10 Automation and robotics

1 **Read the text about automation and match the words with their definition.**

Mechanisation refers to the process of providing human beings with machinery capable of assisting them with the muscular **requirements** of work. A further development of mechanisation is represented by automation, which implies the use of control systems and information technologies to reduce the need for both physical and mental work to produce **goods**.

Automation has had a great impact on industries over the last century, changing the world economy from industrial jobs to service jobs. In **manufacturing**, where the process began, automation has meant that the desired results can be obtained through a series of instructions made automatically by the system, which define the actions to be done. Automated manufacturing grants higher consistency and quality, while reducing **lead times** and **handling**. It also improves **work flow** and increases the morale of workers when a good implementation of the automation is made.

However, the purpose of automation cannot be seen only in terms of a reduction of cost and time; there are several more aspects to be taken into consideration. For example, while it is true that automation offers a higher precision in the manufacturing process, it is also true that it requires skilled workers who can make repairs and manage the machinery.

The following table sums up the main advantages and disadvantages of automation:

Advantages	Disadvantages
Speeding up the developmental process of society	Disastrous effects on the environment (pollution, traffic, energy consumption)
Replacing human operators in tasks that involve hard physical or monotonous work	Sharp increase in **unemployment rate** due to machines replacing human beings
Saving time and money as human operators can be employed in higher-level work	Technical limitations as current technology is unable to automate all the desired tasks
Replacing human operators in **tasks** done in dangerous environments (fire, space, volcanoes, nuclear facilities, underwater)	Security threats as an automated system may have a limited level of intelligence and can make errors
Higher reliability and precision in performing tasks	Unpredictable costs due to research and development, which may exceed the cost saved by the automation itself
Economy improvement and higher productivity	High initial costs as the automation of a new product requires a large initial investment

1 manufacturing	a	☐ the time between the design of a product and its production
2 information technologies	b	☐ the amount of confidence that a group of people have
3 goods	c	☐ a set of tasks performed to complete a procedure
4 service jobs	d	☐ the process of packing and distributing goods
5 skilled	e	☐ the industry in which machinery is used to produce goods
6 morale	f	☐ the development and application of computer systems
7 unemployment	g	☐ having the knowledge and the ability to do something well
8 lead times	h	☐ things that are made to be sold
9 handling	i	☐ jobs in transports, communications, hospitals, energy industry, etc.
10 work flow	j	☐ the state of not having a job

2 **What would you like to automate in your life? In pairs, discuss the impact of automation on your own life and list its main advantages and disadvantages.**

3 **Read the text about automation technologies and answer the questions.**

Numerical control over automated devices has resulted in a rapidly expanding range of applications and human activities. Computer-aided technologies (CAx) is a **broad** term that means the use of computer systems to **aid** in the design, analysis, and manufacture of products, by serving the basis for mathematical and organisational tools used to create complex systems. It includes computer-aided design (CAD software) and computer-aided manufacturing (CAM software).

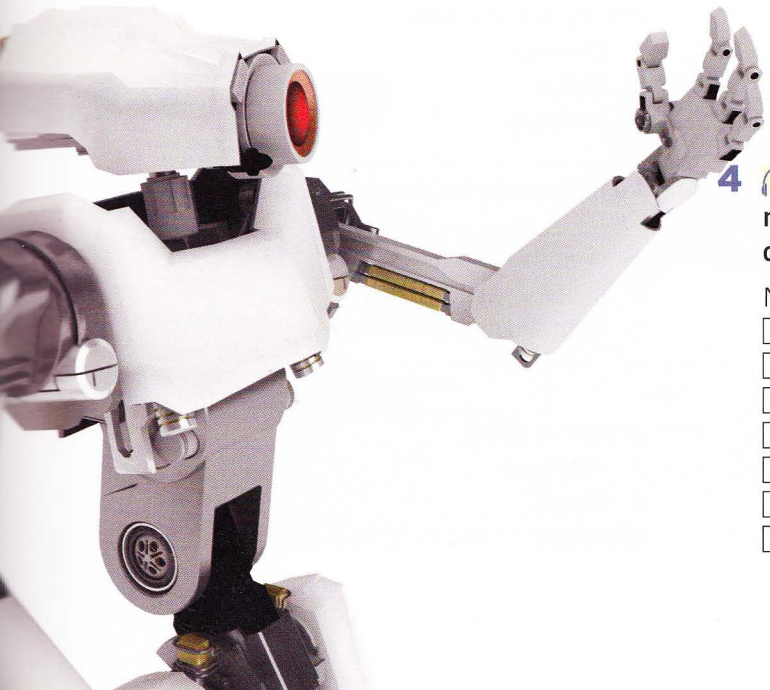
The current limit of computer-aided technologies is that some abilities are well **beyond** the capabilities of modern mechanical and computer systems. Moreover, these technologies require high-skilled engineers and the synthesis of complex sensory data to work properly. As for costs involved, in some cases, automation is more expensive than mechanical approach.

Thanks to the incredible improvements in automation technology, a number of other technologies have developed from it, such as domotics and robotics.

Domotics is a field in building automation aimed at the application of automation technologies in households for the comfort and security of its residents. This means that lights, heating and conditioning systems, windows **shutters**, kitchen equipment and **surveillance** systems can be controlled by a remote control or even by a cell phone at a distance.

Robotics is a special branch of automation in which the automated machines have certain human features and are used to replace human workers in factory operations. Robots are computer-controlled mechanical devices that are programmed to move, manipulate objects and interact with the environment. **Nowadays** more and more sophisticated robots are being built to serve various practical purposes, for example in houses, businesses, in the **army** and for medical appliances for **disabled** people.

1 What does computer-aided technologies mean?
2 Which software does CAx include?
3 What are the current limits of CAx?
4 Can you name two applications of automation technologies?
5 How does a domotic house differ from a traditional house?
6 What are robots used for?



4 11 **In pairs, think of what robots can do nowadays and tick the boxes below. Then listen and check your answers.**

Nowadays robots can...

- ☐ get sick
- ☐ **go underwater**
- ☐ handle dangerous material
- ☐ clean nuclear waste
- ☐ explore volcanoes
- ☐ go to space
- ☐ easily walk on two legs
- ☐ see obstacles
- ☐ speak fluently
- ☐ smell things
- ☐ taste food
- ☐ move objects
- ☐ have feelings

Sensors

5 **Read the text about sensors and match each paragraph with a heading.**

Sensor applications | Types of sensors | What is a sensor?

1 _____

Almost every industrial automated process requires the use of sensors and **transducers**, which are very advanced devices capable of measuring and sensing the environment and translating physical information (e.g. variations of light, pressure, temperature and position) into electrical signals. The sensor **picks up** the information to be measured and the transducer converts it into electrical signals that can be directly processed by the control unit of a system.

2 _____

Because of the industrial and scientific importance of measuring, sensors are widely used in a variety of fields, such as medicine, engineering, robotics, biology and manufacturing. Traditional machines have difficulty measuring small differences in product size, so sensors can be particularly useful as they can **discriminate** down to 0,00013 millimetres. They can also detect temperature, humidity and pressure, acquire data and alter the manufacturing process. Sensors are also vital components of advanced machines, such as robots.

3 _____

There are two types of sensors: analogue and digital. Analogue sensors operate with data represented by measured voltages or quantities, while digital ones have numeric or digital outputs which can be directly transmitted to computers.

The sensors usually employed in manufacturing are classified as mechanical, electrical, magnetic and thermal, but they can also be acoustic, chemical, optical and radiation sensors. Moreover, according to their method of sensing, they can be tactile or visual. Tactile sensors are sensitive to touch, force or pressure and they are used to measure and register the interaction between a contact surface and the environment. These sensors are used in innumerable everyday objects, such as **lift** buttons and lamps which turn on and off by touching the base. Visual sensors, instead, sense the presence, shape and movement of an object optically. They are becoming more and more important in surveillance systems, environment and disaster monitoring and military applications.

6 **Read the text again and choose the correct answer.**

1 Sensors pick up _____ to be measured.
- A electrical signals
- B physical information
- C the control unit

2 Physical data is translated into electrical signals by _____.
- A the transducer
- B the sensor
- C a computer

3 Sensors _____ used to alter the manufacturing process.
- A can't be
- B are never
- C can be

4 _____ sensors can transmit data directly to computers.
- A Chemical
- B Digital
- C Analogue

5 Tactile sensors are commonly used in _____.
- A everyday objects
- B military applications
- C sophisticated machinery

6 _____ sensors are used to localise objects in space.
- A Analogue
- B Visual
- C Tactile

7 12 **Read the text about the computer mouse and underline the correct option. Then listen and check.**

A common example of the application of sensors to everyday objects is the computer mouse.
The mechanical mouse has a ball which rotates and translates the (1) *motion/temperature* of our hand into signals that the computer can use.
Developed in late 1999, the optical mouse is an advanced computer pointing device that uses a light-emitting **diode** (LED), an (2) *acoustic/optical* sensor and a digital signal processor (DSP) in place of the traditional mouse ball and electromechanical transducer. The optical mouse actually uses a tiny (3) *camera/recorder* to take thousands of pictures at a rate of more than 1,000 images per (4) *minute/second*.
Optical mice can work on many surfaces without a mouse pad, thanks to an LED that **bounces** light **off** the surface it is on onto an optical sensor. The sensor sends each image to a digital signal (5) *processor/transistor* which examines how the **patterns** have moved since the previous image, determining how far the mouse has moved. The computer then moves the cursor on the screen based on the coordinates received from the mouse. This happens hundreds of times each second, making the cursor appear to move very (6) *slowly/smoothly*.
The best surfaces reflect but some others, for example a blank sheet of white (7) *plastic/paper*, do not allow the sensor and DSP to work properly because the details are too small to be detected.
In addition to LEDs, a recent innovation are laser-based optical mice that detect more surface details compared to LED technology. This results in the ability to use a mouse on almost any surface and to (8) *reduce/increase* the resolution of the image.

8 **Read the text again and match each sentence with its ending.**

1	A mechanical mouse	a	☐ the optical mouse was developed.
2	There are no sensors	b	☐ provide high-resolution images.
3	In late 1999	c	☐ can reflect light in the same way.
4	An optical mouse	d	☐ in a mechanical mouse.
5	A DPS	e	☐ has got a scroll ball mechanism inside.
6	Not all surfaces	f	☐ uses a light-emitting diode, an optical sensor and a DSP.
7	Laser-based optical mice	g	☐ is a processor for digital signals.

MY GLOSSARY

to aid /tuː eɪd/ _____
army /ˈɑːmi/ _____
beyond /bɪˈjɒnd/ _____
to bounce off /tə baʊnts ɒf/ _____
broad /brɔːd/ _____
diode /ˈdaɪəʊd/ _____
disabled /dɪˈseɪbld/ _____
to discriminate /tə dɪˈskrɪmɪneɪt/ _____
to go underwater /tə gəʊ ʌndəˈwɔːtə(r)/ _____
goods /gʊds/ _____
handling /ˈhændlɪŋ/ _____
lead times /ˈliːd taɪms/ _____
lift /lɪft/ _____
manufacturing /mænjʊˈfæktʃərɪn/ _____
nowadays /ˈnaʊədeɪz/ _____
pattern /ˈpætn/ _____
to pick up /tə ˈpɪk ʌp/ _____
requirement /rɪˈkwaɪəmənt/ _____
shutter /ˈʃʌtə(r)/ _____
surveillance /səˈveɪlənts/ _____
task /tɑːsk/ _____
transducer /trænzˈdjuːsə(r)/ _____
unemployment rate /ʌnɪmˈplɔɪment reɪt/ _____
work flow /wɜːk fləʊ/ _____