

Fakulta strojní VŠB – TUO
Department of Control Systems and Instrumentation

**Control Instrumentation
2024**

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**Lecture No. 5
Actuators and their drives**



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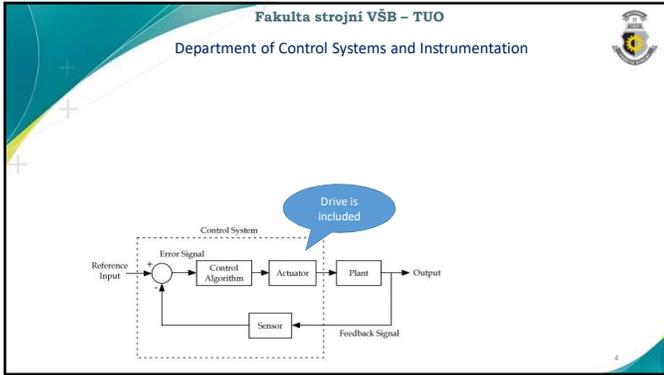
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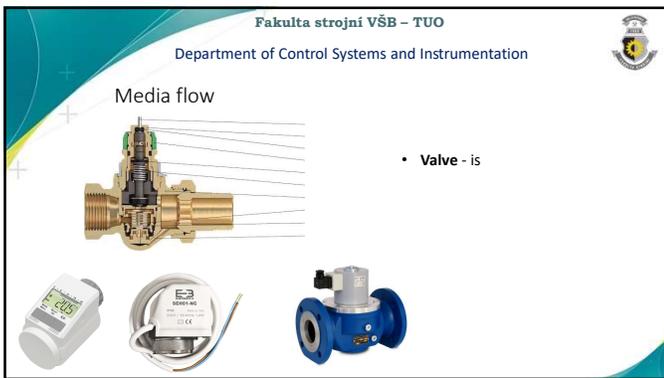
What do you find out?

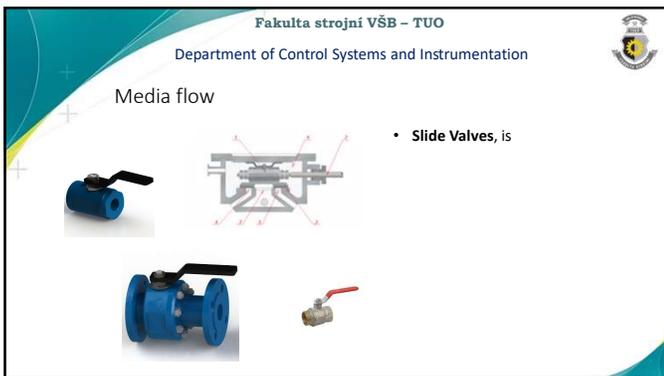
- Actuators
- Drives, structure, management
 - DC motors
 - AC motors
 - Piezomotors
 - Coils, magnets
-



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Temperature



- **Heating coil** – resistance wire changing electrical power to

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Air flow



- The active element in the case of air flow is usually

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Rotational movement



- The action member in the case of rotary motion is usually

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Linear motion



- For actuators implementing rectilinear movement, it is

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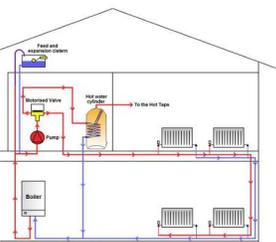
The angle of rotation



- Flap
- Elevator of wing
- ...

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Use of drives for actuators in regulation



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Drives

- Drives can be divided according to the form of energy consumed as follows
- Mechanical drives can perform two types of motion

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Actuators (example depends on technology)

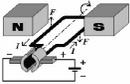
- Regulators for controlling the flow of gases, air and liquids
- Temperature regulation
- Speed control
- Position regulation
- ...



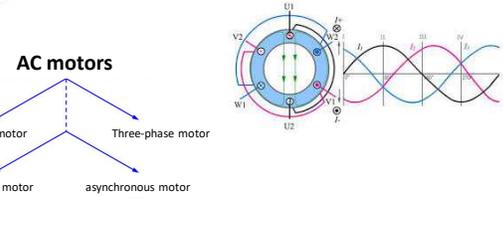
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Drives

- Electric drives
 - by shape
 - according to the cooling method
 - according to the supply voltage.



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Drives



AC motors

- Single-phase motor
 - synchronous motor
 - asynchronous motor
- Three-phase motor
 - synchronous motor
 - asynchronous motor

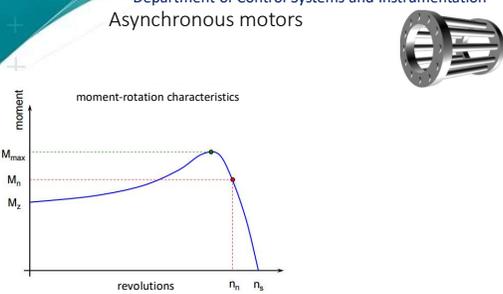
The diagram shows a cross-section of a motor with stator windings labeled U1, U2, V1, V2, W1, W2 and rotor windings labeled I1, I2, I3, I4, I5, I6. It also shows three-phase sinusoidal waveforms.

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Asynchronous motors

The three-phase asynchronous motor is the most widely used electric motor in industry. It is cheap, well adjustable and has a simple design. It is produced for a wide range of powers (from tens of Watts to MegaWatts).



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Asynchronous motors



moment-rotation characteristics

moment

M_{max}
 M_n
 M_2

revolutions

n_{n1} n_s

The graph shows the relationship between moment and revolutions. The curve starts at M_2 at n_s , rises to a peak at M_{max} near n_{n1} , and then drops. A 3D image of a motor is shown to the right.

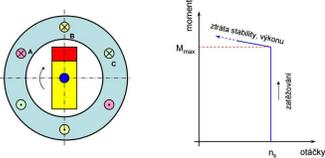
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Asynchronous motors

We can control asynchronous motors:



The slide features a header with the university name and department. Below the title, it states 'Asynchronous motors' and 'We can control asynchronous motors:'. Two ABB inverters are shown: a larger one on the left and a smaller one on the right.

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Synchronous motors



The slide features a header with the university name and department. Below the title, it states 'Synchronous motors'. On the left, there is a diagram of a synchronous motor with its rotor and stator. On the right, there is a graph of torque (otáčky) versus moment (moment) showing a constant torque region up to a maximum moment M_{max} and a stability limit.

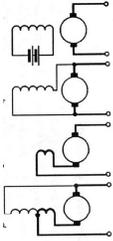
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Single-phase commutator motors

The speed of an asynchronous motor is limited by the frequency of the current. E.g. this speed is not enough for power tools.

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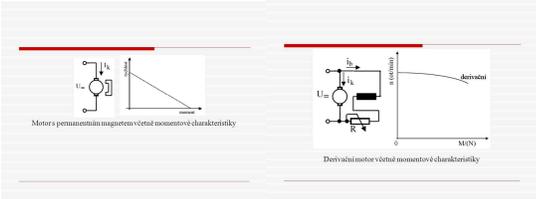
DC motors

According to the excitation, we distinguish:
with foreign (a) –
by derivation (b) –
series (c) –
compound (combined) (d) –



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DC motors



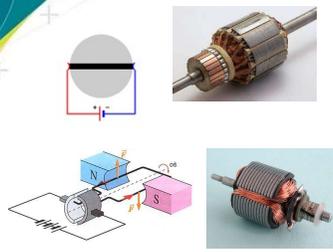
Motor s permanentním magnetem včetně momentové charakteristiky

Derivační motor včetně momentové charakteristiky

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Commutator

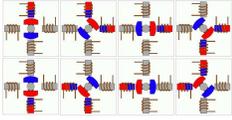
Commutator is a special ring in electrical engineering.



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Stepper motors

A **stepper motor** is a synchronous machine, usually powered by pulses of direct current. The magnetic field is

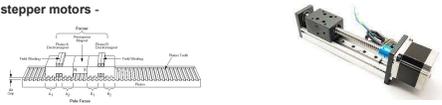
Advantages

A disadvantage

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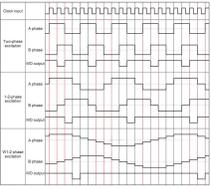
Stepper motors

- Passive Stepper Motors –
- Active stepper motors –
- Hybrid stepper motors –
- Linear stepper motors –



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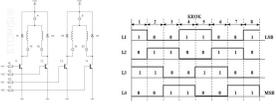
Stepper motors

A full step

Half-step

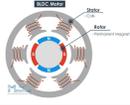
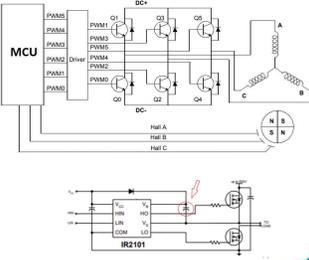
Micro Stepping



L1	1	2	3	4	5	6	7	8	9	10	11	12
L2	1	2	3	4	5	6	7	8	9	10	11	12
L3	1	2	3	4	5	6	7	8	9	10	11	12
L4	1	2	3	4	5	6	7	8	9	10	11	12

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BLDC motor


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Servo drive

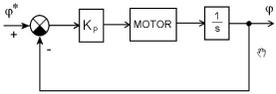
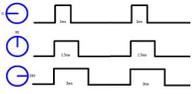
- Servo
 - A servo motor, abbreviated as servo, is a motor for



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Servo drive

A servo motor, abbreviated as servo, is a motor for


The servo can be in motion:
 Loosely
 ... Restricted to a closed interval
 ...

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Linear motors

Rotary Motor: Sator, Winding, Rotor, Permanent Magnet

Linear Motor: Air Gap, Permanent Magnet

What is Linear Induction Motor?

Electrical 4 U

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Piezoactuators

Piezoelectric phenomenon is the ability of a crystal to generate an

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Connection of components

Upper part

Middle part

Bottom part (base)

Piezomotor LT202DA-080D100

Piezomotor LT202DA-101D1A00

power supply 48 V

LAN RS485

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Electromagnets

An **electromagnet** is a coil with a magnetically soft steel core, used to create a temporary magnetic field.

The slide contains three diagrams: 1) A photograph of a small blue and black solenoid. 2) A schematic diagram of an electromagnetic relay with labels: 'spring', 'screw', 'moving part', 'gavel', and 'bell'. 3) A cross-sectional diagram of an electromagnetic valve with labels: 'coil', 'armature', 'spring', 'piston', and 'magnetic valve core'.

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What was the content of the lecture

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Thank you for your attention ...

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