SYLLABUS

1. Data about the program of study

1.1 Institution	The Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Automation and Computer Science
1.3 Department	Computer Science
1.4 Field of study	Computer Science and Information Technology
1.5 Cycle of study	Bachelor of Science
1.6 Program of study/Qualification	Computer science/ Engineer
1.7 Form of education	Full time
1.8 Subject code	15.

2. Data about the subject

2.1 Subject name	***Electronic Measurements and Sensors***				
2.2 Course responsible/lecturer	Assoc. Professor Rodica Holonec, Phd eng				
2.3 Teachers in charge of seminars/ laboratory/ project	Lecturer Septimiu Crisan, Phd eng				
2.4 Year of study	II	2.5 Semester	1	2.6 Type of assessment (E - exam, C - colloquium, V - verification)	E
2.7 Subject category	*DF – fundamentală, DD – în domeniu, DS – de specialitate, DC – complementară*				DD
	DI – Impusă, DOp – opțională, DFac – facultativă				DI

3. Estimated total time

3.1 Number of hours per week	4	of which:	Course	2	Seminars		Laboratory	2	Project	
3.2 Number of hours per semester	56	of which:	Course	28	Seminars		Laboratory	28	Project	
3.3 Individual study:										
(a) Manual, lecture material and notes, bibliography										15
(b) Supplementary study in the library, online and in the field										8
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										15
(d) Tutoring										3
(e) Exams and tests										3
(f) Other activities:										-

3.4 Total hours of individual study (suma (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	
4.2 Competence	Basic Electrical circuit theory, Basic Electronics, Analysis methods for electronic circuits; General Physics

5. Requirements (where appropriate)

5.1. For the course	Computer, Cloud-based team collaboration software
5.2. For the applications	Laboratory room equipped with specific measuring devices and sensors

6. Specific competence

6.1 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
6.2 Cross competences	N/A

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

7.1 General objective	To provide a foundation in important topics of engineering system instrumentation such as: metrology, measurement techniques, electronic measurement devices, sensors 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 in order to perform the documentation, implementation, and development of complex equipment and measurement devices.

8. Contents

8.1 Lectures	Hours	Teaching methods	Notes
Measurement fundamentals. Terms and definitions. The structure of a complex instrumentation system. Sensors	2	Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation	The lectures are taught online
Fundamentals of Metrology. Measurement Units. Measurements Standards. Traceability. Measurement terminology. Errors and Uncertainties. The Measuring Instrument Specifications.	2		
Random Errors Analysis. Basic Concepts in Probability. Normal Distribution. Central Limit Theorem. The Evaluation of Uncertainties in Measurements	2		
Meters. Analog Meters-Classifications and Symbols. Types of Analog Instruments. Voltmeters. Ammeters. Wattmeters, Ohmmeters	2		
Measurements with Bridges and Potentiometers. Wheatstone Bridge. Principle. Strain gauge measurement bridges. Types of AC bridges. Potentiometers.	2		
Amplification in Instrumentation. Operational Amplifiers. Basic circuits. Instrumentation Amplifiers. Current to Voltage, Resistance to Voltage Converters. Bridge Amplifiers.	2		

Electronic Voltmeters. DC Electronic Voltmeters. Types of AC Electronic Voltmeters. Lock-in Amplifiers. Principles and Applications	2		
Electronic Counters. Digital measurement of frequency and time	2		
Digital Multi-meters (DMM). Computing Measuring Systems. Data Acquisition Boards. Sample and Hold Circuits. Nyquist theorem.	2		
Data Acquisition Boards Components. Digital to Analog Converters. Analog to Digital Converters. Virtual Instruments	2		
The Analog and Digital Oscilloscopes	2		
Transducers, Sensors and Actuators. Terminology. Principles and Classifications. Analog and Digital Sensors.	2		
Analog Sensors. Potentiometers. Variable-Inductance and Capacitance Sensors. Temperature sensors.	2		
Digital sensors. Encoders. Optical Sensors: Fiber-Optic Sensors, Light sensors	2		

Bibliography

1. Rodica Holonec, Electrical Measurements and Instrumentation, Editura Mediamira, Cluj-Napoca, 2003, 259 p, ISBN 973-9357-42-3
2. Todoran, Gh.,Copandean,R; Masurari Electrice si Electronice.Editura Mediamira; Cluj Napoca. 2003. 282p. ISBN 973-9357-61-X.
3. Dragomir, N.D., TÂRNOVAN, I.G., Crişan, T.E. – Electrical Measurement of Non Electric Quantities. Vol. I. Editura MEDIAMIRA, Cluj-Napoca, România, 2002. ISBN 973-9358-75-6.
4. TÂRNOVAN, I. G. – Metrologie electrică şi instrumentaţie. Editura MEDIAMIRA, Cluj-Napoca, România, 2003. ISBN 973-9357-39-3.
5. Munteanu,R., TÂRNOVAN,I.G., Dragomir,N.D., Popovici,O. – Electrotehnică şi convertoare energetice. Editura MEDIAMIRA, Cluj-Napoca, România, 1997.
6. http://users.utcluj.ro/~tarnovan/Electronic%20Measurements%20and%20Sensors.htm

8.2 Applications – Seminars/Laboratory/Project	Hours	Teaching methods	Notes
Analog and Digital Measurement Devices	2	Onsite & online 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		
Virtual Instrumentation: LabView - Basic Operations	2		
Virtual Instrumentation applications	2		
Data Acquisition Systems: Single Sample Acquisition Mode	2		
Data Acquisition Systems. Signal Processing Applications	2		
Temperature Measurement	2		
Level and Flow Measurement	2		
Displacement Measurement	2		
Angular Speed Measurement	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. Munteanu,R., Dragomir,N.D., TÂRNOVAN,I.G., Holonec,Rodica, Bortoş,P. – Tehnici de măsurare. Îndrumător de laborator. Atelierul de multiplicare al U.T.C.-N., 1995.

**Se vor preciza, după caz: tematica seminariilor, lucrările de laborator, tematica şi etapele proiectului.*

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 in designing or testing of sensors and instrumentation systems.

10. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	Final exam (E)-Theoretical questions and exercises (3 hours)	Online examination	80%
Seminar			
Laboratory	Practical circuit (P) Homework (HW)	Checking of functionality Verification of results	10% 10%
Project			
Minimum standard of performance: G=(E+P+HW)/100; Condition to take the credits: G≥5;			

Date of filling in:	**Titulari**	**Titlu Prenume NUME**	**Semnătura**
	Course	Assoc.Prof. Rodica Holonec, PhD eng	
	Applications	Lecturer Septimiu Crisan, PhD eng	

Date of approval in the department	Head of department Prof.dr.ing. Rodica Potolea
Date of approval in the Faculty Council	Dean Prof.dr.ing. Liviu Miclea