Fakulta strojní VŠB – TUO

Katedra automatizační techniky a řízení

Control Instrumentation

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Katedra automatizační techniky a řízení

Lecture No. 4
Division of sensors and examples for measuring quantities in engineering and their evaluation

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Katedra automatizační techniky a řízení

What do you find out?

- Division of sensors
- Conversion of the measured value to the measurable
- The essence of transfers
- Examples of sensors
- Ways of evaluation
- … .

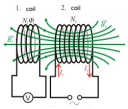
Principles of measurement

The measured quantity **changes the electrical**

- **Direct measurement methods –**
- **Indirect measurement methods –**

Principles of sensors

$$R = \rho * \frac{l}{S}[\Omega] \qquad R = R_0(1 + \alpha\Delta t)[\Omega]$$

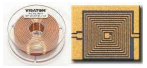


$$C = \frac{Q}{U}[F] \qquad C = \varepsilon_0 \varepsilon_r \frac{S}{d}[F]$$

$$L = \frac{\Phi}{I}[H]$$

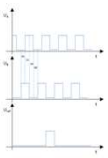
$$U_i = -L\frac{dI}{dt}[V]$$

$$L = \frac{\mu N^2}{l} S[H]$$



Criterion I –

- for measuring
- …



Criterion I - according to the measured quantity

This is one of the **basic criteria used by the designer**

Criterion II –

- Capacitive

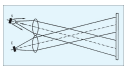
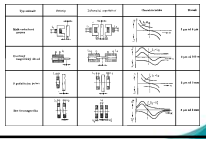
… .









Criterion II –

Not all methods of evaluation may be suitable for measuring in the conditions of technology.

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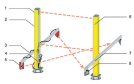
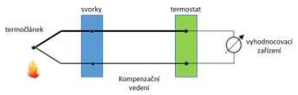
Criterion III - according to

- Active





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Criterion III -

The essence of this criterion is whether the given sensor

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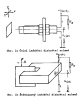
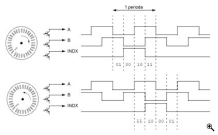
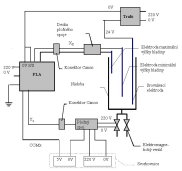
Criterion IV – according to the method of

- Continuous







Criterion IV – according to the method of

Values from sensors can be

Requirements

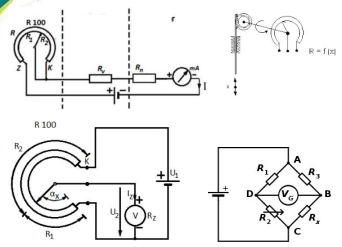
- Principle of sensor

- measurement of dimensions, length, presence of objects, position, level height of liquids and loose materials
- measurement of flows and pressures of gases, liquids and bulk materials
- temperature and heat measure
- measuring speed, shaft speed, weight, forces, torques and vibrations
- …

Position, dimension, displacement - resistiv sensors

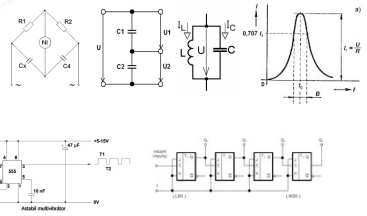
- Angle of rotation

Evaluation of resistance sensors



$$U = IR$$

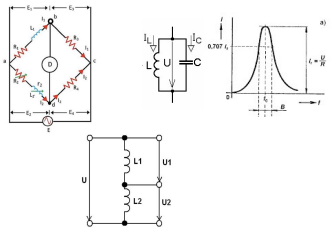
Evaluation of capacitive sensors



$$U = IR$$

$$X_c = \frac{1}{\omega c} = \frac{1}{2\pi f c}$$

Evaluation of induction sensors



$$U = IR$$

$$X_L = \omega L = 2\pi f L$$

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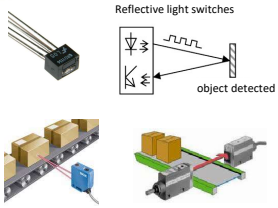
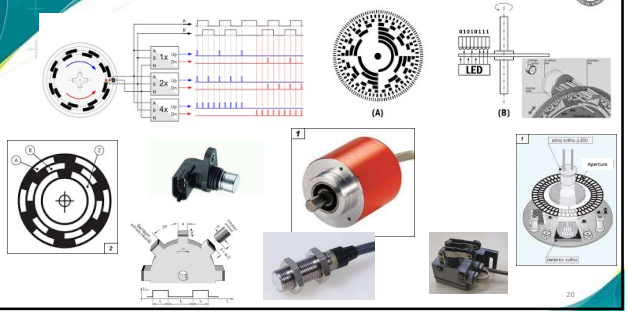
Evaluation of optical sensors

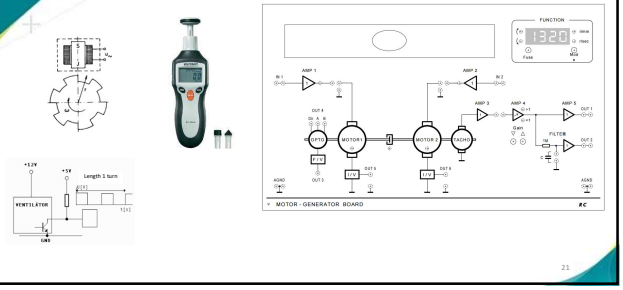
Reflective light switches



Measurement of rotation angle, rotation speed, position



RPM measurement



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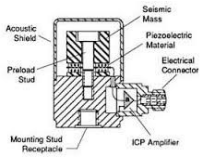
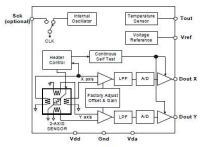
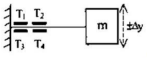
Measurement of acceleration







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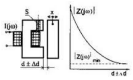
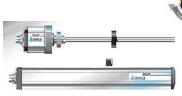
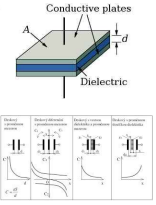
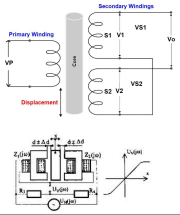
Position measurement - linear



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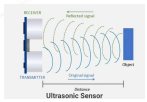
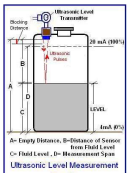
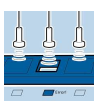
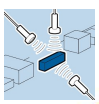
Measurement of water level, presence of an object







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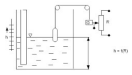
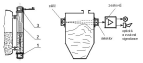
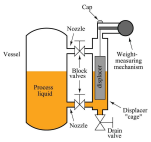
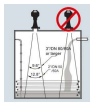
Level measurement



Bubbler type level measurement device

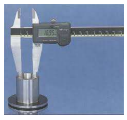


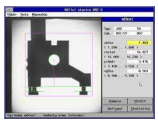




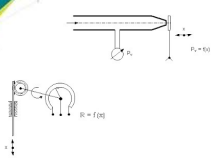
Measurement of dimensions

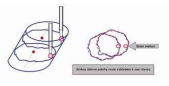
sliding scale



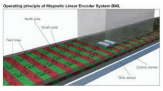


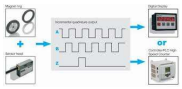
Displacement measurement

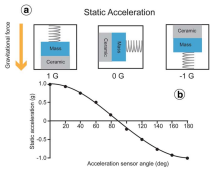




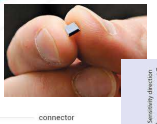
Measurement speed

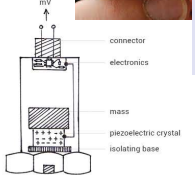


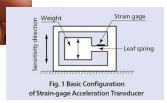


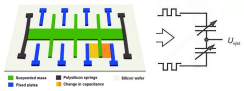


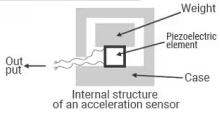
Measurement of acceleration

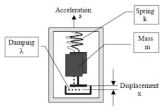




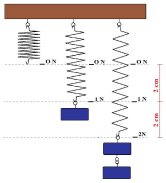


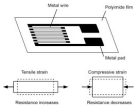


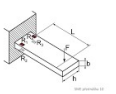




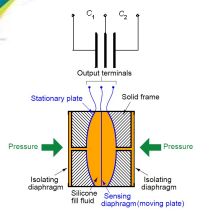
Strength measurement

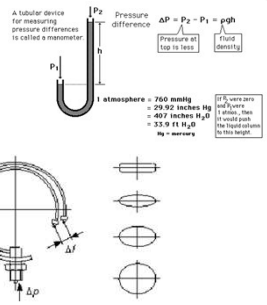




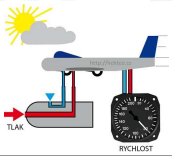


Pressure measurement

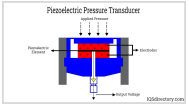


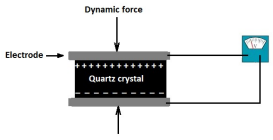


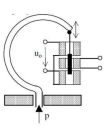
Pressure measurement



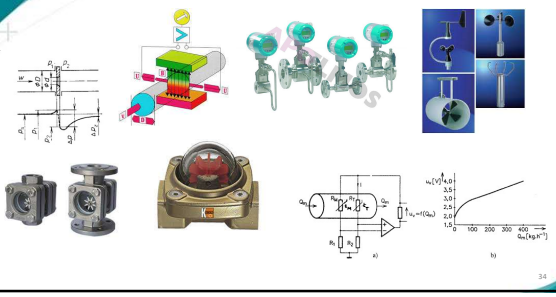
Pressure measurement



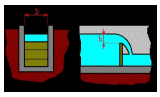


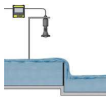


Flow measurement

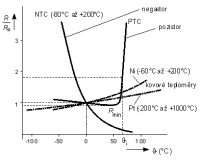


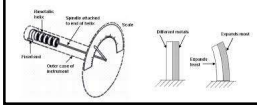
Flow measurement



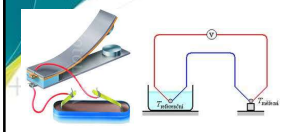


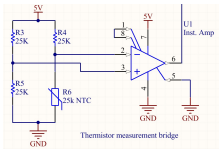
Temperature measurement





Temperature measurement





What was the content of the lecture?

- Division of sensors
- Conversion of the measured value to the measurable
- The essence of transfers
- Examples of sensors
- Ways of evaluation
- … .