Syllabus

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Automation and Computer Science
1.3 Department	Automation
1.4 Field of study	Automation. Applied Informatics and Intelligent Systems
1.5 Cycle of study	Bachelor of Science
1.6 Program of study/Qualification	Automation and Applied Informatics (English)
1.7 Form of education	Full time

2. Data about the subject

2.1 Subject name	***Measurements and Transducers***			Discipline code	**17.00**
2.2 Course responsible/lecturer	Assoc. Professor Rodica Holonec, Phd eng – rodica.holonec@ethm.utcluj.ro				
2.3 Teachers in charge of applications	Assistant Rapolti Laszlo Laszlo.Rapolti@ethm.utcluj.ro, Phd eng –				
2.4 Year of study	II	2.5 Semester	3	2.6 Assessment *(E/C/V)*	E
2.7 Type of subject	*DF – fundamental, DS – specialty, DC – complementary*				DF
	DOB – compulsory, DOP – elective, DFA – optional				DOB

3. Estimated total time

3.1 Number of hours per week	4	of which:	Course	2	Seminar		Laboratory	2	Project	
3.2 Number of hours per semester	56	of which:	course	28	Seminar		Laboratory	28	Project	
3.3 Individual study										
(a) Manual, lecture material and notes, bibliography										16
(b) Supplementary study in the library, online and in the field										6
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										10
(d) Tutoring										10
(e) Exams and tests										2
(f) Other activities:										0

3.4 Total hours of individual study (sum of (3.3(a)...3.3(f)))	44
3.5 Total hours per semester (3.2+3.4)	100
3.6 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1 Curriculum	Mathematics, Physics, Theory of electric circuits;
4.2 Competence	Basic Knowledge in Mathematics, Physics, Electrical and Electronic Engineering

5. Requirements (where appropriate)

5.1. For the course	Multimedia classroom equipped with computer, projector and presentation facilities. Course materials are available through the university learning platform. Course attendance is recommended to facilitate understanding of theoretical concepts and engineering applications.
5.2. For the applications	Laboratory equipped with electrical and electronic measuring instruments, sensors, transducers, data acquisition hardware, and computers running data acquisition and virtual instrumentation software. Attendance at laboratory sessions is mandatory. Students are required to prepare the assigned laboratory work in advance, actively participate in the experiments, and submit laboratory reports.

6. Specific competences

Professional competences	**C1 –** Operating with basic Mathematical, Engineering and Computer Science concepts (2 credits) • **C1.1 –** Recognizing and describing concepts that are specific to the fields of calculability, complexity, programming paradigms, and modeling computational and communication systems • **C1.2 –** Using specific theories and tools (algorithms, schemes, models, protocols, etc.) for explaining the structure and the functioning of hardware, software and communication systems • **C1.3 –** Building models for various components of computing systems • **C1.4 –** Formal evaluation of the functional and non-functional characteristics of computing systems • **C1.5 –** Providing a theoretical background for the characteristics of the designed systems **C2 –** Designing hardware, software, and communication components (2 credits) • **C2.1 –** Describing the structure and functioning of computational, communication and software components and systems • **C2.2 –** Explaining the role, interaction and operation of hardware, software and communication components. • **C2.3 –** Construction of hardware and software components of computing systems using design methods, languages, algorithms, data structures, protocols and technologies. • **C2.4 –** Evaluating the functional and non-functional characteristics of the computing systems using specific metrics • **C2.5 –** Implementation of hardware, software, and communication components
Cross competences	**1.** Identification of the objectives to be achieved, the available resources, the conditions for their completion, work stages, working times, deadlines, and related risks. **2.** Responsible execution of professional duties

7. Expected learning outcomes

Knowledge	Describes, identifies, and explains fundamental concepts and methods related to electrical and electronic measurements, measurement systems, sensors and transducers, as well as their application to practical engineering problems, including: •Fundamental concepts of electrical and electronic measurements •Structure and metrological characteristics of measuring instruments •Measurement errors and methods for uncertainty evaluation •Operating principles of sensors and transducers •Methods for measuring electrical and non-electrical quantities •Data acquisition, signal conditioning and signal conversion systems (ADC, DAC, virtual instrumentation)
Skills	• Use appropriate methods and techniques for measuring electrical and non-electrical quantities. • Identifies and selects suitable measuring instruments, sensors and transducers for specific engineering applications. • Interprets measurement circuits, experimental data and measurement results. • Analyzes measurement errors and evaluates the accuracy, uncertainty and overall performance of measurement systems. • Designs and implements simple measurement systems using sensors, transducers and signal conditioning circuits. • Uses data acquisition systems and virtual instrumentation software (e.g., LabVIEW) for measurement, monitoring and data processing. • Selects appropriate measurement methods according to the characteristics of the measured quantity and the application requirements. • Evaluates and optimizes the performance of measurement systems for practical engineering applications.

Responsibilities and autonomy	Carries out activities specific to the field of measurements and transducers while assuming responsibility for the correctness and reliability of measurement results and the proper use of laboratory equipment, demonstrating: • Responsibility in performing measurements and validating experimental results. • Compliance with laboratory procedures, safety regulations and good engineering practice. • Ability to work independently and collaboratively in conducting laboratory experiments and engineering projects. • Critical judgment in selecting measurement methods, instruments and sensors appropriate to a given application. • Clear and concise communication of technical information and experimental results, both orally and in writing.

8. Course objectives

General objective	The objective of the course is to provide students with the fundamental knowledge of electrical and electronic measurements, measurement systems, sensors and transducers, measurement methods, and the integration of measurement technologies into modern engineering systems.
Specific objectives	After completing the course, students will be able to: • Identify measuring instruments and correctly read their indications. • Select and use appropriate measuring instruments according to the measured quantity and application. • Interpret measurement circuits and measurement schemes. • Analyse measurement results, measurement errors and uncertainty. • Evaluate the accuracy, precision and quality of measurement processes. • Select appropriate sensors and transducers for specific engineering applications. • Design and implement simple systems for measuring electrical and non-electrical quantities. • Evaluate the performance of measurement systems. • Optimize measurement systems for practical engineering applications.

9. Contents

9.1 Lecture	No.hours	Teaching methods	Notes
1.Electronic Measurements. General and Introductory Elements. Methods and Means of Measurement. Examples.	2	Multimedia presentations, interactive discussions, demonstrations, practical engineering examples and formative assessment activities.	The teaching process combines multimedia presentations with interactive discussions, demonstrations and practical engineering examples to facilitate the understanding of theoretical concepts and their engineering applications. Formative assessment activities are used throughout the
2. The Structure of Measuring Devices. Metrological Characteristics of Sensors and Measuring devices.	2		
3. Physical Quantities, Measurement Units and Standards. Measurement Errors and Uncertainties. Calculation Examples.	2		
4. Analog Electronic Measuring Devices. Measuring Signal Conditioning Circuits. Examples. Measurement Bridges. Applications.	2		
5. Digital Measuring Devices. Examples. Applications. Measuring Devices with Microprocessor.	2		
6. Analog to Digital Converters. Digital to Analog Converters. Digital Voltmeters. Virtual Instruments.	2		
7. The Analog and Digital Oscilloscope	2		
8. DC Microvoltmeters with Modulation/Demodulation. Wave Analyzers.	2		
9. Measurement Systems using Measurement Information Conversion.	2		
10. Transducers and Sensors. Principles. Operation. Applications.	2		
11. Sensors for Measuring Electrical Quantities. Examples. Applications.	2		

13. Sensors for Electrical Measurement of Non-electric Quantities. Examples. Applications.	2		course to reinforce learning and provide feedback.
12. Analog and Digital Sensors. Potentiometers. Variable-Inductance and Capacitance Sensors. Temperature sensors. Encoders.	2		
14. Fiber Optic and Laser Sensors. Sensors for Special Applications (biophysics, biomedicine).	2		

Bibliography

1. Holonec Rodica: Electrical Measurements and Instrumentation, Mediamira, 2003
2. Robert B Northrop. Introduction to Instrumentation and Measurements (3rd Edition) CRC Press, 2017
3. Nihal Kularatna, Digital and Analogue Instrumentation testing and measurement: The Institution of Engineering and Technology, London, United Kingdom, 2008
4. Clarence W. de Silva, Sensors and Actuators: Engineering System Instrumentation, Second Edition, 2015 by CRC Press
5. Josef Vedral, Industrial and Laboratory Measuring Systems Sensors, Distributed, Modular and Wireless Systems, 1st Edition, 2024 by CRC Press
6. Bird, J. – Electrical Circuit Theory and Technology, Elsevier, Oxford, 2004
7. Webster, J., Eren, H. – Measurement, Instrumentation and Sensors Handbook, CRC Press 2014

9.2 Applications (seminar/laboratory/project/practical work)	No.hours	Teaching methods	Notes
1. Analog Measurement Devices	2	Hands-on laboratory experiments, practical demonstrations, guided exercises, data acquisition and computer-assisted measurements.	Laboratory sessions combine experimental measurements, data acquisition and result analysis. Students perform experiments and prepare laboratory reports.
2. Digital Measurement Devices	2		
3. Domain Extension of Analog Measurement Instruments	2		
4. Single-phased A.C. Circuits Measurements	2		
5. The Wheatstone Bridge	2		
6. Temperature Measurement	2		
7. Flow and Level Measurement	2		
8. Angular Speed Measurement	2		
9. Displacement Measurement	2		
10. Virtual Instrumentation1: Introduction in LabView	2		
11. Virtual Instrumentation2. Using LabVIEW and NI ELVIS for studying different transducers (sensors and actuators)	2		
12. Virtual instrumentation 3. Data acquisition	2		
13. Virtual instrumentation 4. LabVIEW Signal Processing Applications	2		
14. Submission of reports/evaluation	2		

Bibliography

1. Rodica Holonec, B. Tebrean, I.G. Tarnovan, Gh. Todoran, Electronic Measurements: Laboratory Manual Editura U.T. PRESS, Cluj-Napoca 2010, ISBN.978-973-662-600
2. Rodica Holonec, Radu Adrian Munteanu, Romul Copîndean, Florin Drăgan, Instrumentație virtuală: lucrări de laborator, UT Press, 2018 Cluj-Napoca
3. Dan Iudean, Radu Munteanu jr., Mircea Buzdugan, Eudor Flueraș, Alex Crețu Măsurări electrice și electronice – Îndrumător de laborator- 2016, Editura Mediamira
4. Farzin Asadi, Kei Eguchi, Electronic Measurements: A Practical Approach (Synthesis Lectures on Electrical Engineering), 2021
5. Munteanu,R., Dragomir,N.D., TÂRNOVAN,I.G., Holonec,Rodica, Bortoș,P. – Tehnici de măsurare. Îndrumător de laborator. Atelierul de multiplicare al U.T.C.-N., 1995.

10. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

The content of the discipline is aligned with similar courses offered by universities in Romania and abroad. It is periodically updated to reflect current developments in measurement systems, sensors and instrumentation, while considering the expectations of employers, professional associations and industry representatives.

11. Evaluation

Activity type	11.1 Assessment criteria	1.2 Assessment methods	11.3 Weight in the final grade
11.4 Course	Understanding and application of theoretical concepts; ability to solve engineering problems and analyze measurement systems.	Written examination (theoretical questions and engineering problem-solving exercises, 3 hours).	90%
11.5 seminar/laboratory/project/ practical work	Attendance, active participation, correct execution of laboratory experiments, and quality and completeness of laboratory reports.	Continuous assessment based on laboratory performance and laboratory reports.	10%
11.6 Completion of all laboratory sessions and submission of the required laboratory reports are mandatory prerequisites for taking the final examination. Students must obtain a minimum grade of 5 (out of 10) in the written examination to pass the course.			

Date of filling in:		Title Firstname NAME	Signature
10.07.2026	Course	Assoc.Prof. Rodica Holonec, PhD eng	
	Applications	Assistant Rapolti Laszlo, PhD eng	

Date of approval by the Department Board	Head of Departament Prof.dr.ing. Honoriu VĂLEAN
Date of approval by the Faculty Council	Dean Prof.dr.ing. Vlad MUREȘAN