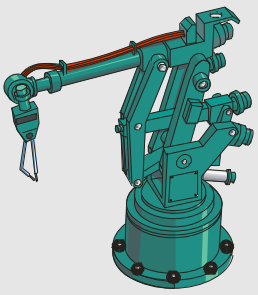
UNIT TEN

Factory automation

Industrial robotics

Industrial safety



SECTION ONE

Pre-reading task

Skim the Reading text below in order to match the terms on the left with their definitions on the right.

1. flexible	***a.*** *determined, established, set*
2. hardware	***b.*** *a large number or amount or extent*
3. batch	***c.*** *arrangement of parts or elements*
4. configuration	***d.*** *metal goods and utensils such as locks, tools, and cutlery*
5. fixed	***e.*** *responsive to change, adaptable*

1.	**2.**	**3.**	**4.**	**5.** .....

Reading 1

Read the text below and do the task that follows.

Manufacturing applications of automation

One of the most important application areas for automation technology is manufacturing. To many people, automation means *manufacturing automation*. Three types of automation in production can be distinguished:
(1) **fixed automation**,
(2) **programmable automation**, and
(3) **flexible automation**.

FIXED AUTOMATION
Fixed automation, also known as "*hard automation*", refers to an automated production facility in which the sequence of *processing operations* is fixed by the equipment *configuration*. In fact, the programmed commands are contained in the machines in the form of *cams*, *gears*, *wiring*, and other *hardware* that is not easily changed over from one product style to another. This form of automation is characterized

by high initial investment and high production rates. It is therefore suitable for products that are made in large volumes. Examples of fixed automation include *machining transfer lines* found in the automobile industry, *automatic assembly machines*, and certain chemical processes.

PROGRAMMABLE AUTOMATION
Programmable automation is a form of automation for producing products in *batches*. The products are made in batch quantities ranging from several dozen to several thousand units at a time. For each new batch, the production equipment must be reprogrammed and changed over to accommodate the new product style. A *numerical-control machine tool* is a good example of programmable automation. The program is coded in computer memory for each different product style, and the machine tool is controlled by the computer program. *Industrial robots* are another example.

FLEXIBLE AUTOMATION
Flexible automation is an extension of programmable automation. The disadvantage with programmable automation is the time required to reprogram and change over the production equipment for each batch of new product. This is lost production time, which is expensive. In flexible automation, the variety of products is sufficiently limited so that the *changeover* of the equipment can be done very quickly and automatically.

Source: Adapted from Microsoft Encarta Student 2009 DVD

Reading task

Read the text again and complete the sentences.

1. The three types of automation in production, are…

……

2. The form of automation characterized by high initial investment and high production rates is called…

……

3. The major drawback of programmable automation is…

……

4. Examples of programmable automation are…

……

Word study – Vocabulary building

a. *Complete the table below with the correct forms of the words which can also be found in Reading 1.*

	Noun	Adjective
1.	flexibility	……
2.	……	transferable
3.	automation	……
4.	……	applicable
5.	sufficiency	……
6.	expense	……
7.	……	accommodating / accommodative
8.	……	stylish
9.	program	……
10.	……	limited / limitable

b. *Complete the following sentences using words from the table above.*

1. The first industrial robots were also called …… transfer machines since their main use at first was to transfer objects from one point to another.

2. The primary goal of autonomous robots is to report is to achieve a high degree of self-……

3. Some manufacturing processes are …… and applicable from one country to another.

4. …… control is the research area and theoretical base for mechanization and automation.

5. In manufacturing automation, robots have to perform their tasks within a determined time ……

Pre-reading task

Skim the Reading text that follows in order to match the terms on the left with their definitions on the right.

1. teleoperator	***a.*** *located far away; distant in space*
2. remote	***b.*** *a robotic device controlled from a distance by a human operator*
3. to punch	***c.*** *the forming of metal objects by injecting molten metal under pressure into dies or molds*
4. to implement	***d.*** *to make or perform again, to repeat*
5. to duplicate	***e.*** *to apply in a manner consistent with its purpose or design*
6 die casting	***f.*** *to make a hole into or between, as for ease of separation*

1.	**2.**	**3.**	**4.**	**5.**	**6.** .....

Fig. 1: The Lin Yan textile factory in Changzhou, China

Reading 2

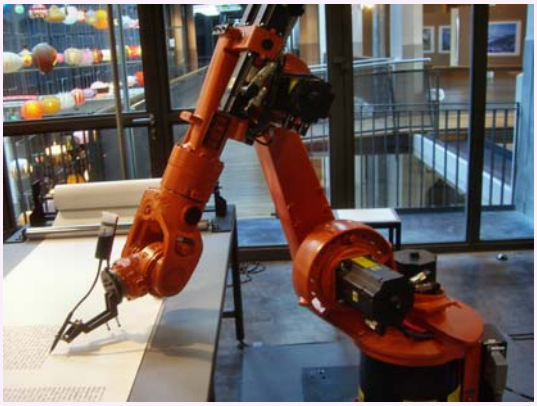
Read the text below and do the task that follows.

Industrial robotics

Industrial robotics is an automation technology that has received considerable attention since about 1960.

DEVELOPMENT OF ROBOTICS

Robotics is based on two related technologies: *numerical control* and *teleoperators*. Numerical control (NC) is a method of controlling *machine tool axes* by means of numbers that have been coded on *punched paper tape* or other media. It was developed during the late 1940s and early 1950s. The first numerical control machine tool was demonstrated in 1952 in the United States at the Massachusetts Institute of Technology (MIT). Subsequent research at MIT led to the development of the APT (Automatically Programmed Tools) language for programming machine tools. A teleoperator is a mechanical manipulator that is controlled by a human *from a remote location*. Initial work on the design of teleoperators can be traced to the handling of radioactive materials in the early 1940s. In a typical *implementation*, a human moves a mechanical arm and hand at one location, and these motions are *duplicated* by the manipulator at another location. Industrial robotics can be considered a combination of numerical-control and teleoperator technologies. Numerical control provides the concept of a programmable industrial machine, and teleoperator technology contributes the notion of a mechanical arm to perform useful work. The first industrial robot was installed in 1961 to unload parts from a *die-casting operation*[1].



Source: Adapted from http://www.learnaboutrobots.com/industrial.htm

[1] *Its development was due largely to the efforts of the Americans George C. Devol, an inventor, and Joseph F. Engelberger, a businessman. Devol originated the design for a programmable manipulator, the U.S. patent for which was issued in 1961. Engelberger teamed with Devol to promote the use of robots in industry and to establish the first corporation in robotics - Unimation, Inc.*

Reading task– **Comprehension questions**

Read the text again and answer the following questions.

1. What is a teleoperator?

2. What does numerical control provide?

3. When and where was the first numerical control machine demonstrated?

4. When was the first industrial robot set up for use and which was its task?

Word study – **Vocabulary building**

a. *Using your dictionary, complete the table below with the correct word forms which can also be found in Reading 2.*

	Verb	Noun	Adjective
1.	.....	.....	considerate
2.	to operate	.....	.....
3.	to control	.....	.....
4.	.....	.....	demonstrative / demonstrable
5.	to develop	.....	.....
6.	.....	.....	implementable

Fig. 2: A robot at a TV Factory in Mexico

b. *Complete the following sentences with the correct form of the words from the table above.*

1. Some industries claim to practice eco-friendly and environmentally-..... manufacturing processes. Their factories are energy efficient, they recycle as much as possible and their production procedures have been designed to eliminate as much waste as possible.
2. Even in the most ..... production environments, unexpected events can happen that may have direct impact on the manufacturing process and the quality.
3. Transnational Inc. has funded a program that will ..... its manufacturing capabilities to potential clients.
4. ASIMO, currently the world's most advanced humanoid robot, is under ..... by Honda.
5. Many companies today are developing engineering strategies and technologies to successfully ..... automation in the industrial field.

Use of English

Fill in the gaps of the following text using the words from the list below.

breakdowns	arm	robotic
human	applications	demonstrating
welding	development	assembly

The field of robotics

The field of robotics is concerned with the design and **1.** ..... of mechanical devices that can be programmed to perform certain functions. Robots have been developed for a large variety of **2.** ....., such as material transport, automated **3.** ....., and operations in controlled

environments, such as high temperature and caustic surroundings. The semiconductor industry, for example, uses advanced **4.** …….. technology to fabricate IC chips[2]. Many robots are simply relied on as a cost-effective alternative to **5.** …….. workers for certain highly repetitive tasks, such as spot **6.** …….. and painting. For these applications, the robot must be able to undergo a range of accelerated motions while **7.** …….. the ability to position accurately its end effector. This must be done with minimum **8.** …….. and rapid repair. The control strategy involves solving the governing dynamic equations as the robot **9.** …….. and end effector move through their operations.

Fig. 3: A palletizing Robot of 180 Kg of handling capacity

Pre-listening task

The process of automation in a typical medium-sized factory is divided into three stages which are given below in the wrong order. Classify them correctly.

[2] Integrated circuit chip, or microcircuit or chip or microchip. Assembly of microscopic electronic components (transistors, diodes, capacitors, and resistors) and their interconnections fabricated as a single unit on a wafer of semi-conducting material, especially silicon.

A. The assembly of the products.
B. The packing and sorting (the assembled products are put in boxes and classified ready for distribution).
C. The supply of materials to the assembly line.

1. ……	**2.** ……	**3.** ……

Listening – Factory automation

a. *During the celebration of the 30-year anniversary of a medium-sized factory, the owners give a speech to the employees regarding the developments in the automation of their firm. In their speech, they talk about three phases of automation. Listen carefully to an extract of their speech and complete the following sentences:*

1. 25 years ago the production line was mainly…
2. The first step to automation in the specific factory had as a result the reduction of the number of workers in the packing department from…
3. The next step was the gradual automation of the…
4. If they choose partial automation the workforce will be reduced from…
5. If they choose total automation the workforce in the supply area will be reduced from…

b. *Listen to the extract of the owners' speech again. They talk about three phases of automation. As you listen, classify the following steps as:*

A. *First phase automation.*
B. *Second phase automation*
C. *Third phase – Option 1*
D. *Third phase – Option 2*

(The first one has been done for you).

	Steps	Phases
1.	Installation of automatic packing equipment	***A***
2.	Reduction of packing workforce from 6 to 2	
3.	Introduction of automatic sorting	
4.	Automation of assembly line	
5.	Reduction of assembly workforce from 27 to 15	
6.	€ 500.000 investment in automatic assembly equipment	
7.	Total automation of supply area	
8.	Automatic picking from stores	
9.	Automatic conveyor feeder	
10.	Automation of component transport to workstations	
11.	Partial automation of supply area	
12.	Automatic conveyor feeder	

Fig. 4: View from the Janesville General Motors Assembly Plant

Writing

Write an e-mail to the electronic newspaper of your college, reacting to its editorial article, which is printed below, by giving counterarguments and questioning the editor's opinion about industrial robots being the ideal solution of the future.

Editorial: FOCUS ON SCIENCE	
INDUSTRIAL ROBOTS: THE IDEAL SOLUTION	 There are many complaints about work in factories: the work is often boring, heavy and repetitive; the operative does not have to thing about the work; he gets no job satisfaction. The solution: a robot of course! Actually, a robot is much more efficient than a human operative for many jobs. Once it has been programmed, it will do its job over and over again. It never gets bored and works at a constant speed; it doesn't make mistakes and its work is always of the same standard. In addition, it doesn't get tired or go on strike. It can work continually without breaks since it doesn't need to eat, rest or sleep; it doesn't take holidays or demand a raise. Robots have other advantages, too. They can be designed to do almost any job. The human body cannot be changed, but a robot's arms, for instance, can be made to move in any direction. Robots can also do a very heavy job and in conditions that are too dangerous, too hot or too cold for humans to work in. They can work under water, in poisonous gas and in radioactive areas. And last but not least, robots never complain.

Speaking

Prepare a short presentation commenting on the advantages and disadvantages of automation. Give your presentation to the class. You may focus on the following points:

- *Higher production rates.*

- *Increased productivity.*
- *More efficient use of materials.*
- *Better product quality.*
- *Improved safety.*
- *Shorter workweeks for labour.*
- *Reduced factory lead times.*
- *Worker displacement.*
- *High capital expenditure required to invest in automation.*
- *Higher level of maintenance needed than with a manually operated machine.*
- *Generally lower degree of flexibility in terms of the possible products as compared with a manual system.*
- *Potential risks that automation technology will ultimately subjugate rather than serve humankind:*
    - *Possibility that workers will become slaves to automated machines.*
    - *Privacy of humans will be invaded by vast computer data networks.*
    - *Human error in the management of technology will somehow endanger civilization.*
    - *Society will become dependent on automation for its economic well-being.*

SECTION TWO

Pre-reading task

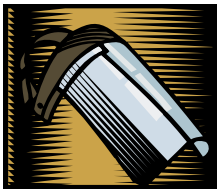
Label the pictures below using the words provided in the box.

1. .....

2. .....

3. .....

4. .....



5. .....

6. .....

Helmet	Boots	Safety glasses
Gloves	Radiation protection suit	Face mask (or headwear mask)

Reading

Read the text below about industrial safety and do the task that follows.

Industrial safety: Hazards and their prevention

Various external sources, such as chemical, biological, or physical hazards, can cause work-related *injury*. Hazards may also result from the interaction between worker and environment; these so-called ergonomic hazards can cause physiological or psychological stress.

Chemical hazards can arise from the presence of *poisonous* or *irritating* gas, *mist*, or *dust* in the workplace. Hazard *elimination* may require the use of alternative and less toxic materials, improved ventilation, *leakage control*, or protective clothing.

Biological hazards arise from bacteria or viruses transmitted by animals or unclean equipment and tend to occur primarily in the food-processing industry. The source of the *contamination* must be eliminated or, when that is not possible, protective equipment must be worn.

Common physical hazards include *ambient heat*, burns, noise, *vibration*, sudden pressure changes, radiation, and electric shock. Industrial safety engineers attempt to eliminate hazards at their source or to reduce their intensity. If this is impossible, workers are required to wear *protective equipment*. Depending on the hazard, this equipment may include *safety glasses*, *earplugs* or *earmuffs*, *face masks*, *heat* or *radiation protection suits*, *boots*, *gloves*, and *helmets*. To be effective, however, the protective equipment must be appropriate, properly maintained, and worn by the worker.

If the physical, psychological, or environmental demands on workers exceed their capabilities, ergonomic hazards arise. This type of hazard frequently occurs in the area of materials handling, where workers must lift or carry heavy loads. Poor working posture or improper design of the workplace often results in muscle strains, sprains, fractures, bruises, and back pain. These injuries account for 25 percent of all occupational injuries, and their control requires designing the job so that workers can perform it without *overexerting* themselves.

Source: Adapted from http://en.wikipedia.org/wiki/Occupational_safety_and_health

➡ Reading task

Read the text again and find words which mean the following.

1. The mechanical system or equipment used to circulate air or to replace stale air with fresh air. ……

2. The act of removing or getting rid of something. ……

3. The act of polluting, including (either intentionally or accidentally) unwanted substances or factors. ……

4. The emission of energy as particles, electromagnetic waves or sound. ……

5. A rapid oscillation of a particle, particles, or elastic solid or surface, back and forth across a central position. ……

6. The discharge of a fluid from some container. ……

7. Capable of harming or killing by or as if by poison or a toxic substance. ……

8. Causing physical discomfort. ……

9. at or within a short distance in space or time or having elements near each other. ……

Word study

Rearrange the letters in capitals so as to complete the sentences.

1. Common sense can prevent many …….. and strains. General safety measures to prevent slips and falls include for instance proper lighting, and handrails on both sides of stairways. **PRISSAN**

2. A …….. usually results from traumatic injury to a bone, causing the continuity of bone tissues or bony cartilage to be disrupted or broken. **RUCAFRET**

3. A …….. can be caused by blunt trauma that in turn causes bleeding under the skin. **SUERBI**

Use of English – Systems approach

Fill in the gaps of the following text using the words from the list below. There is one extra word.

equipment	interaction	supervisors	skill	attention
eliminate	prevention	injuries	physical	conditions

In recent years engineers have attempted to develop a systems approach (termed safety engineering) to industrial accident **1.** …….. Because accidents arise from the **2.** …….. of workers and their work environments, both must be carefully examined to reduce the risk of injury. Injury can result from poor working **3.** ……..., the use of improperly designed **4.** …….. and tools, fatigue, distraction, lack of **5.** ……..., and risk taking. The systems approach examines the following areas: all work locations to **6.** …….. or control hazards, operating methods and practices, and the training of employees and **7.** …….. The systems approach, moreover, demands a thorough examination of all accidents and "near misses". Key facts about accidents and **8.** …….. are recorded, along with the history of the worker involved, to check for and eliminate any patterns that might lead to hazards. The systems approach also pays special **9.** …….. to the capabilities and limitations of the working population. It recognizes large individual differences among people in their **10.** …….. and physiological capabilities. The job and the worker, therefore, should be appropriately matched whenever possible.