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	Telecommunications Technologies and Systems/ Engineer
1.7 Form of education	Full time
1.8 Subject code	TST-E102.00

2. Data about the subject

2.1 Subject name	Sensors and Transducers						
2.2 Subject area	Theoretical area Methodological area Analytic area						
2.3Course responsible	Assoc. Prof. Septimiu Pop, PhD eng. Septimiu.pop@ael.utcluj.ro						
2.4Teacher in charge with seminar / laboratory / project	Assoc. Prof. Septimiu Pop, PhD eng. Septimiu.pop@ael.utcluj.ro						
2.5Year of study	4	2.6Semester	1	2.7Assessment	E	2.8Subject category	DS/DFac

3. Estimated total time

3.1 Number of hours per week	4	of which: 3.2 course	2	3.3 laboratory	2
3.4 To Total hours in the curriculum	56	of which: 3.5 course	28	3.6 laboratory	28
Distribution of time					hours
Manual, lecture material and notes, bibliography					35
Supplementary study in the library, online specialized platforms and in the field					
Preparation for seminars / laboratories, homework, reports, portfolios and essays					28
Tutoring					3
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	N / A
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 applications	Laboratory, Cluj-Napoca

6. Specific competences

Professional competences	N/A
Transversal competences	N/A

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

7.1 General objective	To understand sensors and transducers behavior and to develop and analyze the measurements circuits
7.2 Specific objectives	1. Understanding sensors and transducers characteristics and linear and non-linear transfer function 2. Developing skills into measurement circuits 3. Understanding of a measuring chain.

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 Use of .ppt presentation, projector, blackboard	**Theoretical Exam**
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

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, team work	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 yearto 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 skills acquired will be required for employees in the following possible occupations according to the COR: electronics engineer, design engineer, research engineer in applied electronics, engineer of research in microelectronics, engineers in electrotechnology, manager of information technology and communications, systems and computer systems engineer, communications engineer, specialists in information technology.

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)	*80%*

		- Summative evaluation written exam (theory and problems)	
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 with passive components*
- ✓ *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 First Name SURNAME**	**Signature**
27.09.2021	Course	Assoc. Prof. Septimiu Pop, Ph.D	
	Applications	Assoc. Prof. Septimiu Pop, Ph.D	

Date of approval in the Department of Communications 27.09.2021	Head of Communications Department Prof. Virgil DOBROTA, Ph.D.
Date of approval in the Council of Faculty of Electronics, Telecommunications and Information Technology 27.09.2021	Dean Prof. Gabriel OLTEAN, Ph.D.