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	Applied Electronics
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
1.7 Form of education	Full time
1.8 Subject code	47.00

2. Data about the subject

2.1 Subject name	Sensors and Transducers						
2.2 Subject area	Theoretical area Methodological area Analytic area						
2.3 Course responsible	Assoc. Prof. Pop Septimiu, PhD Eng. Septimiu.pop@ael.utcluj.ro						
2.4 Teacher in charge with seminar / laboratory / project	Assoc. Prof. Pop Septimiu, PhD Eng. Septimiu.pop@ael.utcluj.ro Eng. Flutur Alexandru, Phd. Stud. Alexandru.Flutur@ael.utcluj.ro						
2.5 Year of study	IV	2.6 Semester	1	2.7 Assessment	E	2.8 Subject category	DS/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	36
Supplementary study in the library, online specialized platforms and in the field	
Preparation for seminars / laboratories, homework, reports, portfolios and essays	28
Tutoring	2
Exams and tests	3
Other activities:	

3.7 Total hours of individual study	69
3.8 Total hours per semester	125
3.9 Number of credit points	5

4. Pre-requisites (where appropriate)

4.1 curriculum	Passive Electronics Components and Circuits, Fundamental Electronic Circuits, Basis of Data Acquisition System, Microcontroller, Digital Signal Processing
4.2 competence	Operating principles for electronic devices: resistor, capacitor, diode, operational amplifier, MOSFET and BJT transistors, Theoretical analyses of electronic circuits. Embedded systems,

	Data acquisitions, Data processing.

5. Requirements (where appropriate)

5.1. for the course	Amphitheatre, Cluj-Napoca
5.2. for the seminars / laboratories / projects	Laboratory no. 407 Observatorului, Cluj-Napoca

6. Specific competences

Professional competences	C2. Applying the basic methods for signal acquisition and processing • C2.1 Temporal, spectral and statistical characterization of signals. • C2.2 Explaining and interpreting the methods of acquisition and processing of signals. • C2.3 Use of simulation environments for signal analysis and processing. • C2.4 Use of the specific method and tools for signal analysis. C3. Application of the basic knowledge, concepts and methods regarding the architecture of computing systems, microprocessors, microcontrollers, programming languages and techniques • C3.4 Development of programs for a general and / or specific programming language, starting from the specification of the requirements and until the execution, debugging and interpretation of the results in correlation with the processor used. • C3.5 Projects involving hardware (processors) and software (programming) components. 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 • C4.2 Explanation and interpretation of the specific requirements of the hardware and software structures in the fields: computer programming, high-level and specific languages, CAD techniques for making electronic modules, microcontrollers, computer systems architecture, programmable electronic systems, graphics, reconfigurable hardware architectures • C4.5 Design of dedicated equipment's in the fields of applied electronics, which use: microcontrollers, programmable circuits or computing systems with simple architecture, including related programs C6. To solve technological problems, specific to applied electronics • C6.1 Defining the principles and methods underlying the manufacture, adjustment, testing and troubleshooting of the appliances and equipment in the fields of applied electronics

Cross competences	N.A.

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

7.1 General objective	• To understand sensors and transducers working principle, • Develop the skills in designing digital systems with Sensors, • Presents the concept of measuring instruments and the methods of measurement and the use of different sensors and transducers. • Improve the ability of student to analyze the measurements circuits from performance point of view.
7.2 Specific objectives	1. Understanding sensors and transducers characteristics and linear and non-linear transfer function, 2. Design digital systems with analog and digital convertor/ digital analog converter and microcontroller, 3. Developing skills into measurement circuits, 4. Understanding of a measuring chain, 5. Sensor modeling using electrical equivalent circuit.

8. Contents

8.1 Lecture (syllabus)	Teaching methods	Notes
1. Introduction into sensors transducers and actuators, description, parameters and classification, static and dynamic characteristics.	Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation	Theoretical Exam Use of .ppt presentation, projector, blackboard
2. Resistive sensors for temperature, movement, strain and humidity measurement		
3. Capacitive sensors for level, humidity and accelerometers – MEMS sensors		
4. Inductive sensor for proximity, movement LVDT and a special study of the vibrating wire transducer		
5. Sensors with semiconductor, temperature, hall, photodiode and piezoelectric transducers		
6. Force, Pressure and Flow sensors		
7. Sensors for distance measurement- Optical encoder, Ultrasound method		
8. Conditioning circuits for resistive sensors with current source and differential analog digital converter - AD7705		
9. Conditioning circuits for capacitive sensors – astable-multivibrator with single OpAmp and 555,		

measuring small capacitive sensor's using switched capacitor solution		
10. Conditioning circuits with analog digital convertor and frequency counter design methods		
11. Processing technique of data obtained from the sensor measurement		
12. Interfaces and sensors network		
13. Sensorial systems, Smart sensors, Sensors and IoT		
14. Preparation for the final exam.		
Bibliography Bibliography 1. Jacob Fraden, Handbook of Modern sensors. 1996, Springer-Verlag, New York. 2. Analog Device, Transducer Interfacing Handbook, 1980, Massachusetts, USA.		
8.2 Seminar / laboratory / project	Teaching methods	Notes
1. Presentation of lab instruments and used sensors	Didactic and experimental proof, didactic exercise, teamwork	Practical test the students need to develop an application with a sensor. Use of laboratory instrumentation, experimental boards, computers,
2. Sensors characteristics, Use of nonlinear transfer functions		
3. Temperature sensor NTC, conditioning circuit with current source		
4. Resistive sensor - conditioning circuit for 3 Wire RTD –online compensation technique		
5. Capacitive sensor-measurement of capacitive sensor using lab instruments, measuring small capacitive sensor's using switched capacitor solution		
6. Photodiode - Light detection		
7. Optical encoder, decoding of quadrature output signals A-B		
8. Distance measurement using ultrasound technique		
9. Inductive sensor – voltage measurement transformers, Hall effect current sensor		
10. Vibrating wire transducer –sensing and frequency measurements		
11. Industrial sensors with digital and analog 4-20mA and 0-5V output signal		
12. Sensors Network -RS485 standard-modbus, I2C protocol		
13. Lab recovery and finalization of laboratory activity		
14. Laboratory test		
Bibliography Labs in printed format or electronic format: https://drive.google.com/drive/folders/1p7J33n7upZGpFy18UgUlQrnZ_i5ax2Cs?usp=sharing The lab is updated every year to be in accord with news in sensor theology.		

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, where the students carry out the internship stages and/or occupy a job (in the field of applied electronics), 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	- 3 formative evaluation tests (problem solving) - Summative evaluation written exam (theory and problems)	80%
10.5 Seminar/ Laboratory	The level of acquired knowledge and abilities	- Continuous formative evaluation - practical lab test	20%
10.6 Minimum standard of performance			

Quality level:
Minimum knowledge:
- ✓ Knowledge about passive component: resistor, capacitance, inductance, diode
- ✓ Theoretical analyses of circuit
- ✓ Understanding the operating principles of the fundamental electronic circuits;

Minimum competences:
- ✓ To be able to use the laboratory instruments like: Oscilloscope, Signal generator
- ✓ Knowledge in embedded system

Quantitative level:
- ✓ Need to be made and complete all labs
- ✓ Exam note and lab note to be minimum 5
- ✓ Final note is: 0,8*Exam +0,2*lab

Date of filling in:	Responsible	Title Surname NAME	Signature
26.06.2023	Course	Assoc. Prof. Pop Septimiu, PhD Eng.	
	Applications	Assoc. Prof. Pop Septimiu, PhD Eng.	
		Phd. Stud. Alexandru.Flutur@ael.utcluj.ro	

Date of approval in the Department of Applied Electronics 28.06.2023	Head of Department Prof. Dorin PETREUS, PhD Eng.
Date of approval in the Council of Faculty of Electronics, Telecommunications and Information Technology 11.07.2023	Dean Prof. Ovidiu Aurel POP, PhD Eng.