	Nom :	Date :	
	Working with systems	Cours	*Note :*
		1ère – Tale	

A system is a combination of parts or components, which work together to control a task or activity. All systems have inputs, a process, and outputs.

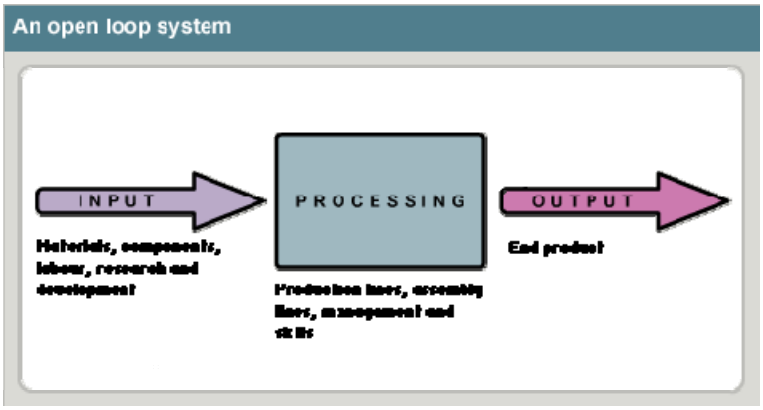
Elements of a system

Most systems need to be controlled, and this is usually done by means of a **feedback loop** which checks the outputs and feeds the results back into the system. A system with a feedback loop is called a closed-loop system.
Digital control systems use a **programme** or series of commands to control the system's functioning.

All systems have three main elements:

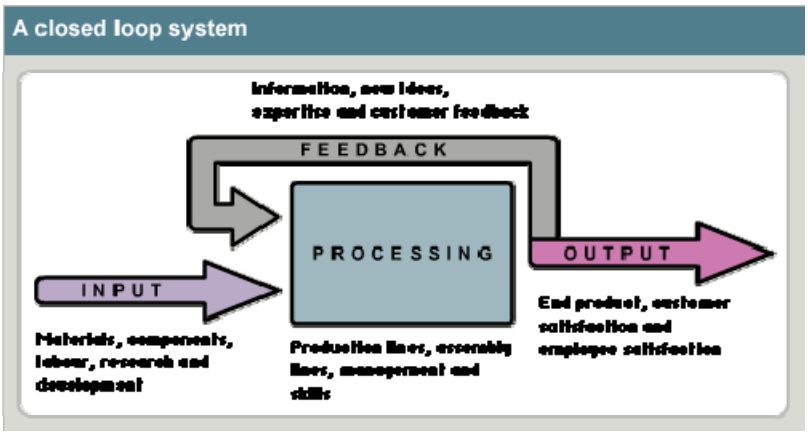
- Input(s)
- Process(es)
- Output(s)

The most basic type of system is called an **open-loop system**. In this type of system, the input triggers the process and the process controls the output. The diagram shows an open-loop system in manufacturing.



A more complex type of system is a **closed-loop system**. Like an open-loop they have inputs, processes and outputs, but they also have another element called **feedback**. Feedback is information from the output of a system which is 'fed back' into the input to control the way the system works.

The following diagram for a manufacturing process shows feedback from customer and employee satisfaction surveys being used to control the process, by adjusting inputs and thereby modifying outputs.

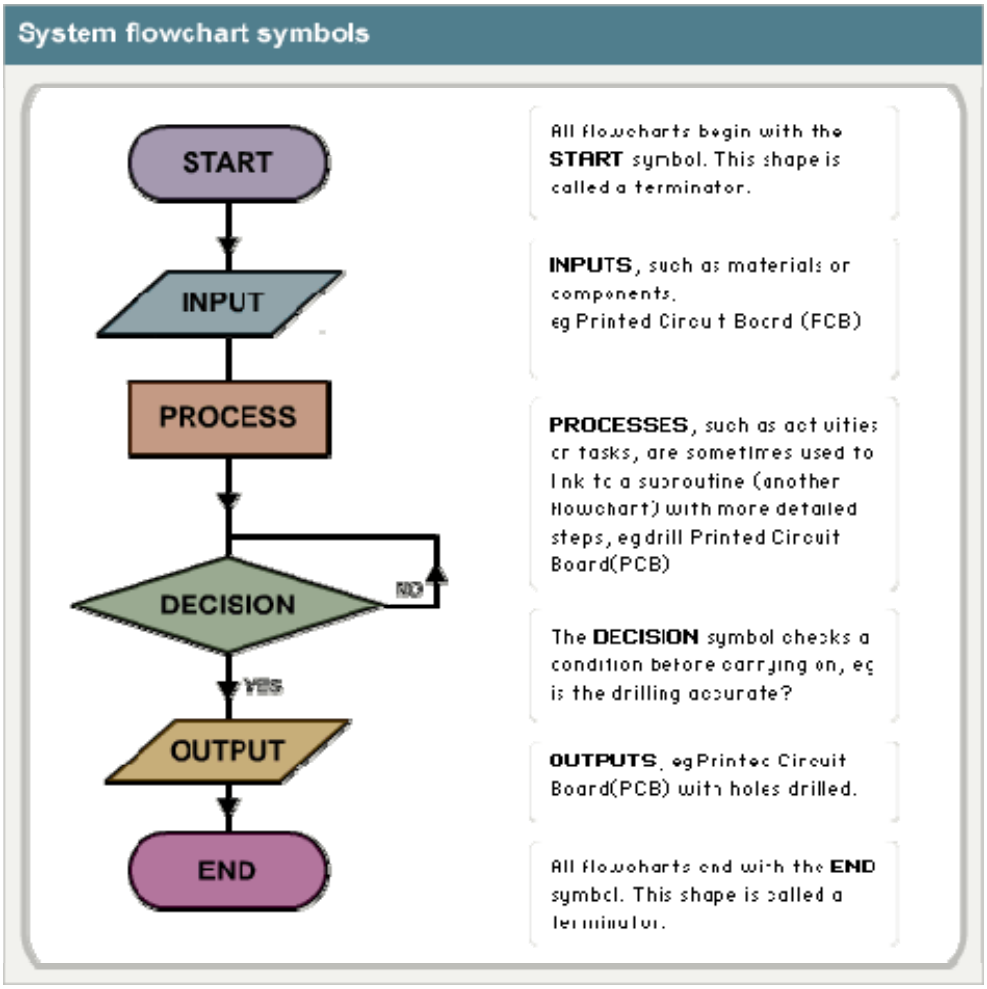


System flowcharts

Flowcharts are used to design and plan control systems. All flowcharts use the same symbols, linked with arrows to show direction of the flow.

- Flowcharts start and end with the **oval** 'start' and 'end' symbols.
- Inputs and outputs are shown as **parallelograms** and processes as **rectangles**. Sometimes the process box links to a sub-routine - another flowchart with more detailed steps, which then feeds back into the main process.
- The **diamond** shape is a "decision box", which checks an input or condition before carrying on.

The diagram below shows the main flowchart symbols and how they are used in a system flowchart.



Flowcharts can also be used to plan systems. Choose an everyday activity or system that you are familiar with, and describe it using the symbols in the diagram above.

Systems and control

There are many advantages to using a systems approach to designing and making products. The systems approach asks the questions:

- What does it do? (output)
- How does it do it? (process) and
- What makes it do it? (input)

Asking these questions is a good way of looking at an existing technical product and understanding how it functions. It is also a good way of approaching the design of any new product. You start with what the product must do (output), then work out how it's going to do it (process) and finally ask yourself what energy or other inputs it might need for the process to take place.

Systems need to be controlled, to make sure that they start working in the first place and continue working correctly. A closed-loop system is a good way of achieving this. In this type of system the output can be checked, and the results fed back into the system - to control it by making changes to the input and/or process.

A system controlling an automatic barrier at a car park, for example, needs control feedback from the sensors which detect the approach of a car. If the feedback is positive, the system changes to 'barrier up' - if negative, the system defaults to 'barrier down'.

Control systems in industry

In manufacturing, electronic, mechanical and pneumatic control systems are used to process materials through a factory. Computerised systems may be used to control the production lines, the ordering and receiving of materials and components, and the storage and shipment of finished products. Just-in-time manufacturing systems rely on efficient control systems to ensure that the inputs, processes and output are perfectly synchronised to avoid delays.

Control systems in manufacture:

- provide a high level of accuracy.
- automate quality control checks.
- monitor safety and performance.
- automate tedious repetitive tasks.
- are quick and can operate continuously.

Programmed systems

Systems need to be controlled, to ensure that the system's output continues to be the one we want. Digital control systems use a sequence of instructions called a **programme**. There are two main ways of writing programmes:

- graphically, using flowcharts
- using computer programming languages, such as BASIC, C, C++

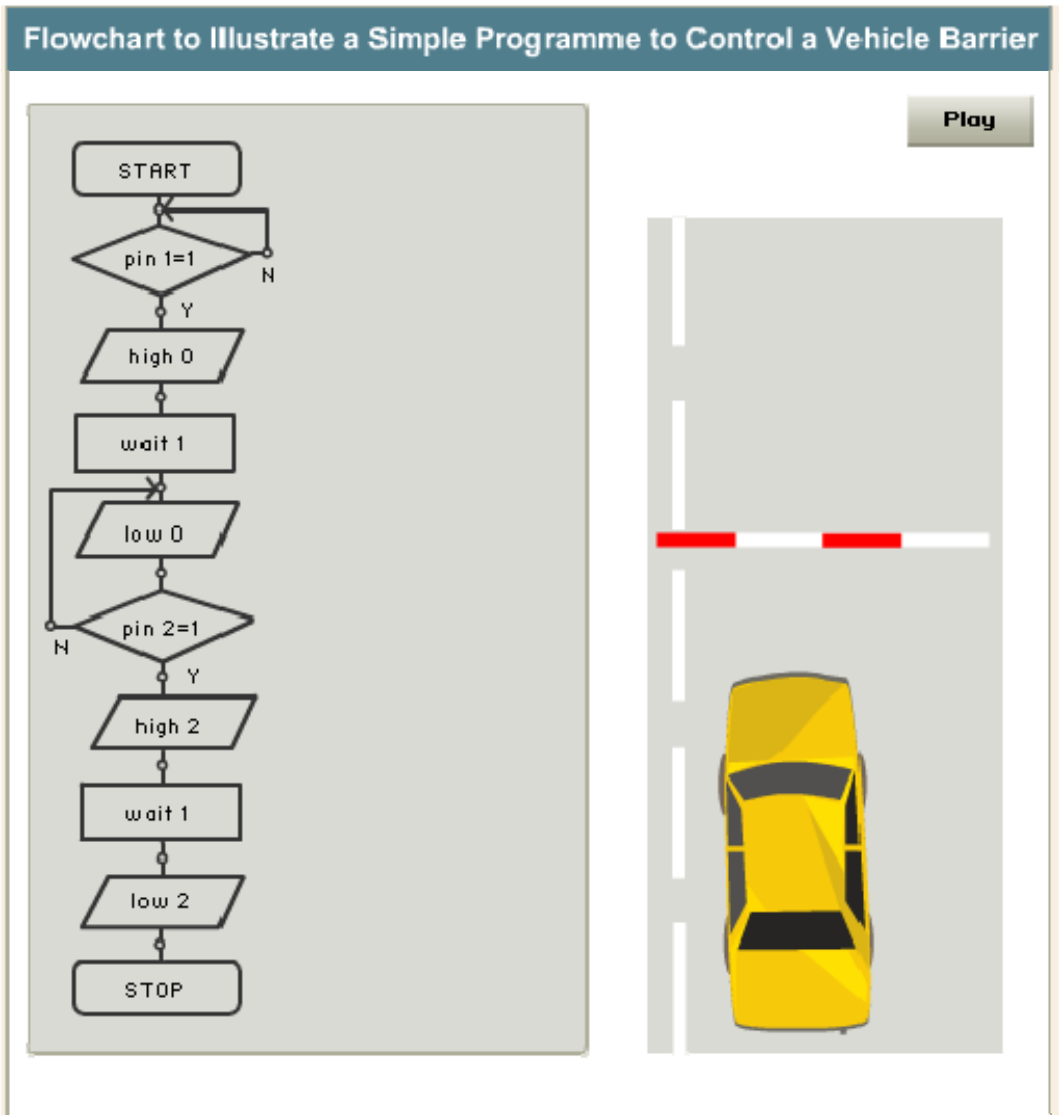
Flowchart Symbols	
START	Start of a sequence (programme or sub -routine)
OUTPUT	Switching or controlling outputs, e.g. LED's, motors, sounders etc.
PROCESS	Process commands, e.g. sub routines, delays etc.
COMPARE (No / Yes)	Checking inputs, e.g switches (digital) or sensors (analogue/digital)
END	End of a sequence (programme or routine)

In an examination you may be asked to plan a control programme for a given situation, using a flowchart. Flowcharts use symbols to show the sequence of actions in a programme.

On page three we listed the main symbols in a system flowchart. A control programme uses exactly the same symbols:

The flowchart diagram below illustrates a simple programme to control an automatic vehicle barrier at a car park. The control system specifications are as follows:

1. A sensor detects an approaching vehicle.
2. Pin 1 checks if there is input from the sensor. If yes...
3. Output 0 lifts the barrier.
4. A second sensor detects the vehicle moving away from the barrier.
5. Pin 2 checks if there is input from the sensor. If yes...
6. Output 2 lowers the barrier.


Flowchart to Illustrate a Simple Programme to Control a Vehicle Barrier
Play
START
pin 1=1
N
Y
high 0
wait 1
low 0
pin 2=1
N
Y
high 2
wait 1
low 2
STOP