

SUBJECT IDENTIFICATION

1. SUBJECT TITLE

Subject title: *Sensors et circuits for conditioning signals*

Tenured Professor: *Conf. Ioan Mihut*

Type: *general training*

Number of course hours: 28 hrs

Number of application hours : 1 hrs

Number of credit points: 3

Home work: 1 hr/week

Semester: 6

Package : common curricular area

Prerequisites: graduating the following courses:

- Materials
- Electronic Devices and Circuits
- Analog ICs
- Digital ICs
- Electronic Measurements I

2. OBJECTIVES OF SUBJECT

- for courses

The course presents fundamentals on measurement techniques for non-electrical system parameters using electrical methods. Main transducers are presented and their corresponding conditioning circuits.

- for applications

N.A.

3. SPECIFIC COMPETENCIES (within the competence range of the academic training programme): C51, C54, C62

The students are acquainted with non-electrical parameters measurement using electrical methods techniques. Graduating this course students will be able to understand and effectively use techniques specific to non-electrical parameter measurements using electronic equipment.

4. SYLLABUS (1 page)

a. Course:

Chapter	Content	Hours
1	General Concepts. 1.1. Terminology. Measurement Systems. Transducers, Sensors and Actuators 1.2. Signal Conditioning. Interfaces, Signal Domains, Conversions. 1.3. Sensors classification.	2
2	Measurements Systems Characteristics. 2.1. Accuracy, Precision, Sensibility, Linearity, Resolution. 2.2. Systematic and Random Errors. 2.2. Dynamic characteristics.	2
3	Primary Sensors. 3.1. Temperature. Debit. Flow Speed. Level. 3.2. Force and Torque. Acceleration.	2
4	Resistive Sensors. 4.1. Potentiometers. Tensometers. Thermo-resistors. Thermistors. 4.2. Magneto-resistors. Photo-resistors. Resistive Higmeters. 4.3. Gas Resistive Sensors	2
5	Variable Reactance Sensors. 5.1. Capacitive Sensors. 5.2. Inductive Sensors. 5.3. Variable Transformers.	2
6	Electromagnetic Sensors. 6.1. Faraday Law Based Sensors. 6.2. Hall Effect Sensors.	1
7	Generating Sensors. 7.1. Thermocouples. Piezoelectric Sensors. Pyroelectric Sensors. 7.2. Photovoltaic Sensors. Electrochemical Sensors.	2
8	Digital Sensors. 8.1. Incremental and Absolute Position Encoders. 8.2. Resonant Sensors.	2
9	Other Sensing Methods. 9.1. Semiconductor Junction Based Sensors. (Temperature, Magneto-diodes and magneto-transistors, Photodiodes, Position Photo-detectors, Phototransistors, Nuclear Radiation Detectors). 9.2. MOS Transistor Based Sensors. CCD and CMOS Image Sensors. 9.3. Optic Fiber Sensors. 9.4. Ultrasound Sensors.	3
10	Operational Amplifier – Fundamental Building Block for Signal Conditioning Circuits.	2
11	Typical Circuits Using OpAmps in Signal Conditioning. 11.1. DC Amplifiers. 11.2. AC Amplifiers. 11.3. Integrators.	6
12	Measuring Amplifiers and Conversion Circuits. 12.1. Differential and Instrumentation Amplifiers (Typical Topologies, Offset and Drift). 12.2. Low Drift Amplifiers. (Chopper Amplifiers, Auto-zero Amplifiers). 12.3. Isolation Amplifiers. Charge Amplifiers. 12.4. Trans-impedance Amplifiers. Voltage-to-Current Converters.	6
13	Nonlinear Circuits. 13.1. Peak Detectors. Sample and Hold Circuits. 13.2. Phase Sensitive Detectors. 13.3. Logarithmic and Exponential Amplifiers. Analog Multipliers. 13.4. Comparators. Hysteretic Comparators.	3
14	Analog Switches and Multiplexers.	1
15	Voltage-to-Frequency and Frequency-to-Voltage Convertors.	2
16	Unbalanced Bridges. 16.1. Sensibility, linearity. Analog Linearization for Resistive Bridge. 16.2. Calibration and Initial Balance. Sensors Connection to the Bridge.	3

	16.3 Unbalanced Bridge Supply.	
17	Analog Compensators.	1
18	Interfaces. 18.1. Reducing interfaces. 18.2. Ground Connection in Signal Conditioning Circuits.	1
	Total:	42

b. Applications:

N.A.		
	total	0h

5. ASSESSMENT

- a) Activities assessed and their weighting :(according to the Graduating Regulations)
- b) Minimum passing requirements:
 - 100% out of the final evaluation task;
- c) Final scoring; :50-55 points – mark 5 ; 56-63 points – mark 6; 64-72- mark 7; 73-81- mark 8; 82-90 mark- 9; 91-100 mark-10.

6. BENCHMARKING (presentation style, materials etc.)

7. BIBLIOGRAPHY

- 1) M. Bodea, I. Mihut, L. Turic, V. Tiponuş, “Aparate electronice de măsurare și control”, Editura didactică și pedagogică, Bucureşti, 1986.
- 2) E.O. Doebelin, “Measurement Systems: Application and Design”, 4th ed., Mc-Graw-Hill, New York, 1990.
- 3) J. Fraden, “Handbook of Modern Sensors, Physics, Design, and Application”, 2nd ed., Woodbury, American Institute of Physics, New York, 1997.
- 4) H.W. Ott, “Noise Reduction Techniques in Electronic Systems”, 2nd ed., John Wiley & Sons, New York, 1988.
- 5) R. Pallas-Areny, J.G. Webster, “Sensors and Signal Conditioning”, 2nd ed., John Wiley & Sons, New York, 2001.

HEAD OF DEPARTMENT / CHAIR

Prof.Dr.Ing. Gheorghe Stefan

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Conf.Dr.Ing. Ioan Mhut