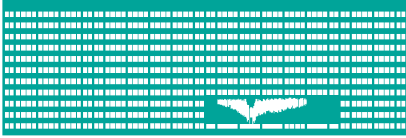




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Measurement Sensor Devices

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Study material

- Lecture notes
- BOLTON, W. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 6th Ed. Harlow: Pearson, 2016. 663 p. ISBN 978-1-292-07668-3.
- FRADEN, J. Handbook of modern sensors: physics, designs, and applications. 5th ed. Springer, 2016. 758 p. ISBN 13 978-3-319-19303-8.
- BOLTON, W. Mechatronics: a multidisciplinary approach. 5th ed. Harlow: Pearson, 2011. ISBN 978-0-273-74286-9.
- Links on the subject pages 352lab.vsb.cz.
- !!! Presentations are not available !!!

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What will you know?

- Content and outline of the course
- Exercise content
- Terms of credit
- Static properties
- Errors
- Uncertainties.

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Subject content

1. Introduction, subject content, description of laboratory tasks
2. Basic description of systems, dynamic and static properties of measuring chain elements, measurement errors
3. Passive circuit elements resistor, capacitor, coil
4. Semiconductor elements diode, transistor, triac, thyristor, ... Use
5. Operational amplifiers
6. Classification of sensors, measurement chain, explanation of the physical principles of sensors, new principles in sensor technology
7. Single-chip computers internal structure, distribution, control systems I/O interface
8. PIC instruction set
9. Programming environment for PIC programming, creating a program in assembler
10. LabView - familiarization with the development environment, description of selected system blocks
11. LabView - procedure for creating an application in the development environment
12. LabView - system communication with the environment.

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Conditions for exercise

- 80% participation in exercises
- Physically measure all practical measurements
- Submission of all protocols (even with zero points)
- Submission of the completed semester work (Measuring chain proposal, LabView application)
- <http://352lab.vsb.cz/>

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Exam

- Enrolled credit (21-35 points).
- Entrance test 0-40 points (min. 21 points)
 - 10 abcd questions (relating to basic knowledge from exercises)
 - 1 creative question (measuring chain design, evaluation, ...).
- 2 oral questions. (preparation 10 min., outline, each question min. 50%).

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Laboratory tasks

- Protocol no. 1 (Evaluation and measurement of speed with optical distance sensor).
- Protocol no.2 (MEMS accelerometer).
- Protocol no. 3 (Measurements on operational amplifiers).
- Protocol no. 4 (Measurements on RLC elements).
- Protocol no. 5 (Two-value control with gates).
- Protocol no. 6 (Tenzometry).
- Protocol no. 7 (Návrh měřicího řetězce).
- Work on the LabView project.

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Lecture No.2

Basic building blocks of measuring systems (repetition).
Static properties of elements of measuring and control systems (beginning).

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Basic terms (revision)

- System
- Element
- Binding
- System surroundings
- Information
- Signal
- Resolution level

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Control circuit diagram (serial form):

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Control circuit variables

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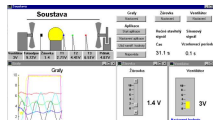
Basic concepts of measurement and sensor technology

Measurement is a source of information:

Elements of measuring technology

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Static properties of control system members



Static characteristics

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Static properties of sensors

- Scale range
- Sensor sensitivity threshold
- Sensor distinguishability
- Sensor reproducibility
- Measuring range
- Device Sensitivity

$$C = \Delta y / \Delta u$$

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Static properties of sensors

- Calibration curve
- Correction
- Accuracy class
- Overload
- ...

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Static properties of sensors – errors (uncertainties)

- Errors are

$$\Delta y = y_m - y_s; \quad \delta_y = \frac{\Delta y}{y_s};$$

- According to their effect, errors can be divided into
- According to their source, they are divided into mistakes

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Static properties of sensors – errors (uncertainties)

- Systematic errors

- Random errors

$$\bar{y} = \frac{1}{n} \sum_{i=1}^n y_i$$

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Static properties of sensors – errors (uncertainties)

- Standard type uncertainties A - u_A

- Standard type uncertainties B - u_B

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Static properties of sensors – errors (uncertainties)

- Combined standard uncertainty - u_c

$$u_c^2 = u_A^2 + u_B^2$$

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What did you learn?

- Subject content and syllabus:
- Exercise content
- Exam prerequisites
- Static properties
- Errors
- Uncertainties.

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Thank you for your attention

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