SYLLABUS

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Electronics, Telecommunications and information Technology
1.3 Department	Electrical Engineering and Measurements
1.4 Field of study	Electronic Engineering, Telecommunications and Information Technologies
1.5 Cycle of study	Bachelor of Science
1.6 Program of study / Qualification	Applied Electronics / Engineer; Telecommunications Technologies and Systems / Engineer
1.7 Form of education	Full time
1.8 Subject code	23.00

2. Data about the subject

2.1 Subject name	Electronic and Telecommunications Measurements						
2.2 Subject area	Theoretical area Methodological area Analytic area						
2.3 Course responsible	Assoc. Prof. Holonec Rodica – rodica.holonec@ethm.utcluj.ro						
2.4 Teacher in charge with seminar / laboratory / project	Assoc. Prof. Holonec Rodica – rodica.holonec@ethm.utcluj.ro Assist. Rapolti Laszlo – Laszlo.Rapolti@ethm.utcluj.ro						
2.5 Year of study	II	2.6 Semester	2	2.7 Assessment	E	2.8 Subject category	DID/DI

3. Estimated total time

3.1 Number of hours per week	4	of which: 3.2 course	2	3.3 seminar / laboratory	2
3.4 To Total hours in the curriculum	56	of which: 3.5 course	28	3.6 seminar / laboratory	28
Distribution of time					hours
Manual, lecture material and notes, bibliography					14
Supplementary study in the library, online specialized platforms and in the field					14
Preparation for seminars / laboratories, homework, reports, portfolios and essays					10
Tutoring					3
Exams and tests					3
Other activities:					0

3.7 Total hours of individual study	44
3.8 Total hours per semester	100
3.9 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1 Curriculum	Required: Electronic Devices, Electrical Circuits Theory Recommended: Fundamental Electronic Circuits, Basics of Electrotechnics
4.2 Competence	Elementary electrical circuit theory, Elementary electronics,

5. Requirements (where appropriate)

5.1. For the course	Whiteboard (blackboard), computer, projector and sound system
5.2. For the seminars / laboratories / projects	Laboratory classroom equipped with specific measuring devices, PCs and specific software.

6. Specific competences

Professional competences	C1. To use the fundamental elements regarding electronic devices, circuits, systems, instrumentation and technology C1.1 To describe the functioning of electronic devices and circuits and of the fundamental methods for measuring electrical quantities C1.4 To use the electronic devices and specific methods to characterize and evaluate the performance of electronic circuits and systems C2. To apply basic methods for signal acquisition and processing C2.2 To explain interpret the methods for signal acquisition and processing C2.4 To use specific methods and instruments for signal analysis C3. To apply knowledge, concepts and basic methods regarding computing systems' architecture, microprocessors, microcontrollers, programming languages and techniques C4. To design and use low complexity hardware and software applications, specific to applied electronics C4.1 To define the concepts, principles and methods used in the fields of computer programming, high-level and specific languages, CAD techniques for making electronic modules, microcontrollers, computer systems architecture, programmable electronic systems, graphics, reconfigurable hardware architectures Specific professional competences: 1. To use the fundamental concepts related to the modern measurement science and uncertainty theory. 2. To have knowledge about basic principles of the electrical, electronic and telecommunication measuring instruments and their correct management. 3. To apply knowledge regarding measurement methods of the main electrical quantities. 4. To use and design modern measurement systems based on PC-based data acquisition.
Cross competences	N/A

7. Discipline objectives (as results from the key competences gained)

7.1 General objective	Developing the competences regarding the important topics in the field of electronic and telecommunications measurements
7.2 Specific objectives	Theoretical and practical competences related to the: Fundamental measurement theory, electronic measurement techniques, analog and digital measuring devices, computer based measuring systems, virtual instrumentation

8. Contents

8.1 Lecture (syllabus)	Teaching methods	Notes
Fundamentals of Metrology. Measurement Units. Measurements Standards. Traceability. Measurement Terminology. Errors and Uncertainties. Measuring Instruments Specifications	Oral Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation, Quiz online,	Projector, whiteboard (blackboard)
Digital measurement of frequency and time. Direct digital measurement of frequency and time period. Digital measurement of the ratio of two frequencies. Multiperiod mode		
Digital measurement of phase shift angles. Totalization mode. Timer function.		
Digital voltmeters, analog-digital conversion circuits, resolution, precision. Average, peak, RMS detector voltmeters.		
Digital multimeters, measuring alternating voltages, currents, resistances, capacities and inductances, the current transfer factor for transistors, diode testing		
Direct current bridges. Balanced and Unbalanced Wheatstone Bridge.		
Measurement of very small and very large resistances.		
AC Bridges. Q-meter		
Digital impedance meters, RLC measurement, quality factor, losses		
Real-time cathode oscilloscope. X-axis circuits. Generation of time base signals. Trigger and synchronization circuit. Synchronization sources.		
Real-time cathode oscilloscope. The y-axis circuits. Frequency compensated attenuator. The frequency response of the deflection amplifier. Multi-channel mode of operation.		
Digital oscilloscopes. Sequential and random sampling. Sampling rate, frequency band. Vertical and horizontal resolution.		
Applications of the oscilloscope in X-Y mode: the Curve Tracer, the Wobbulator		

Digital power measurement. Signal generators		

Bibliography

[1]. Holonec Rodica: Electrical Measurements and Instrumentation, Mediamira, 2003
[2]. Nihal Kularatna, Digital and Analogue Instrumentation testing and measurement: The Institution of Engineering and Technology, London, United Kingdom, 2008
[3]. Robert B. Northrop Introduction to Instrumentation and Measurements, 3rd Edition, CRC Press, 2017
[4]. Robert A. Witte-Spectrum and Network Measurements-SciTech Publishing, 2014
[5]. Tarnovan Ioan: Metrologie electrică si instrumentație, Mediamira, 2003
[6]. Todoran Gh., Copandean R.: Masurari electronice-Amplificatore si convertoare de măsurare, Mediamira, 2003

8.2 Laboratory	Teaching methods	Notes
Digital measurement of time and frequency	Didactic and experimental proof, didactic exercise, team work	Experimental circuits, Hardware and software for data acquisition
Digital multimeter. Measurements of voltages, currents, resistances, attenuation or amplification in dB. Testing diodes, bipolar transistors.		
Measuring bridges. The impedance meter		
Use of analog measuring devices. Extending the measurement domains.		
Q-meter measurement methods.		
The analog oscilloscope: synchronization of periodic signals, measurement of peak and effective values, determination of the frequency band, input impedance		
Digital oscilloscope: phase shift measurements, synchronization for aperiodic signals, synchronization for modulated signals		
8.3 Seminar	Teaching methods	Notes
Representation and writing rules. Measurement errors. Instrumental errors. Measurement units.	Solving of problems and review of some theoretical aspects.	Projector, whiteboard (blackboard)
Measurement uncertainties. Confidence levels. Histogram. Normal distribution. Eliminating outliers.		
Errors when measuring voltage and current. Calculation methods for real values. Current measurement without voltage drop.		
Strain gauges bridge. Principles of implementation.		
The resistor with 4 and 3 terminals.		
Alternating current bridges: Maxwell –Wien, Sauty		

Floating voltmeter. Guarded voltmeter. Guard connection rules.		

Bibliography

[1]. Holonec Rodica: Electrical Measurements and Instrumentation, Mediamira, 2003
[2]. 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
[3]. Rodica Holonec, Radu Adrian Munteanu, Romul Copîndean, Florin Drăgan, Instrumentație virtuală: lucrări de laborator, UT Press, 2018 Cluj-Napoca
[4]. Mircea Dan Iudean, Radu Munteanu jr., Mircea Buzdugan, Eudor Flueras, Alex Cretu, Măsurări electrice şi electronice : îndrumător de laborator , Editura Mediamira, Cluj-Napoca, 2016, ISBN 978-973-713-338-0

8.1 Laboratory	Teaching methods	Notes
Analog Measurement Devices.	Didactic and experimental proof, didactic exercise, teamwork	Experimental circuits, Hardware and software for data acquisition
Digital Measurement Devices		
The Extension of the Measurement Range of Analog Instruments		
Wheatstone Bridge		
Digital Oscilloscope. Basics and Measuring Principles		
Virtual Instrumentation: LabVIEW – Basic operations and structures		
Data Acquisition Systems. Measuring Analog and Digital Signals.		
8.3 Seminar	Teaching methods	Notes
Measurement Fundamentals. Measurement Units. Significant Figures Meter Loading - Voltage Measurement	Solving of problems and review of some theoretical aspects.	Projector, whiteboard (blackboard)
Measurement Uncertainty Computation. Direct and Indirect Measurements.		
Random Errors Analysis. Repeated Measurements. Statistical Parameters		
Parameters of Periodic Signals. AC Voltmeters		
Measurements using Bridges. DC Bridges. AC Bridges		
The Oscilloscope. Basics. Measuring Principles		
Phase Measurement. Case study: The Gilbert Cell.		

Bibliography
[1]. Holonec Rodica: Electrical Measurements and Instrumentation, Mediamira, 2003
[2]. 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
[3]. Munteanu,R.,Todoran,Gh. Teoria si practica prelucrarii datelor de masurare.Editura Mediamira 1997.Cluj Napoca. 350p ISBN 973-9358-09-8.
[4]. TARNOVAN, Ioan Gavril, Metrologie electrica si instrumentatie, Cluj-Napoca : Mediamira, 2003
[5]. Vlaicu C. – Sisteme de măsurare informatizate, Editura ICPE, Bucureşti, 2000

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

The discipline content and the acquired skills are in agreement with the expectations of the professional organizations and the employers in the field of electronic and telecommunications measurements, where the students carry out the internship stages and/or occupy a job, and the expectations of the national organization for quality assurance (ARACIS).

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	The level of acquired theoretical knowledge and practical skills	Written examination	80%
10.5 Seminar/ Laboratory	The level of acquired knowledge and abilities at seminar (S) and laboratory (L)	Continuous assessment	10%(S)+10%(L)= 20%

10.6 Minimum standard of performance

Qualitative level:

Minimal knowledge:

- ✓ *Knowledge about the basic electronic and telecommunications measurement principles, methods and devices.*
- ✓ *Knowledge about acquiring, recording and analyzing the measurement data*

Minimal competences:

- ✓ *To be able to explain basic concepts and definitions in measurement.*
- ✓ *To be able to describe the main measuring methods.*
- ✓ *To be able to describe the principle of analog and digital measuring instruments.*
- ✓ *To be able to record, process and analyze experimental measurement data.*
- ✓ *To be able to operate/design a simple measurement system.*

Quantitative level:

- ✓ *Conditions for participating in the final exam: no absence at laboratory work.*
- ✓ *The final grade computation: G=0,8*(written examination grade) +0,1*(L grade) +0,1*(S grade).*
- ✓ Condition to take the credits: G≥5;

Date of filling in:	Responsible	Title Surname NAME	Signature
27.06.2024	Course	Assoc. Prof. Holonec Rodica	

	Applications	Assoc. Prof. Holonec Rodica	
		Assist. Rapolti Laszlo	

Date of approval in the Department of Electrical Engineering and Measurements

_1.07.2024_____

Director Department
Prof.dr.ing. Sorin HINTEA

Date of approval in the Council of Faculty of Electronics, Telecommunications and Information Technology

__11.07.2024_____

Dean
Prof.dr.ing. Ovidiu POP