SYLLABUS

1. Data about the program of study

1.1	Institution	The Technical University of Cluj-Napoca
1.2	Faculty	Electronics, Telecommunications and Information Technology
1.3	Department	Applied Electronics
1.4	Field of study	Electronics and Telecommunications Engineering
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					Sensors, measurements circuits, data analysis					
2.3	Course responsible/lecturer					Assoc. Prof. Prof. Septimiu Pop, PhD					
2.4	Teachers in charge of applications					Assistant Prof. Vlad Bande, PhD					
2.5	Year of study	III	2.6	Semester	1	2.7	Assessment	Exam	2.8	Subject category	DS/ FAC

3. Estimated total time

Year/ Sem.	Subject name	No. of weeks	Course [hours/week]	Applications [hours/week]			Course [hours/sem.]	Applications [hours/sem.]			Indiv. study	TOTAL	Credits
				S	L	P		S	L	P			
III / 1	Sensors and Transducers	14	2		2		28		28		74	130	5

3.1	Number of hours per week	4	3.2	of which, course	2	3.3	applications	2
3.4	Total hours in the curriculum	56	3.5	of which, course	28	3.6	applications	28

Individual study	Hours
Manual, lecture material and notes, bibliography	40
Supplementary study in the library, online and in the field	-
Preparation for seminars/laboratory works, homework, reports, portfolios, essays	28
Tutoring	3
Exams and tests	3
Other activities	0

3.7	Total hours of individual study	74
3.8	Total hours per semester	130
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 electrical circuits: voltage transfer characteristics; transfer function, embedded systems, data acquisitions, data analyses.

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	Theoretical knowledge (what the student must know):	The electrical characteristics of basic electrical device. Theoretical analyses of electrical circuits: voltage transfer characteristics; transfer function, data acquisitions, digital signal processing, microcontroller.
	Acquired skills (what the student is able to do):	After completing the discipline, the students will be able to: Understand sensors and transducers behavior: electrical equivalent model, electrical parameters, and transfer functions. The measurements circuit; to design an appropriate schema for measurements of a lot of sensors' type. Integrate the sensors and conditioning circuit into electrical systems with the microcontroller, Analyze the data obtained through measurements of sensors in statistical conditions and when the physical parameter evolution is described by a mathematical equation.
	Acquired abilities: (what type of equipment the student is able to handle)	After completing the discipline, the students will be able to: - use a lot of sensors type, resistive, capacitive, inductive, optic, acoustic, piezoelectric, - the lab instrumentation (power supply, oscilloscope, function generator, multimeter) for the experimental study of sensors and measurement circuits - use the experimental boards - connect the lab instrumentation with the experimental boards, in order to experimentally study the sensors - use the computer to the numerical data obtained through the explorations - store and analyze the numerical data obtained through the explorations
	In accordance with Grila1 and Grila2 RNCIS	N.A.
Cross competences (Grila1 and Grila2 RNCIS)		N.A.

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

7.1	General objectives	To understand sensors and transducers behavior and to develop and analyze the measurement 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 and compute of an inverse transfer function.

8. Contents

8.1. Lecture (syllabus)		Teaching methods	Notes
1	Introduction into sensors transducers and actuators, description, parameters and classification.	Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation	Use of .ppt presentation, projector, blackboard
2	Resistive sensors for temperature, movement, strain and humidity measurement		
3	Capacitive sensors for level and vibration measurement		
4	Inductive sensor for proximity, movement 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	Optical encoder		
8	Conditioning circuits with current source		
9	Conditioning circuits with AD7705 an 555		
10	Conditioning circuits with analog digital convertor and counter		
11	Smart sensors		
12	Processing technique of data obtained from the sensor measurement		
13	Interfaces and sensors network		
14	Recapitulation. Preparation for the final exam.		
8.2. Applications (lab)		Teaching methods	Notes
1	PSpice model for RTD, capacitive sensors	Didactic and experimental proof, didactic exercise, team work	Use of laboratory instrumentation, experimental boards, computers, white/magnetic board
2	PSpice model for vibrating wire transducer		
3	Temperature sensor, RTD, NTC		
4	Capacitive level sensor		
5	Industrial proximity sensor		
6	Vibrating wire transducer		
7	Optical encoder		
8	Hall sensor, current sensor		
9	Humidify and light sensor		
10	Measure of heart rate with optical sensor		
11	Ultrasonic sensor in distance measurement		
12	Industrial sensors with 4-20mA and 0-5V output signal		
13	Laboratory test		
14	Lab recovery and finalization of laboratory activity		

Bibliography

1. Jacob Fraden, Handbook of Modern sensors. 1996, Springer-Verlag, New York.
2. Analog Device, Transducer Interfacing Handbook, 1980, Massachusetts, USA.

9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

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. Evaluations

Activity type	10.1	Assessment criteria	10.2	Assessment methods	10.3	Weight in the final grade
Course		The level of acquired theoretical knowledge and practical skills		- 3 formative evaluation tests (problem solving) - Summative evaluation written exam (theory and problems)		- T, max 10 pts. 20% - E, max 10 pts. 60%
Applications		The level of acquired abilities		- Continuous formative evaluation - practical lab test		- L, max. 10 pts. 20%
10.4 Minimum standard of performance						
$L \geq 5$ and $E \geq 4$ and $0,6E+0,2L+0,2T \geq 4.5$						

Date of filling in	Course responsible	Teachers in charge of applications
01.10.2018	Assoc. Prof. Septimiu Pop, PhD	Assist. Prof. Vlad Bande. PhD