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 Devices, Circuits and Architectures**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Bachelor/Undergraduate
1.6 Programme of studies	Microelectronics, Optoelectronics and Nanotechnologies

2. Date despre disciplină

2.1 Course name (ro) (en)				Instrumentaţie electronică de măsură Electronic Measurement Instrumentation			
2.2 Course Lecturer				Conf. Dr. Octaviana DATCU			
2.3 Instructor for practical activities				Conf. Dr. Octaviana DATCU			
2.4 Year of studies	3	2.5 Semester	1	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		D	2.9 Course code	04.D.05.O.004		2.10 Tipul de notare	Nota

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

3.1 Number of hours per week	4.5	Out of which: 3.2 course	2	3.3 seminary/laboratory	2.5
3.4 Total hours in the curricula	63	Out of which: 3.5 course	28	3.6 seminary/laboratory	35
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.					50
Tutoring					0
Examinations					12
Other activities (if any):					0

3.7 Total hours of individual study	62.00
3.8 Total hours per semester	125
3.9 Number of ECTS credit points	5

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Completion and/or passing of the following courses: Measurements in Electronics and Telecommunications
4.2 Results of learning	Acquisition of the following knowledge: To be familiar with basic concepts about signals, their generation and visualization, as well as their specific parameters.

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

5.1 Course	The course will take place in a classroom equipped with a video projector and a computer.
5.2 Seminary/ Laboratory/Project	The laboratory will take place in a room with specific equipment (B204, Leu Campus), which must include: signal generator, oscilloscope, multimeter, analog AC millivoltmeter, and LCR meter.

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 part of the field of Electronic Engineering, Telecommunications, and Information Technologies / specialization in Microelectronics, Optoelectronics, and Nanotechnologies, and aims to familiarize students with the main approaches, models, and explanatory theories of the field, used in solving practical applications and problems, relevant for stimulating the students' learning process.
The course specifically addresses the following basic/advanced notions, concepts, and principles — the generation of electrical signals (voltages), their specific parameters, their visualization and analysis on the oscilloscope, digital measurement of voltages and impedances, analog-to-digital and digital-to-analog conversion — all of which contribute to providing students with an overview of the methodological and procedural benchmarks of the field.

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	The student: • Knows, understands, and uses the specific language of the field. • Correlates the knowledge specific to electronic measurement instrumentation with that of other disciplines belonging to the areas of electronic engineering, telecommunications, and information technology. • Applies in practice knowledge, standardized methods, and tools specific to the field for carrying out the evaluation and diagnosis process of a situation, depending on the reported problems, and identifies solutions. • Argues and analyzes coherently and correctly the context of applying the basic knowledge of the field, using key concepts of the discipline and its specific methodology. • uses the scientific vocabulary specific to the field for effective communication, both in writing and orally.

Transversal (General) Competences	**The student:** • Works in a team and communicates effectively, coordinating efforts with others to solve medium-complexity problem situations. • Autonomy and critical thinking: ability to think in scientific terms, to search for and analyze data independently, as well as to draw and present conclusions / identify solutions. • Capacity for analysis and synthesis: presents acquired knowledge in a synthetic way, as a result of a systematic analysis process. • Respects the principles of academic ethics: correctly cites bibliographic sources used in research. • Puts into practice elements of emotional intelligence in the appropriate socio-emotional management of situations from real life/academic/professional contexts, demonstrating self-control and objectivity in decision-making or in 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.* **The student:** • Lists the most important stages that have marked the development of the field. • Defines notions specific to the field. • 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).* • Builds elementary circuits on a test board. • Measures and graphically represents parts of the transfer function of a linear, time-invariant circuit. • Studies an analog-to-digital conversion chain from the perspective of the architectures involved and their specific errors (successive approximation ADC, R-2R DAC, etc.). • Decides on the performance of the measurement based on the parameters and limitations of the digital sampling oscilloscope used (analog bandwidth, sampling frequency, rise time, horizontal deflection coefficient, acquisition memory). • Interprets datasheet specifications for different types of voltmeters (error, effective number of digits, common-mode or series-mode rejection). • Measures impedances using various measurement methods (2-wire, 4-wire), comparing these methods to minimize measurement error. • Measures and interprets distortions for different types of signals. • Distinguishes between a signal generator and a function generator. • Recognizes the importance of matching output and load impedance when connecting the signal/function generator to another device or circuit.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* **The student:** • Selects appropriate bibliographic sources and analyzes them. • Respects the principles of academic ethics, correctly citing the bibliographic sources used. • Demonstrates receptiveness to new learning contexts. • Shows collaboration with colleagues and teaching staff in carrying out academic activities. • Demonstrates autonomy in organizing the learning context/situation or the problem situation to be solved. • Shows social responsibility through active involvement in student social life / participation in academic community events. • Promotes/contributes new solutions, specific to the field of study, to improve the quality of social life. • Acknowledges the value of their contribution in engineering to identifying viable/sustainable solutions to solve problems from social and economic life (social responsibility). • Applies principles of professional ethics/deontology in analyzing the technological impact of proposed solutions in the field on the environment. • Analyzes and takes advantage of business/entrepreneurial development opportunities in the field. • Demonstrates management skills for real-life situations (time management, collaboration vs. conflict).

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 methods (lecture, presentation) and conversational-interactive methods, based on discovery learning models facilitated by direct and indirect exploration of reality (experiment, demonstration, modeling), as well as action-based methods such as exercises, practical activities, and problem-solving.

In the teaching activity, lectures will be used, supported by PowerPoint presentations or various short videos made available to students. Each course will begin with a recap of the chapters already covered, with emphasis on the topics studied in the previous lecture.

The presentations will use images and diagrams so that the information presented is easy to understand and assimilate.

This course includes both information and practical activities designed to support students in their learning efforts and in developing optimal collaboration and communication relationships within a climate favorable to discovery learning.

Active listening and assertive communication skills, as well as feedback-construction mechanisms, will be practiced as ways of behavioral regulation in various situations and as a means of adapting the pedagogical approach to students' learning needs.

Teamwork skills will also be exercised for solving different learning tasks.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Review – measurements in electronics and telecommunications [C1].	2
2	Digital-to-Analog Converters [C1, C2].	6
3	Analog-to-Digital Converters [C1, C2].	6
4	Digital Oscilloscope [C1, C3].	4
5	Numerical Measurement of Voltages [C1, C5, C6].	4
6	Numerical Measurement of Impedances [C1, C4].	4
7	Exam Preparation – Review	2
	Total:	28

Bibliography:
[C1] O. Datcu, Course: Electronic Measurement Instrumentation, https://moodle.dcae.pub.ro/course/view.php?id=10
[C2] Analog Devices, Fundamentals of Sampled Data Systems, Application Note (AN-282), available online on 01.09.2024: https://www.analog.com/en/index.html
[C3] User Manual, Tektronix, TDS1000- and TDS2000-Series Digital Storage Oscilloscope, 071-1064-00, available online on 01.09.2024: https://people.ece.cornell.edu/land/courses/ece4760/equipment/TEKtds1002.pdf.
[C4] Keysight Technologies, Impedance Measurement Handbook. A Guide to Measurement Technology and Techniques, 6th Edition, Application Note, document available online on 01.09.2024: https://literature.cdn.keysight.com/litweb/pdf/5950-3000.pdf
[C5] Keysight Technologies, Voltage Measurement, available online on 01.10.2019: https://www.keysight.com/main/editorial.jspx?ckey=2674680&cc=RO&lc=eng

[C6] Keysight 3458A Multimeter – Shattering Performance Barriers of Speed and Accuracy, Data Sheet, http://literature.cdn.keysight.com/litweb/pdf/5965-4971E.pdf

LABORATORY

Crt. no.	Content	No. hours
1	Measurements in Steady-State Sinusoidal Regime	3
2	Measurement of Distortions	3
3	A/D and D/A Converters	3
4	Digital oscilloscope.	3
5	Impedance measurement.	3
6	Digital measurement of voltages.	3
7	Colloquium.	3
	Total:	21

SEMINARY

Crt. no.	Content	No. hours
1	Digital-to-Analog and Analog-to-Digital Converters [C1, C2].	6
2	Digital Oscilloscope [C1, C3].	2
3	Numerical Measurement of Voltages [C1, C5, C6].	2
4	Numerical Measurement of Impedances [C1, C4].	2
5	Testing, review, exam preparation.	2
	Total:	14

Bibliography:
[C2] Analog Devices, Fundamentals of Sampled Data Systems, Application Note (AN-282), available online on 01.09.2024: https://www.analog.com/en/index.html
[C3] User Manual, Tektronix, TDS1000- and TDS2000-Series Digital Storage Oscilloscope, 071-1064-00, available online on 01.09.2024:
https://people.ece.cornell.edu/land/courses/ece4760/equipment/TEKtds1002.pdf.
[C4] Keysight Technologies, Impedance Measurement Handbook. A Guide to Measurement Technology and Techniques, 6th Edition, Application Note, document available online on 01.09.2024:
https://literature.cdn.keysight.com/litweb/pdf/5950-3000.pdf
[C5] Keysight Technologies, Voltage Measurement, available online on 01.10.2019:
https://www.keysight.com/main/editorial.jspx?ckey=2674680&cc=RO&lc=eng
[C6] Keysight 3458A Multimeter – Shattering Performance Barriers of Speed and Accuracy, Data Sheet, http://literature.cdn.keysight.com/litweb/pdf/5965-4971E.pdf

Laboratory platforms available online in October 2025 – 2026, at http://ham.elcom.pub.ro/iem-lab/index.html

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course	The ability of students to apply theoretical concepts in a different, yet related context to the one in which they originally acquired that knowledge.	Written test on chapters 13.	7.5 %
	The ability of students to apply theoretical concepts in a different, yet related context to the one in which they originally acquired that knowledge.	Written test on chapters 4–6.	7.5 %
	The ability of students to apply theoretical concepts in a different, yet related context to the one in which they originally acquired that knowledge.	Final exam.	40 %

11.5 Seminary/laboratory/project	The ability to implement a physical circuit by applying theoretical knowledge to practical problems.	Laboratory reports submitted at the end of each experiment, containing the results obtained by the students from the measurements performed on the circuit they implemented themselves or were provided with already implemented, in cases where the circuit is highly complex.	12.5%
	The ability to implement a physical circuit by applying theoretical knowledge to practical problems.	Final laboratory colloquium, in which the student discusses with the instructor, demonstrating the functioning of the implemented circuit and explaining the concepts involved.	12.5%
	The ability of students to apply theoretical concepts in a different, yet related context to the one in which they originally acquired that knowledge.	Test and seminar project.	20 %
11.6 Passing conditions			
• Achieving at least 50% of the total score. • Achieving at least 50% of the score from semester activities. • Passing the laboratory colloquium with a minimum grade of 5/10.			

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 provide solutions to problems and to propose ideas for improving existing situations in the field of electronic engineering, telecommunications, and information technologies.
- In developing the course content, knowledge, aspects, and phenomena described in the specialized literature were taken into account.
- The course has content similar to that of courses taught at the Massachusetts Institute of Technology in Cambridge, Massachusetts.
- Through laboratory and lecture activities, the course aims to develop the graduate's ability to manage practical situations they may encounter in real life, in order to increase their contribution to improving the socio-economic environment.

Date Course lecturer Instructor(s) for practical activities

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25.09.2025 Conf. Dr. Octaviana DATCU  Conf. Dr. Octaviana DATCU 

Date of department approval

26.09.2025

Head of department

Prof. Dr. Claudius Dan 

Date of approval in the Faculty Council

26.09.2025

Dean

Prof. Dr. Mihnea Udrea 