TELECOMMUNICATIONS
Learning Outcomes

Section 1 – Communication Using Waves

Since the earliest times, humans have tried to communicate with each other. The ability to communicate effectively is at the heart of civilisation. All of the early attempts at telecommunications relied on two types of waves: light and sound.

In this section, you will find out about communicating using sound and other waves, and you will also find out more about waves themselves.

At General level you should be able to:

- ❑ 1. Give an example that shows the speed of sound in air is very much less than the speed of light in air.
- ❑ 2. Describe an experimental method for measuring the speed of sound in air.
- ❑ 3. Carry out calculations involving $speed = \frac{distance}{time}$ in problems on sound.
- ❑ 4. State that waves are one way of carrying signals.
- ❑ 5. Use each of these terms correctly with respect to sound: *wave*; *frequency*; *wavelength*; *speed*; *energy, energy transfer*; *amplitude*.
- ❑ 6. Carry out calculations involving $speed = \frac{distance}{time}$ in problems on water waves.
- ❑ 7. Carry out calculations involving *wavespeed = frequency x wavelength* in problems on both water and sound waves.

At Credit level you should also be able to:

- ❍ 8. Explain why wavespeed can be calculated using either *frequency x wavelength* or $\frac{distance}{time}$.

Section 2 – Communication Using Cables

In some modern telecommunications systems, the messages are carried along cables. This could be electrical cables, such as in telegraph and telephone systems, or optical fibres. Optical fibres are lighter, cheaper and less prone to tapping or crossed lines, and so most telecommunications companies are adopting them nowadays.

As the information age takes off, we are going to rely heavily on optical fibres to bring the TV channels, phone messages, closed video captioning and Internet services that we will come to expect from our communications services.

At General level you should be able to:

- ❑ 1. Describe how a message can be sent using a code – for example, Morse Code.
- ❑ 2. State the function of: *(a)* a transmitter; and *(b)* a receiver.
- ❑ 3. State that the telephone is an example of long range communication between a transmitter and receiver.
- ❑ 4. State the energy changes in: *(a)* a microphone; and *(b)* a loudspeaker.
- ❑ 5. State which device can be found in a telephone's: *(a)* earpiece; and *(b)* mouthpiece.
- ❑ 6. State that electrical signals can be transmitted along wires during a telephone call.
- ❑ 7. State that the speed of a telephone signal is very much greater than the speed of sound.
- ❑ 8. Describe the effect on a C.R.O. signal pattern due to a change in a sound's: *(a)* loudness; and *(b)* frequency.
- ❑ 9. Describe how these terms relate to sound signals: *frequency*; *amplitude*.
- ❑ 10. State what is meant by the term '*optical fibre*'.
- ❑ 11. Describe one practical use of optical fibres in telecommunications.
- ❑ 12. State that both electrical cable and optical fibres can be used in telecommunication systems.

❑ 13. State that light can be reflected.

❑ 14. Describe how a ray of light is reflected from a flat mirror with the help of the *Law of Reflection*.

❑ 15. State that light signals pass along an optical fibre at very high speeds.

At Credit level you should also be able to:

❍ 16. Explain how changes in the loudness and frequency of a sound signal affect the corresponding electrical signal pattern.

❍ 17. Compare the properties of electrical cables and optical fibres.

❍ 18. Explain what is meant by *reversibility of light*.

❍ 19. Describe how an optical fibre transmission system works.

❍ 20. Carry out calculations using $speed = \frac{distance}{time}$ in problems on light travelling through optical fibres.

Section 3 – Radio and Television

Radio communication is used by millions of people for entertainment and for information. Radio is very important to the emergency services, and to the military. Most people use the television a lot, usually for entertainment, and often for news and other information. Television has become such an important part of society that it is often a person's main window on the world.

In this section, you will discover how a radio and a television work.

At General level you should be able to:

❑ 1. Name the main parts of a radio receiver.

❑ 2. Identify these parts on a block diagram of a radio receiver.

❑ 3. Describe the function of each of these parts of a radio receiver.

❑ 4. Name the main parts of a television receiver.

❑ 5. Identify these parts on a block diagram of a television receiver.

❑ 6. Describe the function of each of these parts of a television receiver.

❑ 7. Describe how a picture is produced on a television screen in terms of line build-up.

❑ 8. Explain how colour pictures can be produced on a television screen using red, green and blue light.

At Credit level you should also be able to:

❍ 9. Explain how radio transmission works using these terms: *transmitter*; *carrier wave*; *amplitude modulation*; *receiver*.

❍ 10. Explain how television transmission works using these terms: *transmitter*; *carrier wave*; *amplitude modulation*; *video and audio receivers*.

❍ 11. Describe how a moving picture is seen on a television screen using these terms: *line build-up*; *image retention*; *brightness variation*.

❍ 12. Describe the effects of mixing red, green and/or blue light.

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Section 4 – Transmission of Radio Waves

A lot of the modern telecommunications systems use radio waves or microwaves to carry the information between the transmitter and receiver. To understand how these systems work, we have to first understand how the waves that carry the information behave. You will find out about the behaviour of waves in this section.

The first man-made satellite, "Sputnik I", was launched in 1957. Nowadays, several satellites are used to transmit thousands of phone calls and many television channels around the world (and all at the same time!)

In this section you will find out about the use of satellites to enable communication with all parts of the world, and about the aerials used to send and receive signals over long distances.

At General level you should be able to:

- ❑ 1. State that mobile telephones, radio and television are examples of long range communication which do not need cables between the transmitter and receiver.
- ❑ 2. State that microwaves, radio and television signals are waves that carry energy.
- ❑ 3. State that microwaves, television and radio signals travel at very high speeds.
- ❑ 4. State the speed of microwaves, television and radio signals through air.
- ❑ 5. State that a radio transmitter can be identified by wavelength or frequency values.
- ❑ 6. State the purpose of the curved reflector on certain aerials.
- ❑ 7. Explain the effect the curved reflector has on the received signal.
- ❑ 8. Describe one use of curved reflectors in telecommunications.
- ❑ 9. Say how a satellite's height affects the time it takes to complete an orbit around the earth.
- ❑ 10. Explain the meaning of the word *period*.
- ❑ 11. State the meaning of a *geostationary satellite*.
- ❑ 12. Describe how geostationary satellites and dish aerials can be used to allow satellite television broadcasting.
- ❑ 13. Describe how geostationary satellites and ground stations make intercontinental communications possible.

At Credit level you should also be able to:

- ❍ 14. Carry out calculations involving the relationship between speed (v), distance (d) and time (t) in problems on microwaves, television and radio waves.
- ❍ 15. Carry out calculations involving the relationship between speed (v), wavelength (λ) and frequency (f) for microwaves, television and radio waves.
- ❍ 16. Explain some of the differences between radio bands in terms of source strength, ability to diffract, reflection, etc.
- ❍ 17. Explain how wavelength affects radio reception in terms of *diffraction*.
- ❍ 18. In addition to ***6*** above, explain the action of curved reflectors on certain transmitters.