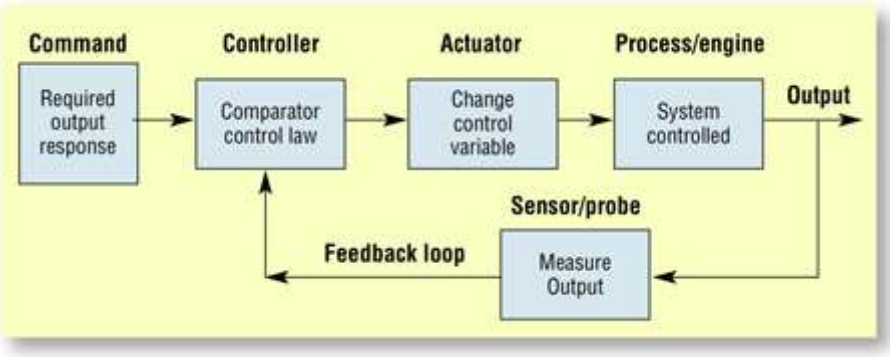
DIDACTIC UNIT

“Automatic Control Systems”



Cavazzuti Carla

ITT “Primo Levi – Vignola (MO)

Corso di Automazione

A.S. 2015-16

1. Planning of pedagogical task for each lesson

1ST LESSON (2 hours)

TYPE	PURPOSE	BASED ON	TIMING	INTERACTION
METHODOLOGY PRESENTATION	To motivate students	1. The teacher will explain the meaning of the CLIL acronym and its main aims.	5’	TEACHER
BRAISTORMING ON TOPIC	To activate prior knowledge.	1.The teacher will introduce the topic that will be given in class. 2. Learners have to find out what they already know about “Automation” and to draw a map on their sheet. 3. Students have to enunciate their conclusion to teacher, who compiles a map on the white-board.	1’ 10’ 15’	TEACHER AND STUDENTS STUDENTS STUDENTS
CONTROLLED LISTENING	To listen “What is automation” one time and “What is Control Engineering” two times.	1. On the first video, students have to read and listen to the speaker . 2. During the second play of the second video students will have to recognize and to write on some key words. 3. Teacher and students write a list of key-words on the white board.	6’ 15’ 5’	STUDENTS STUDENTS TEACHER AND STUDENTS
CONTROLLED WRITING	To write a short description with student’s own knowledge of English.	Students have to write a very short description of an automation , using key-words and also block diagram.	13’	STUDENTS (work in pairs)
SPEAKING/ READING	To read what students have written.	Learners have to read their own description aloud and discuss it in class with the classmates.	10’	STUDENTS (teacher as a moderator)
READING	To read aloud the text in “Automation 1 “	After the reading the students have to complete some exercises related to the text.	20’	STUDENTS
VOCABULARY	To give a list of vocabulary related to Automation	1. Students have to do exercises A (match word-definition) B (label picture) C (fill in the gap) of “Automation 2” 2. Teacher corrects exercises	15’ 5’	STUDENTS TEACHER

2ND LESSON (1 hour)

TYPE	PURPOSE	BASED ON	TIMING	INTERACTION
VOCABULARY	To explore chunks and collocations related Automation	Students have to underline chunks and collocations in the text of "Automation 1" and to do exercise D-E (translation) of "Automation 2"	15' .	STUDENTS
LISTENING	To listen to Teacher's presentation "Automatic Control Systems" .	Students have to listen and to recognize key-words and collocation	10'	TEACHER AND STUDENTS
CONTROLLED READING/ LISTENING	To read the text in "Automation 3".	1. After the reading the students have to complete some exercises related to the text. 2. Then they check their answers to ex.1 with the listening.	10' 5'	STUDENTS
SPEAKING/ READING	To read what students have written.	Learners have to read their own answers to ex.2 aloud and discuss it in class with the classmates.	10'	STUDENTS (work in pairs) (teacher as a mediator)
WRITING/ HOMEWORK	To promote culture skills.	Students have to write more or less a paragraph about "What do you think?".	10' (explanation)	STUDENTS

3RD LESSON (1 hour)

TYPE	PURPOSE	BASED ON	TIMING	INTERACTION
CONTROLLED LISTENING / SPEAKING	To listen "What is industrial automation" and "The Future Begins Today - Robotics and Automation: The Key to Sustainability".	1. During the first and the second video students will have to recognize some of their ideas written in their homework . 2. Students have to discuss in class with the classmates and the teacher. 3. Students compile a T-chart about for and against automation .	10' 15' 5'	STUDENTS TEACHER AND STUDENTS STUDENTS
LISTENING / WRITING	To listen to Teacher's presentation "Introduction to sensors" .	Students have to listen and to write down some notes	15'	TEACHER AND STUDENTS

VOCABULARY PRESENTATION	To give a list of vocabulary related to sensors.	1. The teacher will explain the vocabulary that will be given in class. 2. Learners have to match some device (sensors of laboratory) with the words given in the exercise.	10’ 5’	TEACHER STUDENTS

3RD LESSON (1 hour)

TYPE	PURPOSE	BASED ON	TIMING	INTERACTION
CONTROLLED LISTENING / SPEAKING	To listen “What is industrial automation” and “The Future Begins Today - Robotics and Automation: The Key to Sustainability”.	1. During the first and the second video students will have to recognize some of their ideas written in their homework . 2. Students have to discuss in class with the classmates and the teacher. 3. Students compile a T-chart about for and against automation .	10’ 10’ 5’	STUDENTS TEACHER AND STUDENTS STUDENTS
LISTENING / WRITING	To listen to Teacher’s presentation “Introduction to sensors”(ppt) and to “Introduction to sensors” (video).	Students have to listen and to write down some notes	20’	TEACHER AND STUDENTS
HOMEWORK PRESENTATION	To introduce webquest activity related to sensors.	1. The teacher describe what the end result of the project will be. 2. Outline the technology that students will be using. 3. Give a list of pre-selected internet sites on sensors	15’	TEACHER

4TH - 5TH - 6TH LESSON (1 hour)

TYPE	PURPOSE	BASED ON	TIMING	INTERACTION
ORAL PRESENTATION	Students have to work in group at home, to organize information, to expose individually their task .	The oral product consists of a talk of a defined sensor in the form of multimedia presentation. They have 10-15 minutes per person to talk about what they have researched.	60’	STUDENTS

7TH LESSON (1 hour)

TYPE	PURPOSE	BASED ON	TIMING	INTERACTION
CONTROLLED LISTENING	To listen "Sensor, Types of Sensor and their applications - Simtel Robotics"	1. During the video students will have to recognize their sensors and write down other new sensors. 2. Students compile a T-chart about known and unknown sensors .	10' 5'	STUDENTS STUDENTS
LISTENING / WRITING	To listen to "te.ugm.ac.id/~pyatmadi/new/kendali/kul2.ppt" to summarize the experience and generalized what students have learned	Students have to listen and to write down some notes	45'	TEACHER AND STUDENTS

2. Materials for lesson 1-2

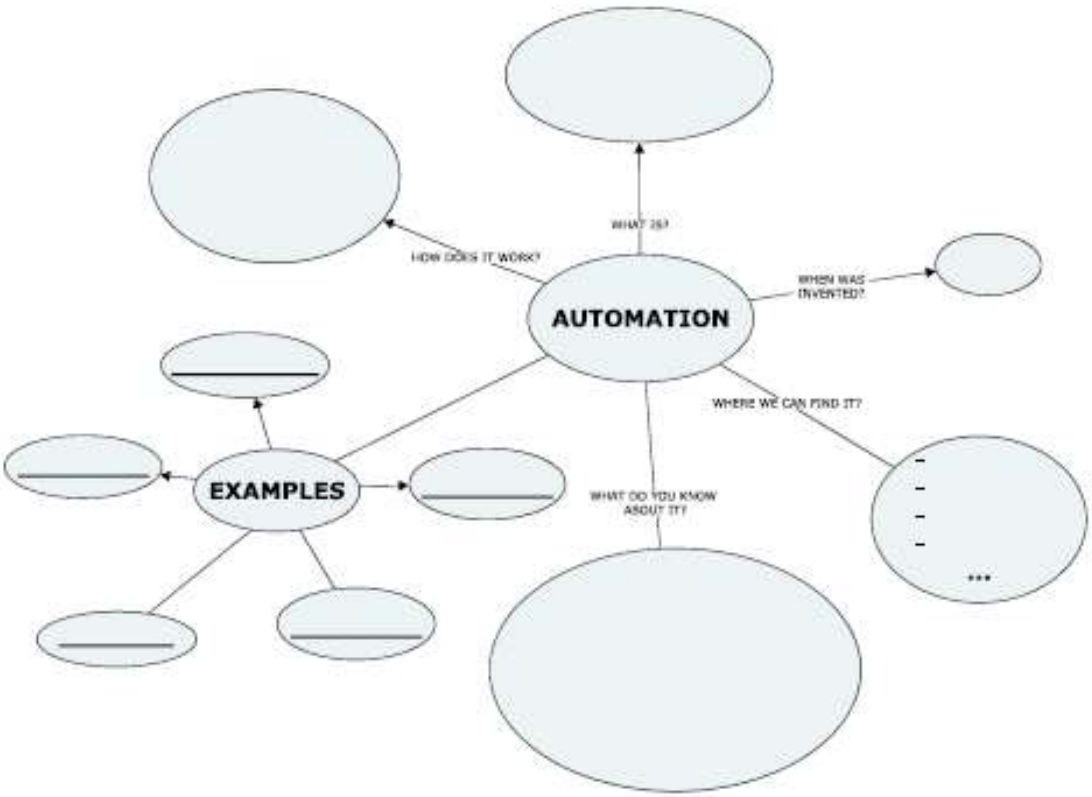
What is automation

www.youtube.com/watch?v=B-m8VPogKjA

What is control engineering

https://youtu.be/Im88eVfkeBo

Enter brainstorming



Automation 1

UNIT

12 Automation

The advantages of automation

1 Talk to your partner. What are the advantages of using machinery to replace human workers? Are there any disadvantages?

2 Read the text and make a table like the one below. Then take notes.

	Advantages of machines over people	Specific examples
a.		
b.		
c.		
d.		
e.		

Automation is the use of machines to carry out tasks that involve making decisions. The simple replacement of human workers by machines is often called "mechanization", but automation generally implies[1] something more: the integration of machines into a self-controlling system. Automation is used for a wide variety of jobs that are too complex or dangerous for people to do, for repetitive tasks that people would find too monotonous, and for work that would be extremely costly if done by people.

Automated systems can make decisions more quickly than people can. For example, high-speed military aircraft sometimes fly at low altitudes to avoid radar detection. These aircraft use automated guidance systems that can react much faster than a pilot can if obstacles suddenly appear.

Automated systems can also make planning decisions that would be too complex for people to make. For example, many cities use automated systems to coordinate traffic lights and maintain the flow of traffic. Sensors determine the number and speed of vehicles on the street and send the data to a computer. The computer decides how to time each traffic light in the area and sends out the appropriate signals.

Automated machinery is better suited[2] than people to perform routine, repetitive tasks, such as assembling, inspecting, and packaging manufactured products. In addition, machines can operate in environments that are unsafe for people. Automated systems are used for repairing underwater pipelines at high pressures; automobiles are painted by robots using spray paint that would harm people. Automated systems can also work more cheaply than people can. Many stores use automated systems to perform tasks previously done by managers. Cash registers take note of each item[3] as it is sold and send the information to a computer, which keeps a record of stock levels and places orders to restock items whenever necessary. The use of automation also enables companies to avoid spending money on making dangerous work areas safe for human workers.

1. implies: implica
2. suited: adatto
3. item: articolo

Automation 2

WORD POWER

A Match each word (**a-t**) to the correct definition (**1-20**), then write the translation in Italian of each word.

a. ☐	adjust	1. a device that automatically responds to temperature changes and activates controls
b. ☐	assemble	2. a difference between two things that should be the same
c. ☐	automation	3. a continuous moving band used for transporting goods from place to place in a factory
d. ☐	comparator	4. a piece of work that has to be done
e. ☐	conveyor belt	5. a set of operations in a program that are continuously repeated
f. ☐	discrepancy	6. a supply of something to be kept and sold or used when needed
g. ☐	evaluate	7. a thermoelectric device used to measure temperatures
h. ☐	feedback	8. a device for comparing a particular property with a standard measure
i. ☐	foresee	9. the automatic self-regulating operation or control of a process or a system
j. ☐	inspect	10. the continuous return of information about results to keep a process under control
k. ☐	loop	11. the process of controlling equipment from a distance, using radio or electronic signals
l. ☐	mechanization	12. the replacement of human workers by machines
m. ☐	monitor	13. to carefully observe a situation in order to see how it changes over a period of time
n. ☐	oversee	14. to examine something carefully in order to check that there is nothing wrong with it
o. ☐	remote control	15. to join pieces of metal by applying heat to melt them
p. ☐	stock	16. to judge how good or useful something is
q. ☐	task	17. to make small changes to something in order to improve it
r. ☐	thermocouple	18. to organize and observe an activity to make certain that it is being done correctly
s. ☐	thermostat	19. to predict what is going to happen in the future
t. ☐	weld	20. to put all the parts of something together

B Label the pictures using the following words:

(a.) thermostat (b.) monitor
(c.) weld (d.) conveyor belt
(e.) manual assembly
(f.) remote control
(g.) mechanization

C Fill in the gaps using the following words:

adjust • assemble • discrepancy • environment
evaluate • foresee • inspect • monitor • stock • task

a. Closed circuit TV cameras ..... the robots' work.
b. The liquid needs to be a little cooler. You'll have to ..... the temperature control.
c. Special machines ..... each product for defects.
d. The ..... of the robots is to paint the outside of the cars.
e. The microchips are manufactured in a completely dust-free .....
f. Workers ..... the different parts to produce the final machine.
g. There is a big ..... between the results of the two tests.
h. We need time to ..... the plan before making a final decision.
i. The ..... is stored in a warehouse next to the factory.
j. We try to ..... what the problems will be before they happen.

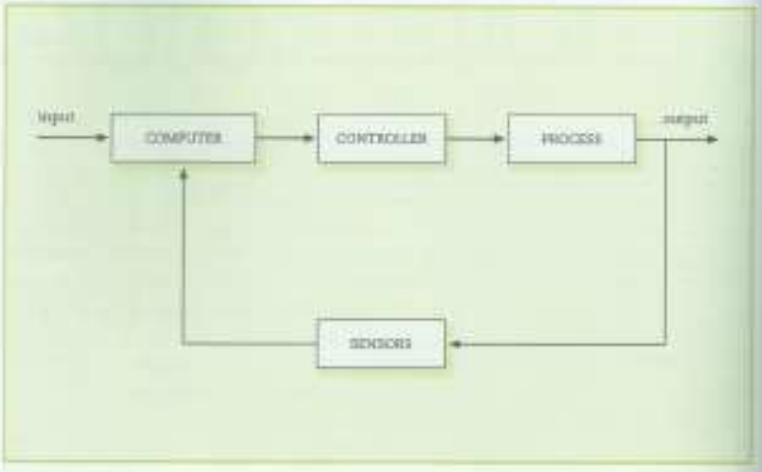
D Translate the following sentences into English.

a. Una moderna fabbrica automatizzata può avere migliaia di giri di feedback interconnessi.
b. L'automazione richiede l'integrazione delle macchine in un sistema di autocontrollo.
c. Se c'è una differenza tra i due valori, il termostato manda un segnale di errore.
d. Le macchine possono operare in ambienti che sono pericolosi per le persone.
e. I robot assemblano i pannelli e li saldano insieme.

E Translate into Italian the first paragraph of the passage on the previous page.

Automation 3

How automation works



1 TRACK 08 Read the passage and fill in the gaps using the following words. Then listen to the recording and check.

- controller
- feedback
- mechanization
- sensors
- computer
- robots
- automated
- monitor

What makes automation different from **(a.)** _____ is the ability of a machine to regulate itself through feedback. A feedback system, called a "loop", enables a machine to **(b.)** _____ its own output, compare it with a set of standards and adjust its performance. This adjustment of operations in response to changing external conditions is carried out in three steps: measurement, evaluation, and control.

In order to respond to the external environment, an automated system must be able to measure the physical variables in that environment. This is done through **(c.)** _____ : photoelectric cells, thermocouples, X-ray machines, electrical meters etc. which measure properties such as dimensions, weight, temperature, pressure, colour, or electrical resistance.

The measured information is then evaluated, usually by a **(d.)** _____ , in order to determine if corrective action is required. The data supplied by the sensors is compared with the standards which are stored in the control program. If discrepancies exist, the computer activates the **(e.)** _____ to bring the performance of the system into line with the programmed values. The control element may consist of switches, valves, or other mechanisms.

When the sensing, evaluating and control elements are all operating properly, an **(f.)** _____ system is able to regulate its behaviour in a wide variety of circumstances, even when it is not possible to foresee all the details in advance. An airplane autopilot is a classic example of a **(g.)** _____ device: it uses information obtained from flight instruments to make continuous adjustments to the controls, keeping the plane on its course.

A modern automated factory may have hundreds or even thousands of interconnected self-regulating loops. The part of an automated system that is controlled by feedback, and changes the output, is called "the process"; the application of automation to the control of manufacturing operations is called "process control". Process control is used extensively in many industries.

Automated machines, called industrial robots, are commonly used in manufacturing. They can be programmed to perform different jobs under various operating conditions. By reprogramming the computer that oversees the operation, the same machine can be used for different applications. As technology develops, **(h.)** _____ are becoming increasingly self-adaptable, capable of evaluating a new situation and deciding upon a course of action autonomously.

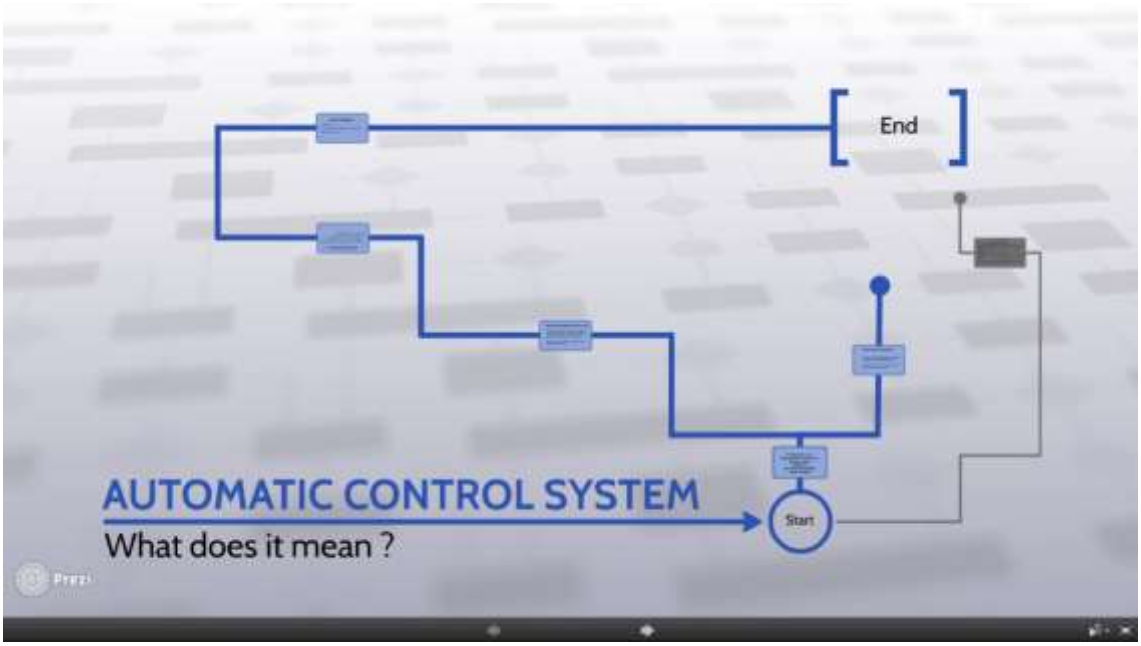
2 Use the information in the passage to answer the following questions in Italian.

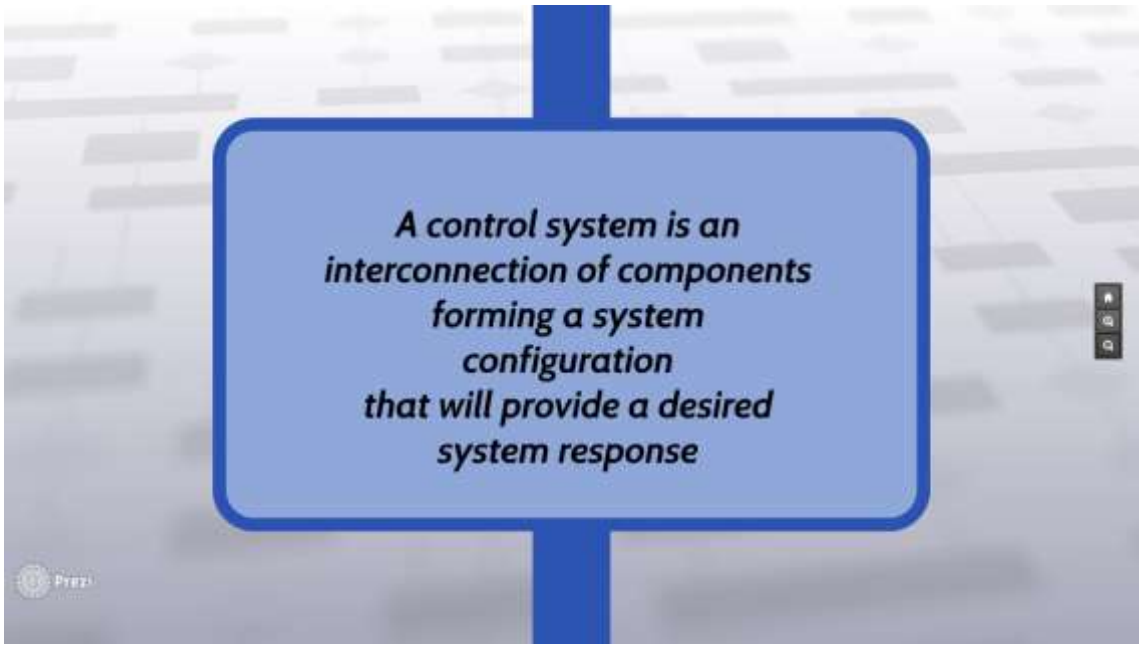
a. What are the following?
1. a feedback loop
2. an industrial robot
3. process control

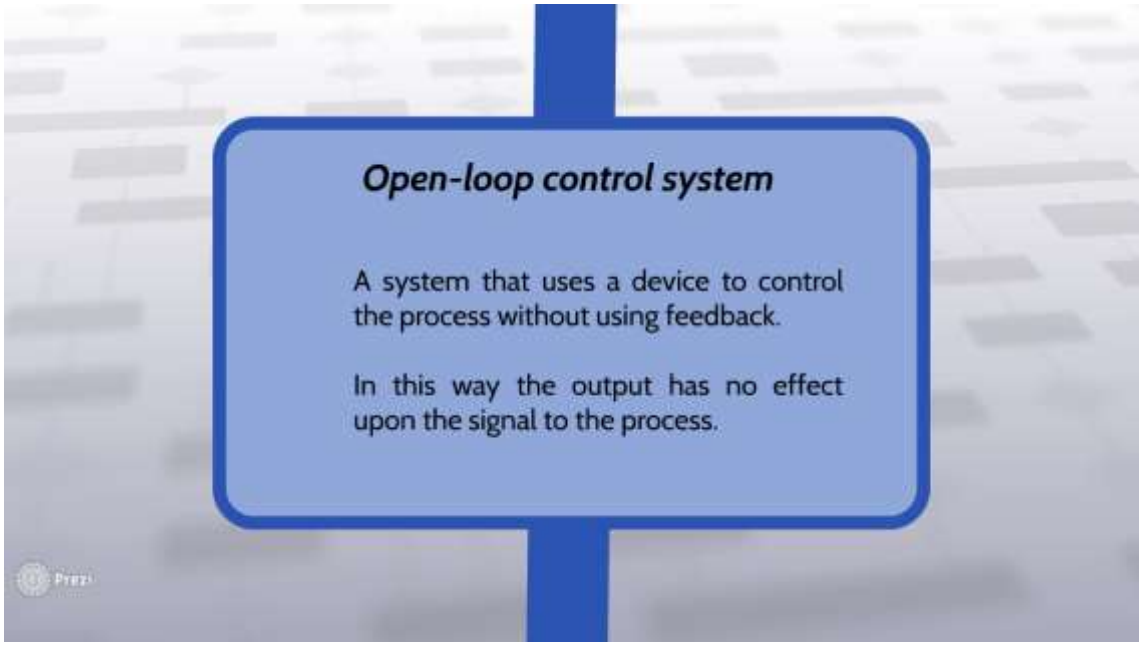
b. What is the function of the following elements in the system?
1. the sensors
2. the computer
3. the controller

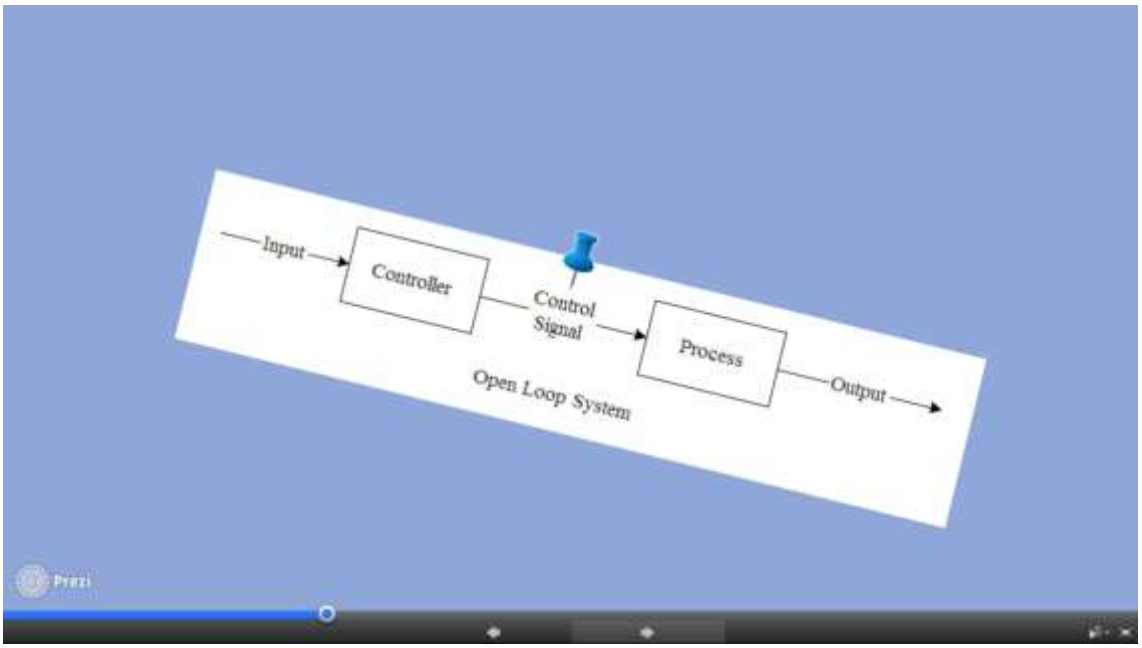
Automatic control systems (made with Prezi)

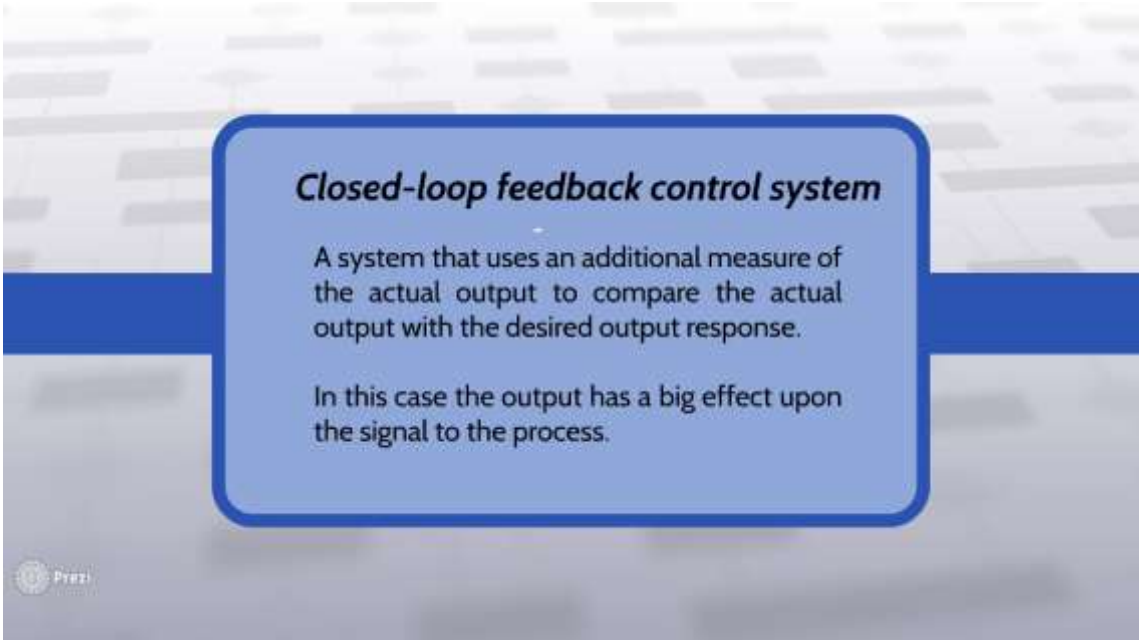
https://prezi.com/yecy5-0d1x50/automatic-control-system/

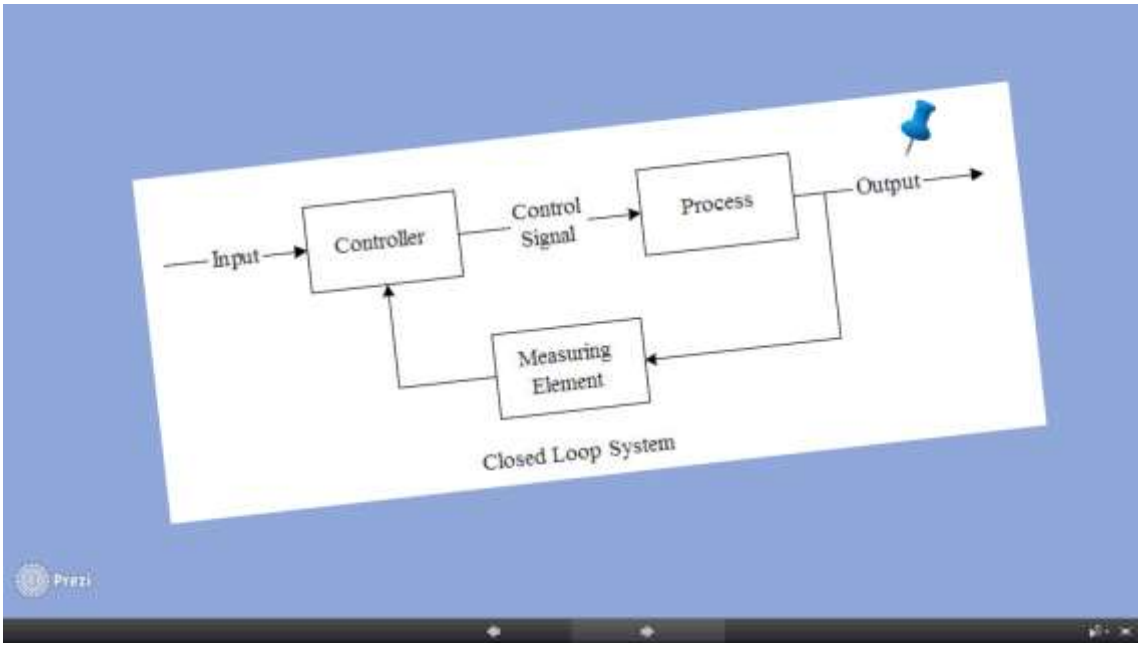




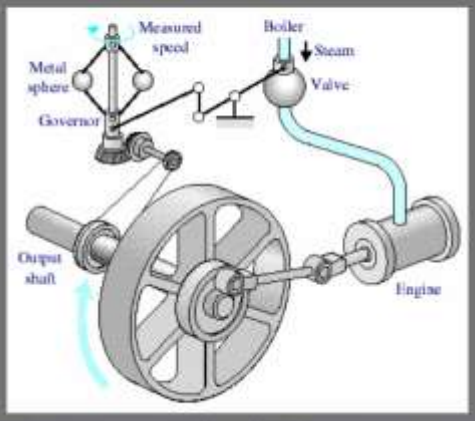

Open-loop control system
A system that uses a device to control the process without using feedback.
In this way the output has no effect upon the signal to the process.


Input
Controller
Control Signal
Process
Output
Open Loop System

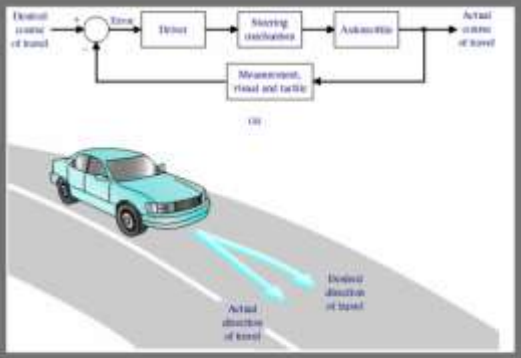

Closed-loop feedback control system
A system that uses an additional measure of the actual output to compare the actual output with the desired output response.
In this case the output has a big effect upon the signal to the process.


Input
Controller
Control Signal
Process
Output
Measuring Element
Closed Loop System

The first automatic feedback controller used in an industrial process is generally agreed to be James Watt's flyball governor, developed in 1769 for controlling the speed of a steam engine .



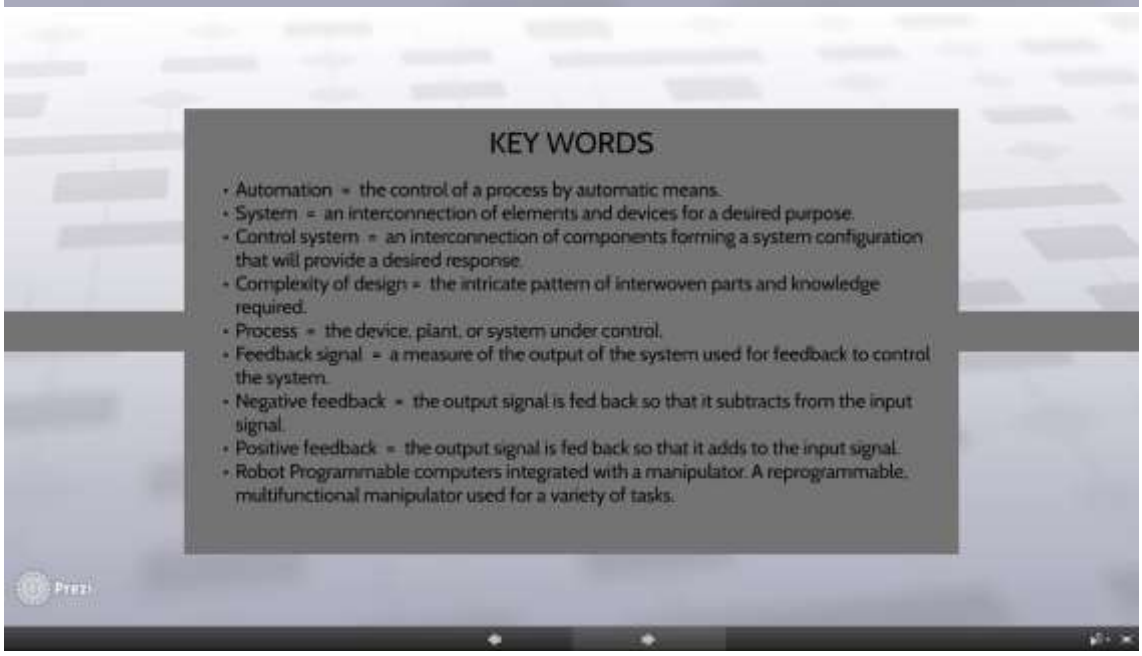
Automobile steering control system



Evolution of control systems and robotics


ADVANTAGES OF FEEDBACK
• INCREASED ACCURACY (REDUCED THE STEADY-STATE ERROR)
• INCREASED SPEED OF RESPONSE AND BANDWIDTH
• REDUCED EFFECTS OF DISTURBANCES


COST OF FEEDBACK
• LOSS OF GAIN
• INCREASED NUMBER OF COMPONENTS AND COMPLEXITY
• POSSIBILITY OF INSTABILITY


KEY WORDS
• Automation = the control of a process by automatic means.
• System = an interconnection of elements and devices for a desired purpose.
• Control system = an interconnection of components forming a system configuration that will provide a desired response.
• Complexity of design = the intricate pattern of interwoven parts and knowledge required.
• Process = the device, plant, or system under control.
• Feedback signal = a measure of the output of the system used for feedback to control the system.
• Negative feedback = the output signal is fed back so that it subtracts from the input signal.
• Positive feedback = the output signal is fed back so that it adds to the input signal.
• Robot Programmable computers integrated with a manipulator. A reprogrammable, multifunctional manipulator used for a variety of tasks.

What do you think?

WHAT DO YOU THINK?

Prepare to discuss the following questions with tour classmates:

HAS MODERN SOCIETY BENEFITTED FROM AUTOMATION?

FOR:

Greater productivity has produced

- a higher standard of living
- improvement in the quality of manufactured goods and uniformity of standards
- reduction in working hours
- greater physical safety for workers
- workers freed from repetitive, monotonous tasks

AGAINST

Overproduction has produced

- a more wasteful and materialistic society
- disruption of traditional working patterns
- creation of unemployment, especially among low-skilled workers
- reduced jo satisfaction and greater sense of alienation among workers

3. Materials for lesson 3

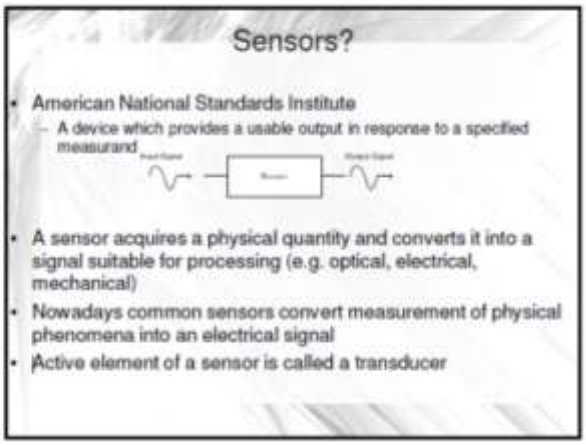
(What is industrial automation?

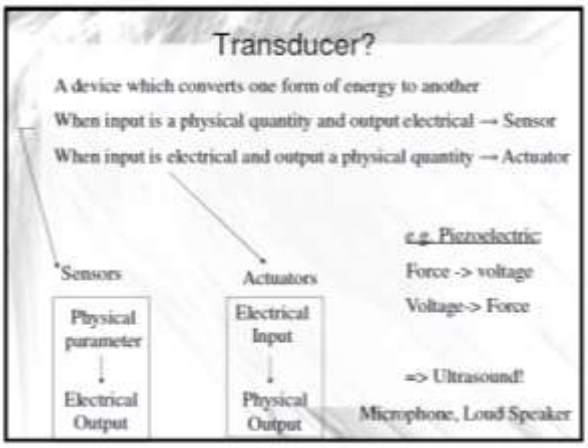
www.youtube.com/watch?v=1WzqzWQLGOE

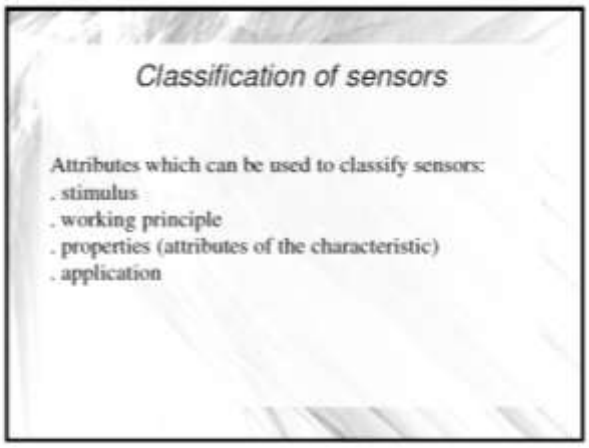
The Future Begins Today - Robotics and Automation: The Key to Sustainability)

www.youtube.com/watch?v=mwOhLU62JTQ

Introduction to sensors







Commonly Detectable Phenomena

- Biological
- Chemical
- Electric
- Electromagnetic
- Heat/Temperature
- Magnetic
- Mechanical motion (displacement, velocity, acceleration, etc.)
- Optical
- Radioactivity

Common Conversion Methods

- Physical
  - –thermo-electric, thermo-elastic, thermo-magnetic, thermo-optic
  - –photo-electric, photo-elastic, photo-magnetic,
  - –electro-elastic, electro-magnetic
  - –magneto-electric
- Chemical
  - –chemical transport, physical transformation, electro-chemical
- Biological
  - –biological transformation, physical transformation

Commonly Measured Quantities

Stimulus	Quantity
Acoustic	Wave amplitude, phase, polarization, Spectrum, Wave velocity
Biological & Chemical	Fluid Concentration (Gas or Liquid)
Electric	Charge, Voltage, Current, Electric Field (amplitude, phase, polarization), Conductivity, Permittivity
Magnetic	Magnetic Field (amplitude, phase, polarization), Flux, Permeability
Optical	Refractive Index, Reflectivity, Absorption
Thermal	Temperature, Flux, Specific Heat, Thermal Conductivity
Mechanical	Position, Velocity, Acceleration, Force, Strain, Stress, Pressure, Torque

Physical Principles: Examples

- **Amperes's Law**
  - A current carrying conductor in a magnetic field experiences a force (e.g. galvanometer)
- **Curie-Weiss Law**
  - There is a transition temperature at which ferromagnetic materials exhibit paramagnetic behavior
- **Faraday's Law of Induction**
  - A coil resist a change in magnetic field by generating an opposing voltage/current (e.g. transformer)
- **Photoconductive Effect**
  - When light strikes certain semiconductor materials, the resistance of the material decreases (e.g. photoresistor)

SENSOR CHARACTERISTIC

Accuracy : Error measurement

Sensitivity: change in output for unit change in input

Resolution: the smallest change in the signal that can be detected and accurately indicated by a sensor.

Linearity: the closeness of the calibration curve to a straight line.

Drift: the deviation from the null reading of the sensor when the value is kept constant for a long time.

SENSOR CHARACTERISTIC

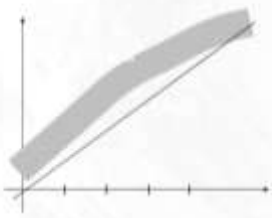
Hysteresis: the indicated value depends on direction of the test (increasing and decreasing)

Repeatability (precision): the maximum deviation from the average of repeated measurements of the same static variable.

Dynamic Characteristics: A sensor may have some transient characteristic. The sensor can be tested by a step response where the sensor output is recorded for a sudden change of the physical variable.

The rise time, delay time, peak time, settling time, percentage overshoot should be as small as possible.

Sensor properties



A sensor should represent a physical variable as fast and as accurately as possible.
A sensor is represented by its *characteristic*.
Ideally, the sensor characteristic is a straight line

4. Materials for lesson 4-5-6

Presentation of different kind of sensors made by students (realized by Power Point or Prezi)

5. Materials for lesson 4-5-6

Presentation of “te.ugm.ac.id/~pyatmadi/new/kendali/kul2.ppt” (to long to be edited)