Surname	Centre Number	Candidate Number
Other Names		

GCE A level

1144/01

ELECTRONICS – ET4

P.M. THURSDAY, 6 June 2013

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**3**	
2.	**4**	
3.	**5**	
4.	**6**	
5.	**8**	
6.	**9**	
7.	**11**	
8.	**4**	
Total	**50**	

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ADDITIONAL MATERIALS

In addition to this examination paper, you will need a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The total number of marks available for this paper is 50.

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

You are reminded to show all working. Credit is given for correct working even when the final answer given is incorrect.

INFORMATION FOR THE USE OF CANDIDATES

Preferred Values for resistors

The figures shown below and their decade multiples and sub-multiples are the E24 series of preferred values.

10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91.

Standard Multipliers:

Prefix	Multiplier
T	$\times 10^{12}$
G	$\times 10^{9}$
M	$\times 10^{6}$
k	$\times 10^{3}$

Prefix	Multiplier
m	$\times 10^{-3}$
µ	$\times 10^{-6}$
n	$\times 10^{-9}$
p	$\times 10^{-12}$

Filters

$f_b = \dfrac{1}{2\pi RC}$ Break frequency for high pass and low pass filters

$X_C = \dfrac{1}{2\pi fC}$ Capacitive reactance

$X_L = 2\pi fL$ Inductive reactance

$Z = \sqrt{R^2 + X_C^2}$ For a series RC circuit

$f_0 = \dfrac{1}{2\pi\sqrt{LC}}$ Resonant frequency

$R_D = \dfrac{L}{r_L C}$ Dynamic resistance

$$Q = \frac{2\pi f_0 L}{r_L}$$

$$Q = \frac{f_0}{B}$$

Modulation

$m = \dfrac{(V_{max} - V_{min})}{(V_{max} + V_{min})} \times 100\%$ Depth of modulation

$\beta = \dfrac{\Delta f_c}{f_i}$ Modulation index

$\text{resolution} = \dfrac{\text{i/p voltage range}}{2^n}$ PCM

$\left.\begin{array}{l}\text{Bandwidth} = 2(\Delta f_c + f_i) \\ \text{Bandwidth} = 2(1+\beta)f_i\end{array}\right\}$ Transmitted FM Bandwidth

Radio receivers

$$C = \frac{1}{4\pi^2 f_0^2 L}$$

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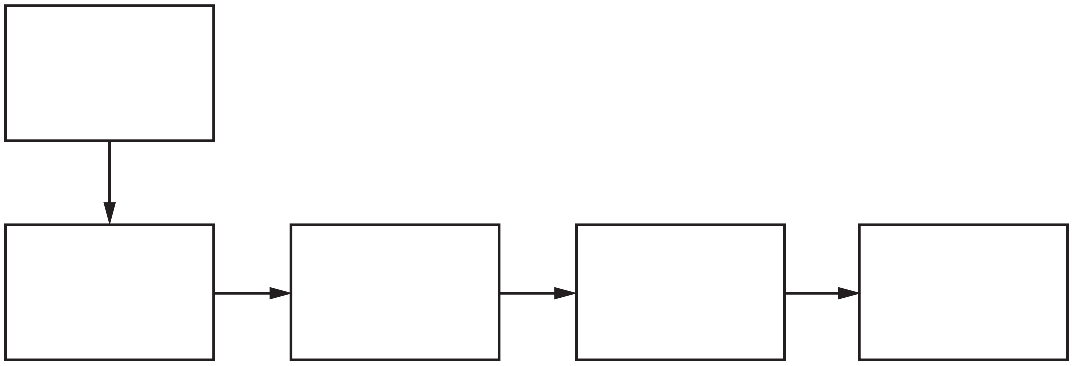
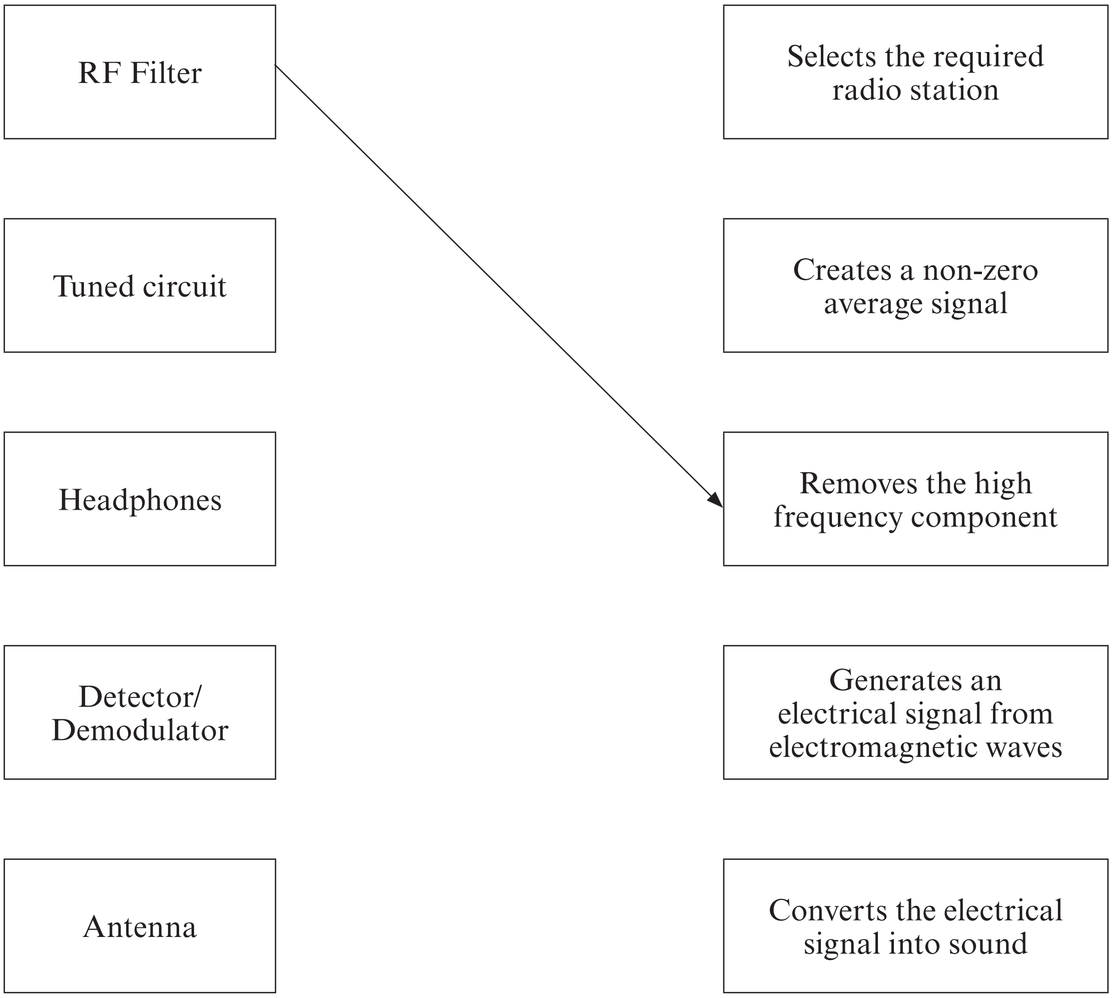
1. *(a)* Complete the following system diagram for the simple radio receiver, using the blocks in the list below. [1]

RF Filter, *Tuned circuit,* *Headphones,* *Detector/Demodulator,* *Antenna*



(b) Match the block with its function. One has been done for you. [2]



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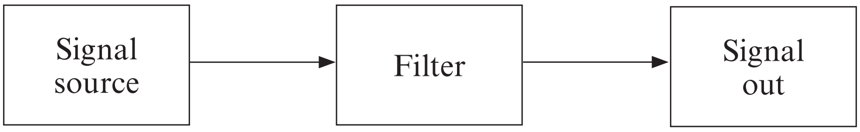
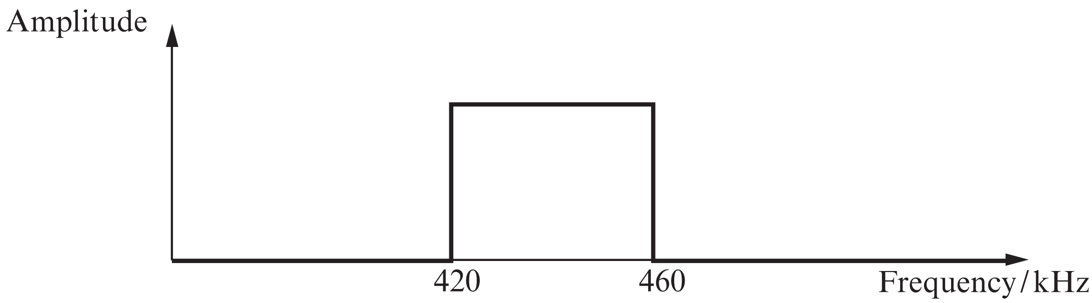
2. An engineer investigated the behaviour of a filter in response to different input signals. A block diagram of the test system is shown below.



The frequency response of the filter is shown in the following graph.

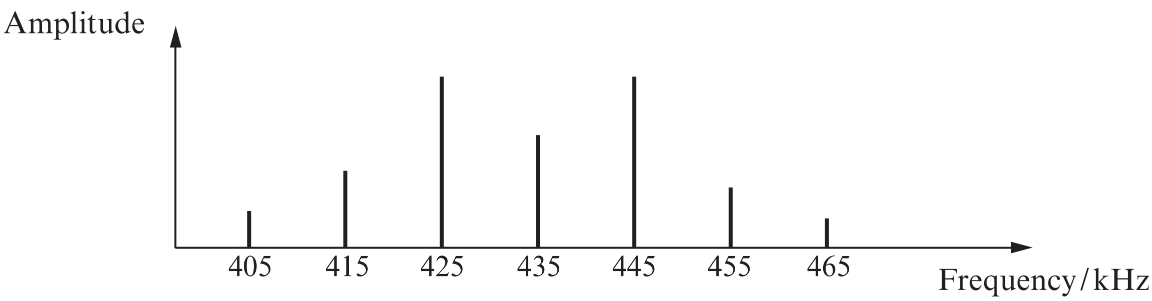


(a) What is the name of the type of filter which has this frequency response?

....

[1]

(b) A Frequency Modulated signal having the following frequency spectrum is connected to the input of the filter. [1]



Sketch the frequency spectrum of the filter output, labelling all relevant frequencies.

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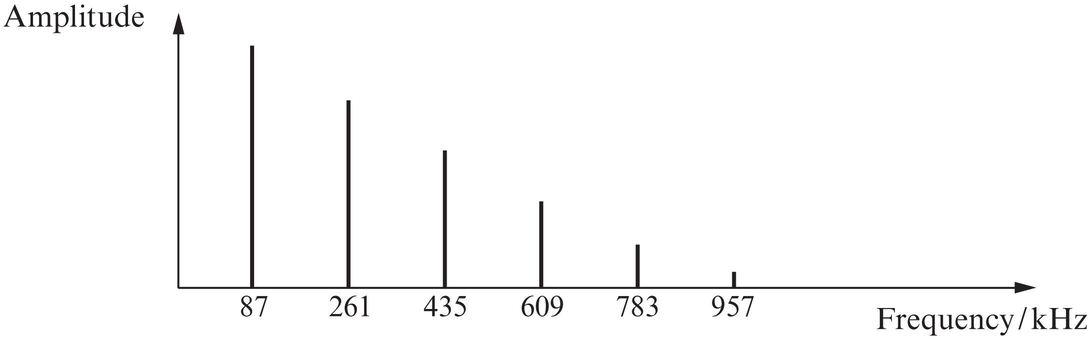
(c) A square wave signal having the following frequency spectrum is connected to the input of the filter. [1]



Sketch the frequency spectrum of the filter output, labelling all relevant frequencies.

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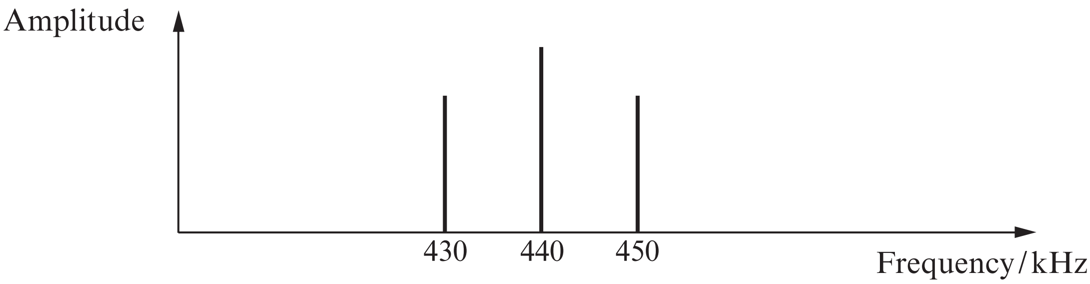
(d) An Amplitude Modulated signal having the following frequency spectrum is connected to the input of the filter. [1]



Sketch the frequency spectrum of the filter output, labelling all relevant frequencies.

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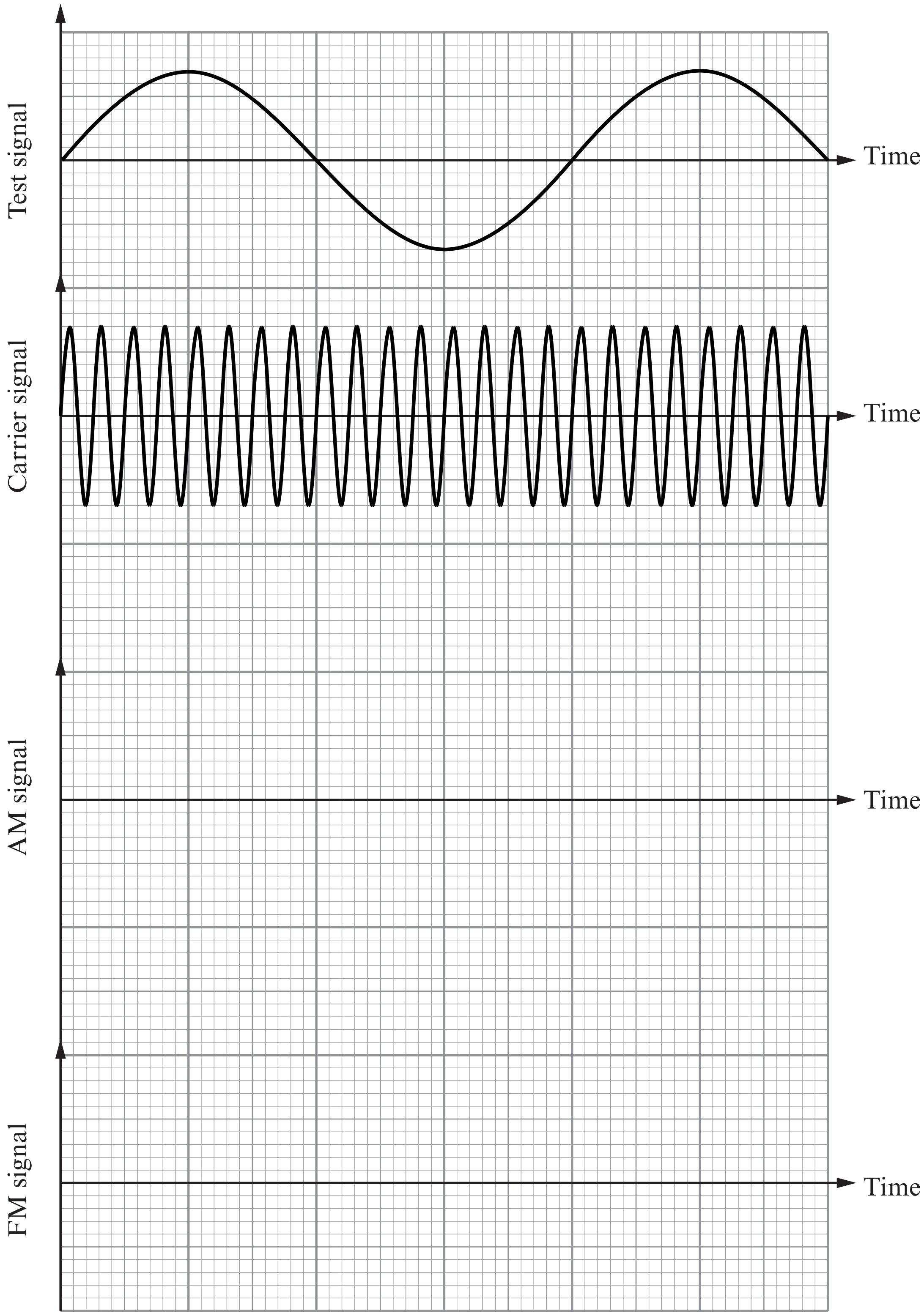
3. *(a)* Two modulation techniques used for radio communication are Amplitude Modulation and Frequency Modulation.

The test signal below is used to modulate the carrier signal using these modulation techniques. Use the axes provided to sketch the output of the modulation process in each case. [2]



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(b) A 200 MHz carrier signal is frequency modulated by an audio signal in the range 100 Hz to 20 kHz. The frequency deviation is 100 kHz. Calculate:

(i) the modulation index; [1]

....

....

(ii) the bandwidth of the resulting FM waveform. [2]

....

....

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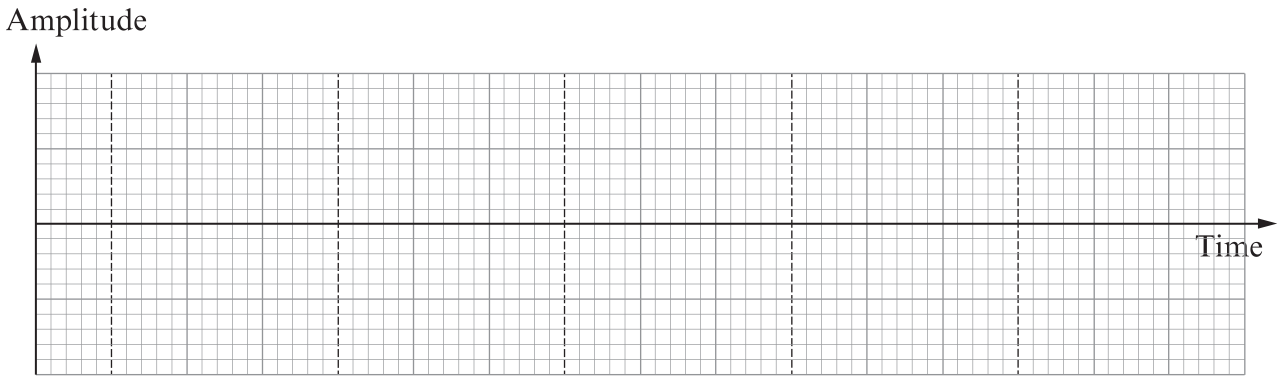
4. The following graphs show different ways in which Pulse Modulation can be used in a communication system. For **each** case state:

- which method is being used, either PPM, PWM or PAM;
- sketch the original modulating signal.

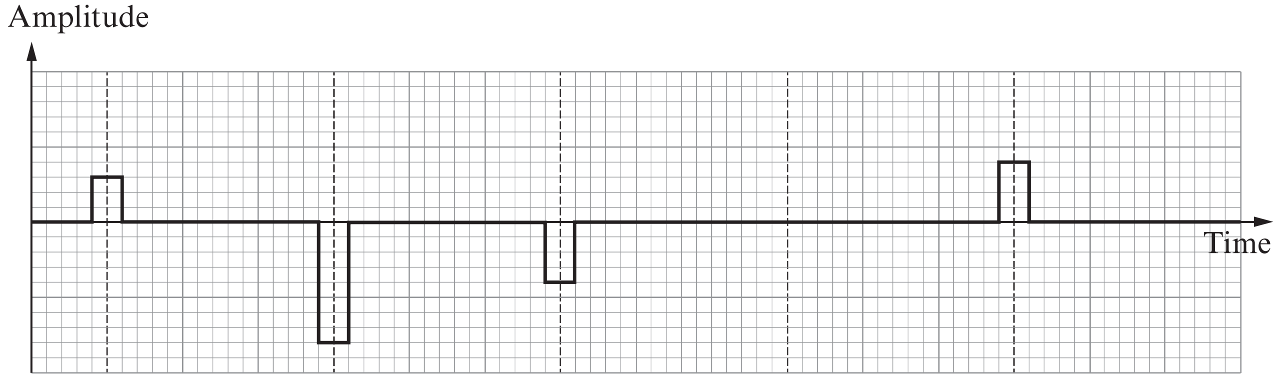
(a)

(i) Type of Pulse Modulation used ....

(ii) Sketch the modulating signal below. [3]

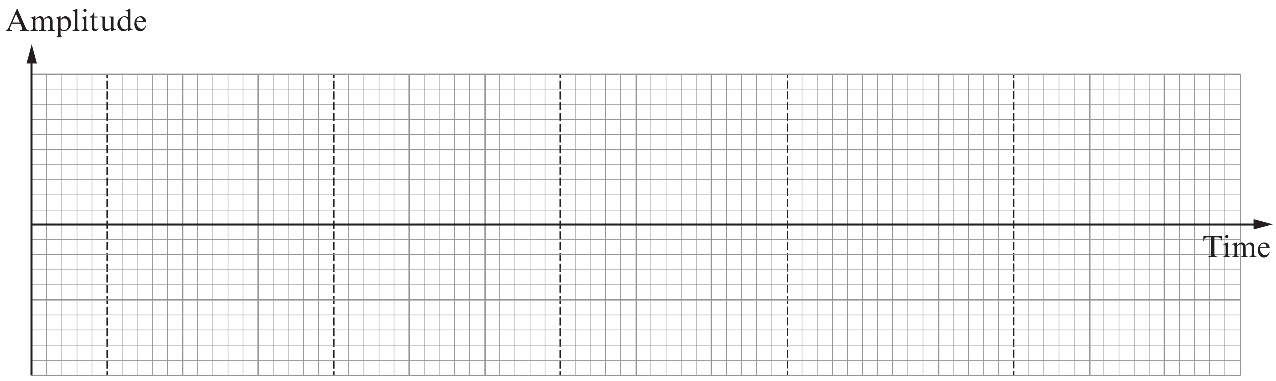


(b)



(i) Type of Pulse Modulation used ....

(ii) Sketch the modulating signal below. [3]



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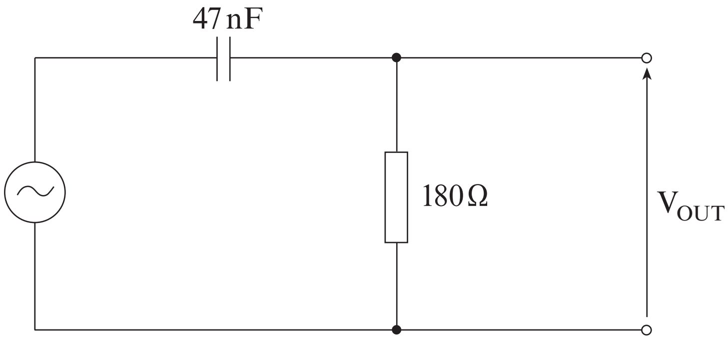
5. The following circuit is used as a filter.



(a) What is the name of this type of passive RC filter? .... [1]

(b) Calculate the reactance of the capacitor at 1 kHz. [2]

....

....

....

(c) What is the reactance of the capacitor at 100 kHz? [1]

....

(d) Calculate the break frequency for this filter. [2]

....

....

....

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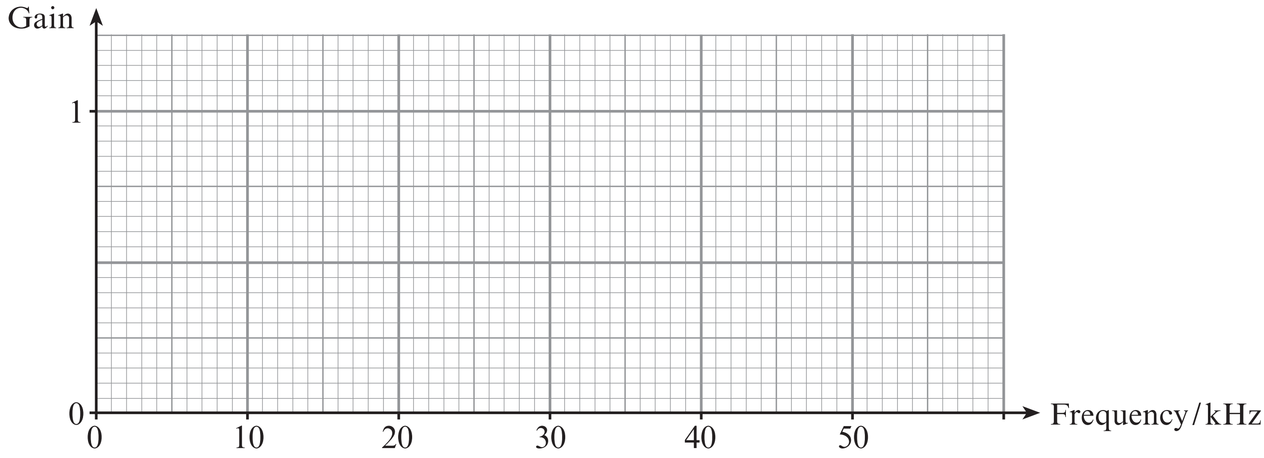
(e) Sketch the frequency response of this filter. [2]



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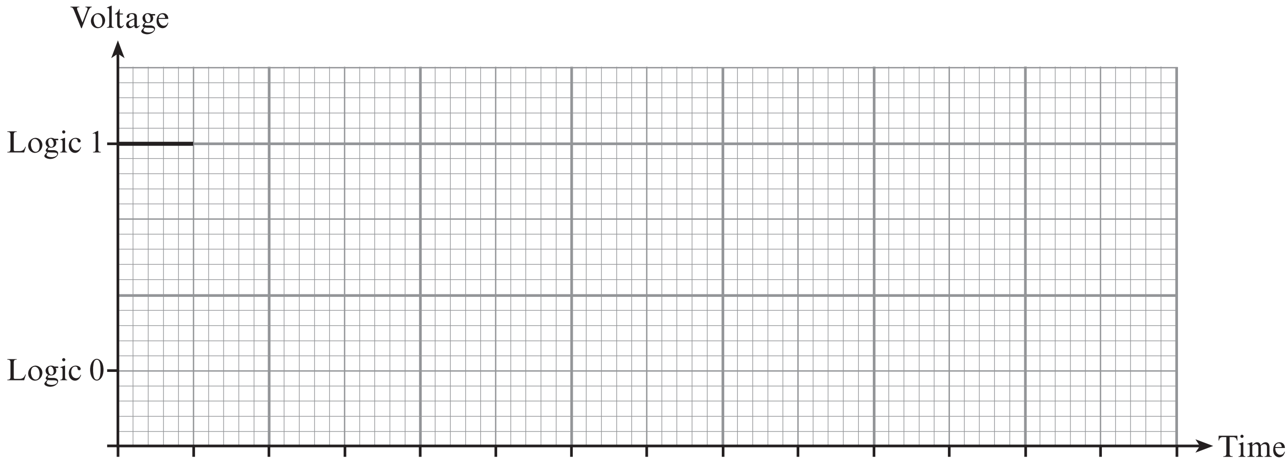
6. *(a)* A computer system uses **even** parity.

The computer system transmits the character ‘h’. The ASCII code for the character ‘h’ is 1101000.

(i) What is the logic state of the parity bit? .... [1]

(ii) Complete the graph to show the transmitted signal for the character ‘h’. Label the start, stop and parity bits. [4]



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(b) A high-quality transmission system uses a five bit parity system, which allows single errors in the transmission to be detected and also corrected. The parity bits are assigned to the data bits in accordance with the following table.

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	P_4	P_3	P_2	P_1	P_0
				x	x	x	x					x
x	x	x	x								x	
		x	x			x	x			x		
	x	x			x	x			x			
x	x			x	x			x				

(i) The data in the table below is transmitted along a transmission line. Complete the table showing the values of the parity bits P_4 - P_0 that should be transmitted after this data for an **odd** parity system. [2]

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	P_4	P_3	P_2	P_1	P_0
1	1	0	1	1	1	0	1					

(ii) In a later transmission the following data and parity bits are received from a distant source. The transmission system was using **odd** parity. [1]

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	P_4	P_3	P_2	P_1	P_0
1	0	1	1	0	0	1	0	1	1	0	1	0

There is a **single** error in the received transmission. Determine where the error is located and therefore write down the correct version of the received data.

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	P_4	P_3	P_2	P_1	P_0

Explain how you have determined the location of the error. [1]

....

....

....

....

....

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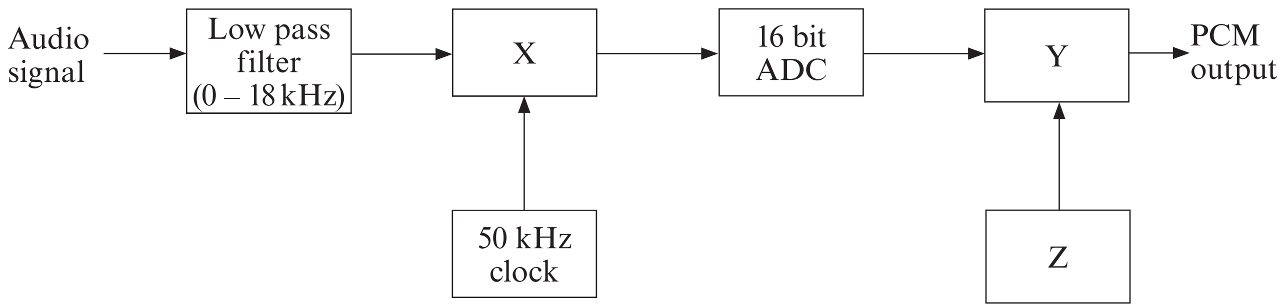
7. The system diagram shows a Pulse Code Modulation **transmitter**.



(a) Identify the blocks labelled X, Y and Z.

(i) Block X = ... [1]

(ii) Block Y = ... [1]

(iii) Block Z = ... [1]

(b) (i) How many sampling levels are available using a 16-bit code? [1]

....

(ii) Explain why a PCM sampling frequency of 50 kHz is suitable in this application. [1]

....

....

....

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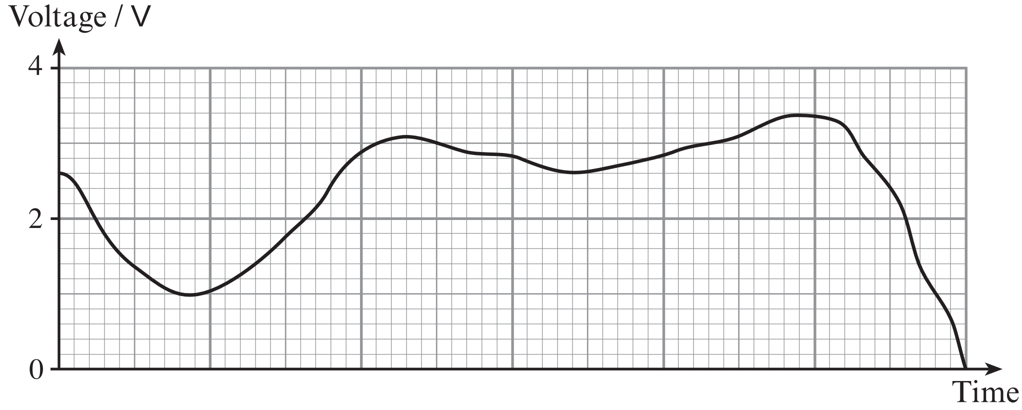
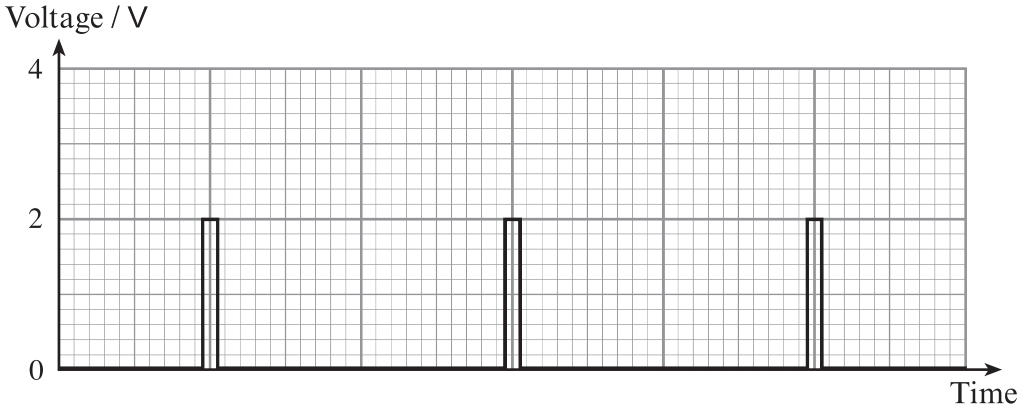
(c) The analogue input signal shown is applied to the PCM system. The 50 kHz clock signal is also shown. [2]

Analogue signal

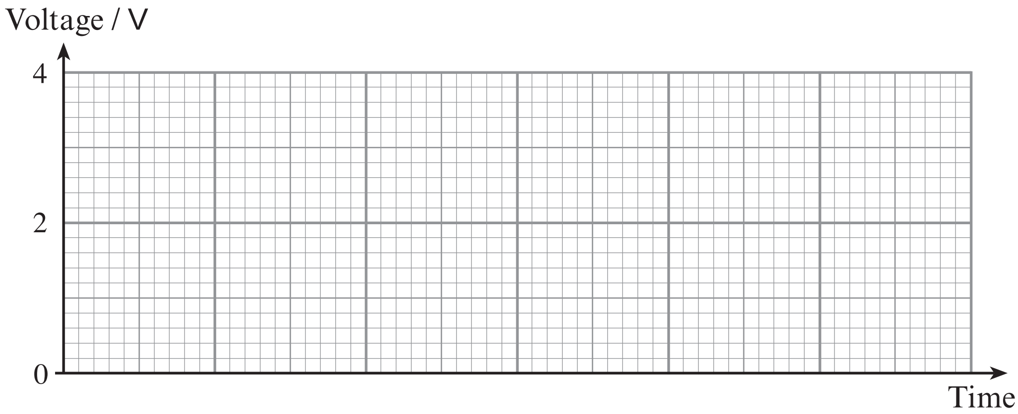


50 kHz clock



Use the grid to show the output of Block X.

Block X output



Turn over.

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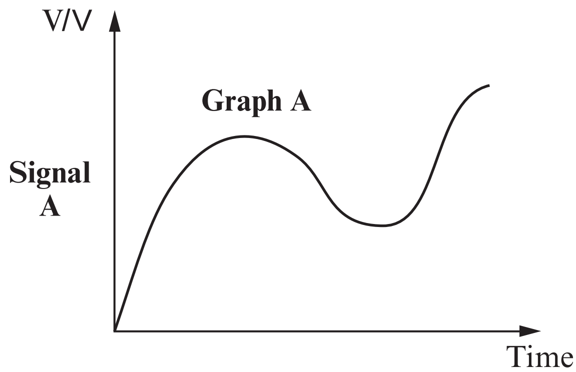
(d) The **receiver** of a **different** Pulse Code Modulation system is constructed from the following sub-systems:

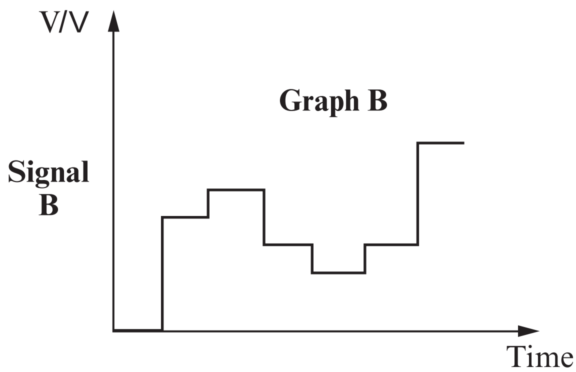
SIPO shift register *2 MHz clock* *Schmitt trigger*

Low pass filter *Digital to Analogue Converter (DAC)*

(i) Draw the block diagram for this receiver, using **only** these sub-systems. [2]

(ii) The following graphs show the output of two sub-systems in the PCM receiver.





(I) What is the name of the sub-system that has the form of output shown by Graph **A**?

....

(II) What is the name of the sub-system that has the form of output shown by Graph **B**?

....

[2]

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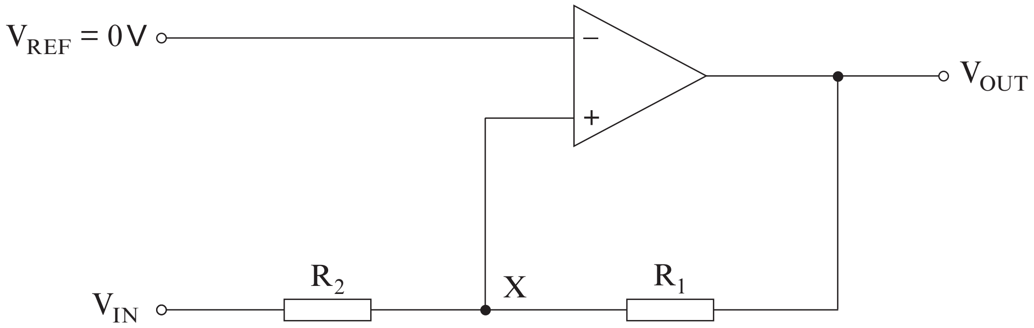
8. A non-inverting Schmitt trigger has saturation values of ±13V, and switching thresholds of ±2V.



(a) Explain why the switching thresholds for this circuit are symmetrical about 0V. [1]

....

....

(b) Determine the values of R_1 and R_2. [3]

....

....

....

....

....

....

....

....

....

R_1 = ... R_2 = ...

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