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	Systems Engineering
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
1.8 Codul disciplinei	17.00

2. Data about the subject

2.1 Subject name	***Measurements and Actuators***				
2.2 Course responsible/lecturer	Assoc. Professor Rodica Holonec, Phd eng – rodica.holonec@ethm.utcluj.ro				
2.3 Teachers in charge of applications	Phd. Student Rapolti Laszlo Laszlo.Rapolti@ethm.utcluj.ro				
2.4 Year of study	II	2.5 Semester	1	2.6 Assessment *(E/C/V)*	E
2.7 Type of subject	*DF – fundamental, DD – in the field, DS – specialty, DC – complementary*				DD
	DI – compulsory, DO – elective, Dfac – optional				DI

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										14
(b) Supplementary study in the library, online and in the field										14
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										10
(d) Tutoring										3
(e) Exams and tests										3
(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	Basic Electrical circuit theory, Basic Electronics, Analysis methods for electronic circuits; General Physics
4.2 Competence	

5. Requirements (where appropriate)

5.1. For the course	Amphitheatre equipped with blackboard, computer, projector and sound system
5.2. For the applications	Laboratory classroom equipped with specific measuring devices, sensors and actuators, PCs

6. Specific competences

6.1 Professional competences	C1 Using knowledge from mathematics, physics, measurement technique, technical graphics, mechanics, chemistry, electrical engineering and electronics to systems engineering. C1.1 Using, in professional communication, of the concepts, theories and fundamental sciences methods utilized in systems engineering. C1.2 Explaining the assignments and the solutions argumentation from systems engineering, by using techniques, concepts and principles from

	mathematics, physics, engineering graphics, electrical engineering and electronics. C1.3 Solving common systems engineering issues by identifying techniques, principles, appropriate methods and by applying mathematics, with emphasis on numerical computation methods. C1.3 Estimating the potential, advantages and disadvantages of methods and procedures in the field of systems engineering, the projects scientific documentation level and the applications consistency using mathematical techniques and other scientific methods. C2. Operating with fundamental concepts from computer science, information technology and communications C2.2 The argued utilization of computer science concepts and computer technology in solving systems engineering well-defined problems and in applications requiring the use of hardware and software in industrial systems or computer systems C4 Design, implementation, testing, operation and maintenance of systems with general purpose and dedicated equipment, including computer networks, applications of automation and applied informatics. C4.1 Defining, by means of operating and design principles, the requirements of applicable standards and the methods of implementation, testing, maintenance and operation of equipment used in applications of automation and applied informatics
6.2 Cross competences	CT 3 Identifying opportunities for continuous training and efficient use of learning resources and techniques for self-development.

7. Course objectives

7.1 General objective	To provide a foundation in important topics of engineering system instrumentation such as: metrology, measurement techniques, electronic measurement devices, sensors and actuators principles and applications , virtual instrumentation
7.2 Specific objectives	To provide principle knowledge, practical training and measurement best practice regarding the instrumentation systems. To provide knowledge about sensors and actuators in order to perform the documentation, implementation, and development of complex equipment and measurement devices

8. Contents

8.1 Lecture	No.hours	Teaching methods	Notes
Measurement Fundamentals. Terms and definitions. Measuring Instruments Classification. Instrumentation Systems. Sensors and Actuators. Applications.	2	Oral Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation	Projector, blackboard
Fundamentals of Metrology. Measurement Units. Measurements Standards. Traceability. Measurement Terminology. Errors and Uncertainties. The Measuring Instruments Specifications.	2		
Random Errors Analysis. Basic Concepts in Probability. Normal Distribution. Central Limit Theorem.	2		
Classical Electrical Measurements. Indicating Analog Meters. Classifications and Symbols. Types of Analog Instruments. Voltmeters. Ammeters. Wattmeters, Ohmmeters	2		
Measurements with Bridges. Wheatstone Bridge. Strain Gauge Measurement bridges. Types of AC bridges.	2		
Methods and circuits for Interfacing Sensors and Actuators. Amplification in Instrumentation (1): Operational Amplifiers. Basic circuits. Instrumentation Amplifiers.	2		
Amplification in Instrumentation (2): Current Amplifiers, Resistance to Voltage Converters. Bridge Amplifiers. Time	2		

domain measurements Electronic Counters. Digital measurement of frequency and time			
Digital Multimeters (DMM) Fundamentals. Computer based Measuring Systems. Data Acquisition (DAQ) Hardware and Software Components. Nyquist–Shannon sampling theorem.	2		
Data Converters. Analog-to-Digital converters (ADC). Digital-to-Analog Converters (DCA). Virtual Measuring Systems.	2		
Oscilloscope Fundamentals. Analog and Digital Oscilloscopes. Waveform Measurements Principles	2		
Transducers, Sensors and Actuators. Terminology. Principles, Characteristics and Classifications. Analog and Digital Sensors.	2		
Temperature Sensors and Thermal Actuators. Optical Sensors and Actuators.	2		
Electric and Magnetic Sensors and Actuators. Mechanical Sensors and Actuators	2		
MEMS Sensors and Actuators	2		

Bibliography

1. Holonec Rodica: Electrical Measurements and Instrumentation, Mediamira, 2003
2. Tarnovan Ioan: Metrologie electrica si instrumentatie, Mediamira, 2003
1. Pavel Ripka, Alois Tipek. Modern sensors handbook London: ISTE, 2007
2. Nihal Kularatna, Digital and Analogue Instrumentation testing and measurement: The Institution of Engineering and Technology, London, United Kingdom, 2008
3. Clarence W. de Silva, Sensors and Actuators: Engineering System Instrumentation, Second Edition, 2015 by CRC Press

8.2 Applications (seminar/laboratory/project)	No.hours	Teaching methods	Notes
Analog and Digital Measurement Devices	2	Exposure applications	Experimental circuits, Computer LabView software, NI hardware
Domain Extension of Analog Measurement Instruments	2		
Single-phased A.C. Circuits Measurements	2		
The Wheatstone Bridge	2		
The Oscilloscope. Basics and Measuring Principles	2		
Temperature Measurement	2		
Level and Flow Measurement	2		
Displacement Measurement	2		
Angular Speed Measurement	2		
Introduction to NI ELVIS Computer Based Measuring Systems	2		
Virtual Instrumentation. Introduction in NI LabVIEW programming software	2		
Sensors and Actuators in NI LabVIEW Applications. Acquiring and Generating Analog Signals.	2		
Sensors and Actuators in NI LabVIEW Applications. Acquiring and Generating Digital signals	2		
Final Assessment of Laboratory Reports	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. 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 acquired skills will be required of employees who work with instrumentation systems where a suitable incorporation of sensors, actuators and hardware/software interfaces is required.

10. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade

Course	To understand of the theoretical concepts and to solve the course given problems	Written exam (E) + evaluation of the solved Homework (HW)	70%(E)+10%(HW)=80%
Seminar			
Laboratory	Active participation at laboratory works. The ability to develop small practical applications.	Continuous assessment	20%(L)
Project			
Minimum standard of performance: Final Grade G=(E+HW+L)/100; Condition to take the credits: G≥5;			

Date of filling in:		**Title Firstname NAME**	**Signature**
3.09.2022	Course	Assoc. Professor Rodica HOLONEC	
	Applications	Phd. Student Rapolti Laszlo	

Date of approval by the Department Board ……..

_____9.09.2022_____

Head of Departament …….
Prof.dr.ing. Honoriu VĂLEAN

Date of approval by the Faculty Council ……

_____26.09.2022_____

Dean
Prof.dr.ing. Liviu Cristian MICLEA