EEM 451 Industrial Control Systems

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What does Industrial Control System mean?

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An *industrial control system* is union of several control systems used in industrial process.

Industrial process is the set of consecutive steps that is applied to the raw material to get end product.
Milk Factory

- Store the collected milks in refrigerated silos
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- Testing by taking sufficient samples whether the milk quality is same as in previous ones
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- Transportation to the main distributors
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Some of the process variables in milk factory are...:
Why do we pay attention to these variables
Process types

Common process schemes:

- Discrete process
Process types

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- Continuous process
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- Discrete process
- Continuous process
- Batch process
Discrete process

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Process control

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Let us consider the process in Milk factor
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Let us consider the process in Milk factor

Process variables should be controlled:

- Pressure process control
- Temperature process control
- Level process control
- Flow process control
Process control

In industrial process, control of machines and some equipments should be taken into account.
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**Motion Control:**

- Velocity control
- Position control
- Acceleration control
- Torque control
Controller types

- Open-loop control
- Closed-loop control
  - In order to provide the stability of system with a designed controller against the differences between the actual model and the mathematical model, which is called *uncertainty*
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- Delays
- Non-linearities
- Aging
- Uncertainty
Industrial Control elements

\[ r(t) \rightarrow e(t) \rightarrow K \rightarrow u(t) \rightarrow P \rightarrow y(t) \]

\[ n(t) \]
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Industrial Control elements

Sensors and Actuators

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- Physical Sensors
- Measurement Sensors
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**Actuator:** An electromechanical device generates some type of forces, for instance, electrical, magnetic, pneumatic, hydraulic, to drive shafts of the equipments.
- Electric actuators
- Magnetic actuators
- Pneumatic actuators
- Hydraulic actuators
- Piezoelectric actuators
Industrial Control elements
Switches, Transducers, and Valves

**Switches:** It is a device of two states on or off

**Transducer:** It is usually an electrical, electronic, electro-mechanical device that converts input physical energy in one form into output physical energy of another form.

**Valve:** It is a device regulates the flow of materials.

- Limit switches
- Photoelectric switches
- Proximity switches
- Ultrasonic transducer
- Control valve