Communication information - 2020 A2

1. Nov/2020/Paper_42/No.4

(a) State **two** advantages of the transmission of data in digital, rather than analogue, form.

1. .....

.....

2. .....

.....

[2]

(b) An analogue signal is to be transmitted in digital form.

The transmission system may be represented in block form as in Fig. 4.1.

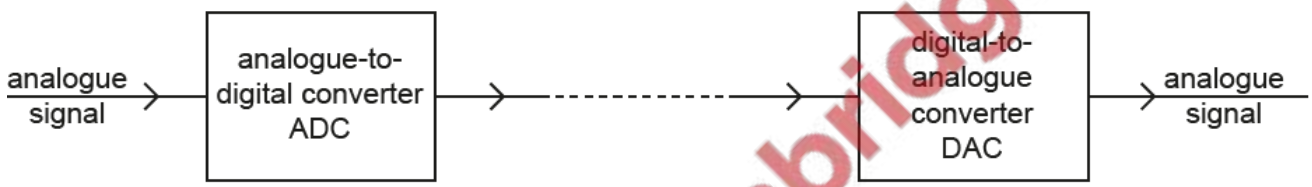

Fig. 4.1

The variation with time *t* of part of the input analogue signal is shown in Fig. 4.2.

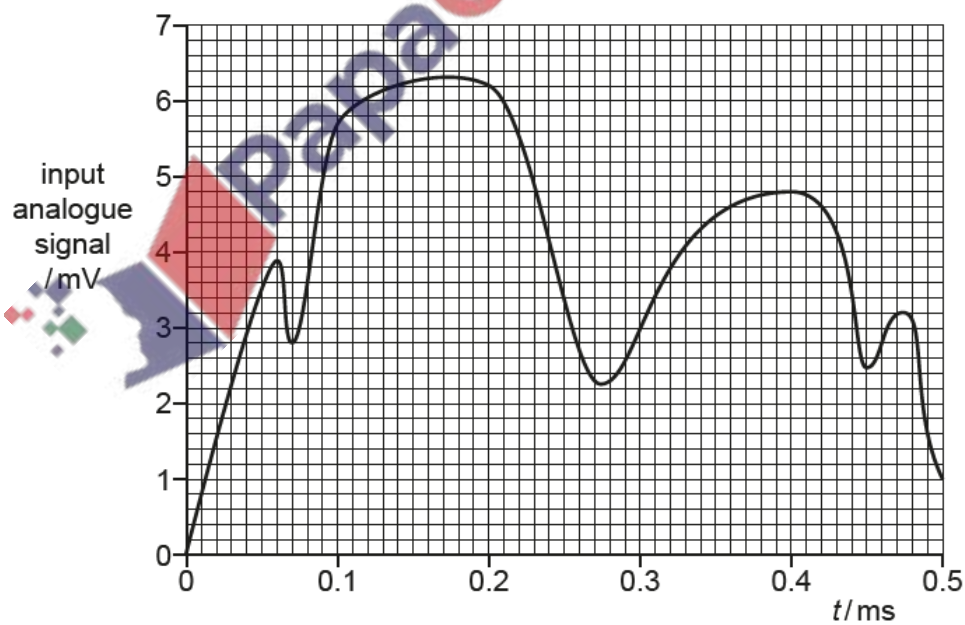

Fig. 4.2

The analogue signal is sampled at time intervals of 0.10 ms. The first sample is taken at time $t = 0$.

Some values of the sampled analogue signal and the corresponding digital signals are shown in Table 4.1.

Each digitised number contains four bits.

Table 4.1

time t / ms	0	0.10	0.20	0.30	0.40	0.50
analogue signal / mV	0	5.7	6.2	.....	.....	.....
digital signal	0000	0101	0110	.....	.....	.....

(i) In Table 4.1, underline the least significant bit (LSB) in the digital signal for the time of 0.20 ms. [1]

(ii) Complete Table 4.1. [3]

(c) A single bit from the output of the digital-to-analogue converter corresponds to an output analogue signal of 1.0 mV.

Assume that the conversion and transmission do not introduce a time delay.

On the axes of Fig. 4.3, show the variation with time *t* of the output from the digital-to-analogue converter.

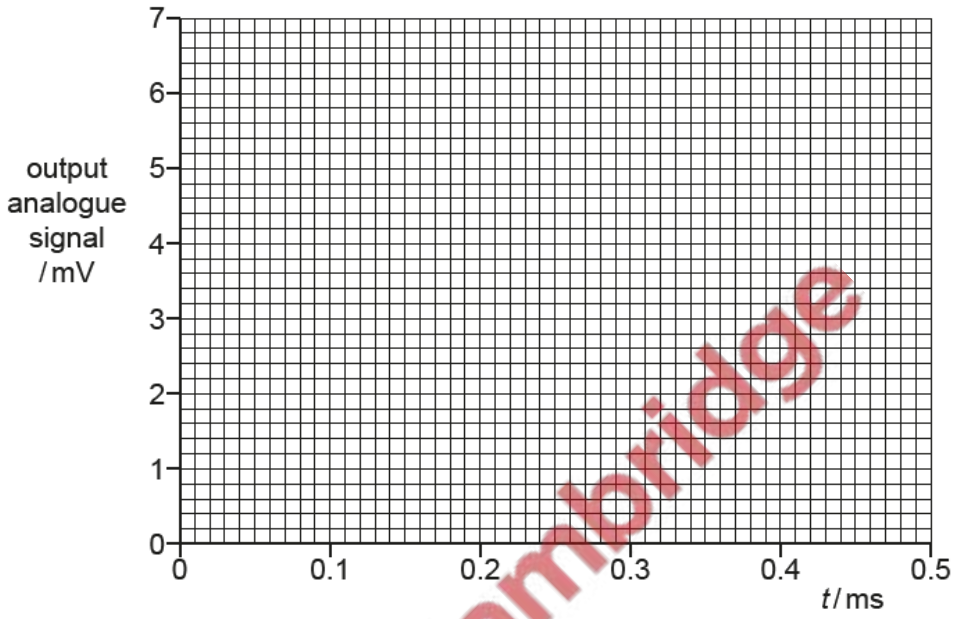

Fig. 4.3

[3]

[Total: 9]

2. June/2020/Paper_41/No.6

(a) The transmission of signals using optic fibres has, to a great extent, replaced the use of coaxial cables.

Advantages of optic fibres include greater bandwidth and very little crosslinking.

(i) Suggest an advantage of greater bandwidth.

.....

..... [1]

(ii) State what is meant by *crosslinking*.

.....

.....

..... [2]

(b) In telecommunications, a signal power of 1.0 mW is used as a reference power.
Signal powers relative to this reference power and expressed in dB are said to be measured in 'dBm'.

Show that a signal power of 13 dBm is equivalent to 20 mW.

[2]

(c) A signal of input power 20 mW is transmitted along an optic fibre for an uninterrupted distance of 45 km.

The optic fibre has an attenuation per unit length of 0.18 dB km^{-1}.

Calculate the output power P from the optic fibre.

P = ... mW [2]

[Total: 7]

3. June/2020/Paper_42/No.6

(a) Telephone signals may be transmitted either by means of an optic fibre or by means of a wire pair.

State **three** advantages of the use of an optic fibre rather than a wire pair.

1. .....

.....

2. .....

.....

3. .....

.....

[3]

(b) It is proposed to transmit a signal over a distance of 4.5×10^3 km by means of an optic fibre.

The input signal has a power of 9.8 mW.

The minimum signal that can be detected at the output has a power of 6.3×10^{-17} W. For this signal power, the signal-to-noise ratio is 21 dB.

Calculate:

(i) the power of the background noise

power = ... W [2]

(ii) the maximum attenuation per unit length of the optic fibre that allows for uninterrupted transmission of the signal.

attenuation per unit length = ... dB km^{-1} [2]

[Total: 7]

4. March/2020/Paper_42/No.5

(a) State **two** advantages of the transmission of data in digital form, rather than analogue form.

1. .....

.....

2. .....

.....

[2]

(b) Optic fibres are used for the transmission of data.

(i) A signal in an optic fibre is carried by an electromagnetic wave of frequency 1.36×10^{14} Hz. The speed of the wave in the fibre is $2.07 \times 10^{8}\,m\,s^{-1}$.

For this electromagnetic wave, determine the ratio:

$$\frac{\text{wavelength in free space}}{\text{wavelength in fibre}}.$$

ratio = ... [2]

(ii) The attenuation per unit length of the signal in the fibre is $0.40\,dB\,km^{-1}$. The input power is 1.5 mW and the output power is 0.060 mW.

Calculate the length of the fibre.

length = ... km [3]

[Total: 7]