The course has an interactive character, aiming at asking questions in the room and obtaining answers from the students, which will help them understand the concepts taught.
5.2 Seminary/ Laboratory/Project	Laboratory work is made in teams of 2 students, having at their disposal a Tektronix TDS1001 oscilloscope, a GW-Instek SFG-2110 generator, a GW-Instek GDM-8246 digital multimeter, an analog millivoltmeter, a power source, as well as test boards ("solderless breadboard") on which they must assemble circuits from discrete components, and then measure different parameters.

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 course aims to learn basic techniques and measuring devices used in electronics. These represent basic knowledge expected from an electronics engineer capable of working both in design and in operation or service. The aim is thus to acquire specific engineering skills for estimating measurement errors; understanding the parameters of measuring devices and the situations in which they are, or are not, important.

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	Acquiring specific engineering skills for estimating measurement errors; understanding the parameters of measuring devices and the situations in which they are, or are not, important.
Transversal (General) Competences	Teamwork and effective communication with teammate to complete laboratory tasks; Capacity for analysis, synthesis and analogy with the concepts taught in the course; Honorable, responsible, ethical behavior in the spirit of the law to ensure the reputation of the profession.

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.* • Select appropriate bibliographic sources and analyze them. • Respect the principles of academic ethics, correctly citing the bibliographic sources used. • Defines domain-specific notions. • Describes/classifies notions/processes/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).* Determining the types of passive and active electronic components • Determination of measurement errors when measuring certain components or in various configurations • Hands-on dexterity by designing and building electronic circuits • Effective and appropriate use of measuring devices • Identify and determine the parameters of different types of continuous and alternating signals
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* • 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 • 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. • Select appropriate bibliographic sources and analyze them.

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.)*

In order to facilitate the understanding and assimilation of the concepts presented throughout the course, interactive courses will be held consisting of both PowerPoint presentations of the concepts taught, but also numerical examples and their applicability in real life. For a more eloquent illustration of the measuring devices described in the course and subsequently used in the laboratory, specialized sites (including Youtube) will be presented where tutorials related to the functionality and handling of these devices can be found. The teaching is done gradually, starting from the concepts of electrical physics known in high school to the exposition of new, more complex concepts in the field. The teaching is interactive and there is always a dialogue with the students to encourage thinking and the free expression of their opinions/knowledge.

In the laboratory, the ability to work in a team will be practiced to solve different learning tasks.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**

1	Signals and instruments for their generation: Periodic signals: shapes and parameters, electronic measurement systems, types of electronic circuits, signal generators	4
2	Oscilloscope: general configuration of an analog oscilloscope: Y channel, synchronization system and time base, display, cathode ray tube, X channel; general configuration of a digital oscilloscope; detailed presentation of the Y channel of an oscilloscope: functions, main settings and adjustments, performance parameters, amplitude-frequency characteristic, functional blocks, operating modes; detailed presentation of the X channel of an oscilloscope: synchronization system and time base, conditions for signal synchronization, other adjustments and operating modes of the time base; block diagram of the X channel; oscilloscope with dual time base	10
3	Measurement of voltages and electric currents: general aspects, units of measurement, diports, frequency characteristic, integration/derivation circuits; measurement errors: relative error, absolute error, reported error, error propagation; parameters of periodic signals: average value, effective value, absolute average value, shape/peak factor; measurement of AC/DC voltages.	6
4	Impedance measurement: impedance characterization, dissipative reactors, series/parallel equivalence, DC resistance measurement: Wheatstone bridge, complex impedance measurement: AC bridges, classifications, bridges for measuring	6
5	Measurement of frequencies and time intervals: universal counter, frequency meter and period meter configurations.	2
	Total:	28

Bibliography:

1. Marcu Ioana, curs Măsurări în electronică şi telecomunicaţii, suport de curs electronic https://curs.upb.ro/2021/course/view.php?id=8921
2. Pagina laboratorului http://ham.elcom.pub.ro/metc/
3. I. Marcu, I. Pirnog, A. Vulpe, L. Dogariu, A.-M. Drăgulinescu, "Electronic measurements. Theory and applications", Editura Politehnica Press, ISBN 978-606-515-987-7, 166 pag, 2021

LABORATORY

Crt. no.	Content	No. hours
1	Generating and visualizing signals	3
2	Oscilloscope measurements	3
3	Circuits measurement on the test board	3
4	Voltage measurement	3
5	Measurement of transfer characteristics	3
6	Impedances measurement	3
7	Recap: Building an oscillator and measuring the parameters of the produced signals	3
	Total:	

Bibliography:

1. Marcu Ioana, curs Măsurări în electronică şi telecomunicaţii, suport de curs electronic https://curs.upb.ro/2021/course/view.php?id=8921
2. Pagina laboratorului http://ham.elcom.pub.ro/metc/
3. I. Marcu, I. Pirnog, A. Vulpe, L. Dogariu, A.-M. Drăgulinescu, "Electronic measurements. Theory and applications", Editura Politehnica Press, ISBN 978-606-515-987-7, 166 pag, 2021

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course	- understanding the theory associated with the functioning of electronic measuring equipment; - analytical and numerical problem solving skills, including the calculation of measurement errors	Final exam	40%
11.5 Seminary/laboratory/project	- completion of 7 laboratory works	Worksheets	20%
	- individual practical test on the day of the exam	Practical and oral test	40%
11.6 Passing conditions			
· Achievement of minimum 50% of the overall score.			

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 "Measurements in Electronics and Telecommunications" course aims to acquaint students with the active and passive physical components used in electronics and, implicitly, in telecommunications and with classic signal measurement and visualization devices (AC and DC voltmeter, multimeter, oscilloscope, LCR - the meter, etc.). The aspects integrated in this course have a close correlation with the subsequent subjects taught such as Analog and Digital Communications (CAD) and Electronic Instrumentation for Measurement (IEM).

As the practical part of this course is highly developed, students acquire the skills of managing electronic devices and components, learn to read electronic schematics, determine measurement errors within certain configurations. Thus, electronics enthusiasts will be able to later use the knowledge acquired in the design of robots, electronic cars, etc. and they will be able to collaborate with large companies in the field that emphasize the practical implementation of contracted projects.

Date	Course lecturer	Instructor(s) for practical activities
	Prof. dr. ing. Octavian Fratu	As. drd. ing. Octavian Fratu

Date of department approval Head of department

Date of approval in the Faculty Council Dean