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	Telecommunications Technologies and Systems/ Engineer Applied Electronics/Engineer
1.7 Form of education	Full time
1.8 Subject code	TST-E23.00/EA-E23.00

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. Rodica HOLONEC, Ph.D. rodica.holonec@ethm.utcluj.ro						
2.4 Teacher in charge with seminar / laboratory / project	Assoc.Prof. Rodica HOLONEC, Ph.D. rodica.holonec@ethm.utcluj.ro Eng. Laszlo RAPOLTI, Ph.D. student, laszlo.rapolti@ethm.utcluj.ro						
2.5 Year of study	II	2.6 Semester	4	2.7 Assessment	E	2.8 Subject category	DD/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.

1. Specific competences

Professional competences	C1. Use of the fundamental elements related to devices, circuits, systems, instrumentation and electronic technology C2. Applying the basic methods for the acquisition and processing of signals C4. Design, implementation and operation of data, voice, video and multimedia services. This is based on the understanding and the application of fundamental concepts in telecommunications and transmission of information C5. Selecting, installing, configuring and operating fixed or mobile telecommunications equipment. Equipping a site with usual telecommunications networks
Transversal 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
1. Measurement Fundamentals. Terms and definitions. Measuring Instruments Classification. Instrumentation Systems. Transducers	Oral Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation, Quiz online,	Projector, whiteboard (blackboard)
2. Fundamentals of Metrology. Measurement Units. Measurements Standards. Traceability. Measurement Terminology. Errors and Uncertainties. Measuring Instruments Specifications		
3. Random Errors Analysis. Basic Concepts in Probability. Normal Distribution. Central Limit Theorem.		
4. Basic Electrical Measurements. Indicating Analog Meters. Voltmeters. Ammeters. Wattmeters, Ohmmeters		
5. Measurements with Bridges. Balanced and Unbalanced Wheatstone Bridge. AC bridges.		

6. Analog Signal Conditioning in Electronic Measuring Systems 1. Instrumentation Amplifiers. Current to Voltage converters, Resistance to Voltage Converters.		
7. Analog Signal Conditioning in Electronic Measuring Systems 2 Bridge Amplifiers. Lock-in amplifiers		
8. Time domain measurements. Electronic Counters. Digital measurement of frequency and time		
9. Digital Multimeters: Theoretical and practical aspects.		
10. Computer based Measuring Systems 1. Data Acquisition (DAQ) Hardware and Software Components. Nyquist–Shannon sampling theorem.		
11. Computer based Measuring Systems 2. Data Converters. Analog-to-Digital converters (ADC). Digital-to-Analog Converters (DAC). Virtual instrumentation.		
12. Oscilloscope Fundamentals 1. The Systems and Controls of an Oscilloscope. Digital Oscilloscopes.		
13. Oscilloscope Fundamentals 2. Oscilloscope Measurement Techniques		
14. Frequency domain measurements. Spectral Analyzers. Working principles and architectures		

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 electrica si instrumentatie, Mediamira, 2003
6. Todoran Gh., Copandean R.: Masurari electronice-Amplificatore si convertoare de masurare, Mediamira, 2003
7. Holonec Rodica, Online bibliography: http://users.utcluj.ro/~holonec/RH/ETM_C_RH.rar

8.2 Laboratory	Teaching methods	Notes
1. Analog Measurement Devices.	Didactic and experimental proof, didactic exercise, team work	Experimental circuits, Hardware and software for data acquisition
2. Digital Measurement Devices		
3. The Extension of the Measurement Range of Analog Instruments		
4. Wheatstone Bridge		
5. Digital Oscilloscope. Basics and Measuring Principles		
6. Virtual Instrumentation: LabVIEW – Basic operations and structures		
7. Data Acquisition Systems. Measuring Analog and Digital Signals.		

8.3 Seminar	Teaching methods	Notes
1. Measurement Fundamentals. Measurement Units. Significant Figures Meter Loading - Voltage Measurement	Solving of problems and review of some theoretical aspects.	Projector, whiteboard (blackboard)
2. Measurement Uncertainty Computation. Direct and Indirect Measurements.		
3. Random Errors Analysis. Repeated Measurements. Statistical Parameters		
4. Parameters of Periodic Signals. AC Voltmeters		
5. Measurements using Bridges. DC Bridges. AC Bridges		
6. The Oscilloscope. Basics. Measuring Principles.		
7. 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. Seminar online bibliography: http://users.utcluj.ro/~holonec/RH/ETM_S_RH.rar
4. Laboratory online bibliography: http://users.utcluj.ro/~holonec/RH/ETM_L_RH.rar
5. Rodica Holonec, Radu Adrian Munteanu, Romul Copîndean, Florin Drăgan, Instrumentație virtuală: lucrări de laborator, UT Press, 2018 Cluj-Napoca
6. 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

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 Competences acquired will be used in the following COR occupations (Electronics Engineer; Telecommunications Engineer; Electronics Design Engineer; System and Computer Design Engineer; Communications Design Engineer) or in the new occupations proposed to be included in COR (Sale Support Engineer; Multimedia Applications Developer; Network Engineer; Communications Systems Test Engineer; Project Manager; Traffic Engineer; Communications Systems Consultant).

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 the 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 works*
- ✓ *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;

Data of filling in:	**Responsible**	**Title First name SURNAME**	**Signature**
13.09.2022	Course	Assoc. Prof. Rodica HOLONEC, Ph.D.	
	Applications	Assoc. Prof. Rodica HOLONEC, Ph.D.	
		Eng. Laszlo RAPOLTI, Ph.D. student	

Date of approval in the Council of the Communications Department 13.09.2022	Head of Communications Department Prof. Virgil DOBROTA, Ph.D.
Date of approval in the Council of the Faculty of Electronics, Telecommunications and Information Technology 21.09.2022	Dean Prof. Ovidiu POP, Ph.D.