ELECTRONICS
Learning Outcomes

Section 1 - Overview

The modern world is full of things that use electronics. Radios, televisions, calculators, computers, telephones, washing machines, autobanks and microwave ovens are just a few examples. In this unit, you will find out about some of the bits and pieces that are used in electronic devices. You will also be given the opportunity to design and build electronic circuits.

Some electronic systems are very complex, but you can get a very good idea of how the system works by thinking about it in three parts - INPUT, PROCESS and OUTPUT.

At General level you should be able to:

- ❑ 1. State that an electronic system can be described by three parts: *input*; *process*; *output*.
- ❑ 2. Distinguish between *digital* and *analogue* outputs.
- ❑ 3. Identify analogue and digital signals from oscilloscope traces.

Section 2 - Output Devices

There are many different types of output devices. Some turn information from an electronic system into a form we can easily understand. Often this involves an energy change. Other output devices allow electronic systems to control pieces of equipment.

In this section you will use a number of output devices.

At General level you should be able to:

- ❑ 1. Give examples of output devices, and state the energy changes involved.
- ❑ 2. Give examples of digital output devices and analogue output devices.
- ❑ 3. Draw and identify the symbol for an LED.
- ❑ 4. State that an LED will only light when it is connected one way round.
- ❑ 5. Explain why you need to connect a resistor in series with an LED.
- ❑ 6. State that different numbers can be produced by lighting up segments of a 7-segment display.

At Credit level you should also be able to:

- ❍ 7. Choose the most appropriate output device for a given application.
- ❍ 8. Use a circuit diagram to show the correct way to connect up an LED to allow it to light.
- ❍ 9. Calculate the value of series resistor needed to protect an LED.
- ❍ 10. Calculate the decimal equivalent of a binary number in the range 0000 (*0*) to 1001 (*9*).

Section 3 - Input Devices

Any electronic system must be fed information in some way. This is the job of the input device. In this section, you will examine a number of input devices and use them in sensor circuits.

At General level you should be able to:

- ❑ 1. Describe the energy transformations in these devices:
  microphone;
  thermocouple;
  solar cell.
- ❑ 2. State how the resistance of a thermistor changes as the temperature changes.
- ❑ 3. State how the resistance of an LDR changes as the light intensity changes.
- ❑ 4. Carry out calculations using $V = IR$ for a thermistor and an LDR.
- ❑ 5. State that the voltage across a capacitor increases as time goes on whilst it is charging.
- ❑ 6. Choose an appropriate input device for an application from a list.

At Credit level you should also be able to:

- ❍ 7. Carry out calculations involving voltages and resistances in a voltage divider.
- ❍ 8. State that the time taken to charge a capacitor depends on 2 things:
  resistance of the circuit;

the value of the capacitor.

❍ 9. Choose the most appropriate input device for a given application.

Section 4 - Digital Processes

In sections 2 and 3 you found out about input and output devices. To make a useful electronic system, these have to be connected by a process device.

In this section, the first process device you will meet is the transistor. You will use it to make systems which can switch on lights or heaters automatically. Later, you will investigate the use of more complex process devices called gates.

At General level you should be able to:

❑ 1. State that the transistor may be conducting (*ON*) or non-conducting (*OFF*).

❑ 2. State that a transistor can be used as a voltage-controlled switch.

❑ 3. Draw and identify the circuit symbol for a transistor.

❑ 4. Work out, from a circuit diagram, the purpose of a simple transistor switching circuit.

❑ 5. Draw and identify the symbol for the following gates: *AND; OR; NOT*.

❑ 6. State what a truth table is.

❑ 7. State that:
logic '1' = high voltage (usually 5V)
logic '0' = low voltage (usually 0V)

❑ 8. Draw the truth table for the following gates: *AND; OR; NOT*.

❑ 9. Explain how to use combinations of these gates for simple control circuits.

❑ 10. State that a digital circuit can produce a series of clock pulses.

❑ 11. State that there are digital circuits which can count clock pulses.

❑ 12. State that the output of a counter circuit is in binary.

❑ 13. State that the output of a counter circuit can be converted to decimal.

❑ 14. Give an example of a device which contains a counter circuit.

At Credit level you should also be able to:

❍ 15. In addition to ***4*** above, explain the operation of a transistor switching circuit.

❍ 16. Identify the following gates from truth tables: *AND*; *OR*; *NOT*.

❍ 17. Draw a truth table for a simple circuit containing a combination of gates.

❍ 18. Explain how a simple oscillator produces clock pulses.

❍ 19. Describe how to change the frequency of the clock.

Section 5 - Analogue Processes

The process devices in section 4 were digital devices. In those, the voltage changed in steps (OFF or ON). In analogue devices, the voltage changes smoothly. In this section you will discuss the function of amplifiers.

At General level you should be able to:

❑ 1. Pick out some devices which amplifiers are an important part of from a list.

❑ 2. State the function of an amplifier in devices such as radios, intercoms and music centres.

❑ 3. State that an audio amplifier increases the amplitude of a signal but does not affect its frequency.

❑ 4. Carry out calculations involving input voltage (V_{in}), output voltage (V_{out}) and voltage gain of an amplifier.

At Credit level you should also be able to:

❍ 5. Describe a method of measuring the voltage gain of an amplifier.

❍ 6. State that power can be calculated from V^2/R, where V is the voltage and R is the resistance of the circuit.

- 7. State that the power gain of an amplifier is the ratio of power output to power input.
- 8. Carry out calculations involving the power gain of an amplifier.