Surname		Other Names	
Centre Number			Candidate Number	
Candidate Signature			

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General Certificate of Education
June 2004
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

ELECTRONICS ELE5
Unit 5 Communications Systems

Thursday 1 July 2004 Morning Session

In addition to this paper you will require:
- a calculator;
- a pencil and a ruler.

Time allowed: 1 hour 30 minutes

Instructions
- Use blue or black ink or ball-point pen. Use pencil for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.
- A *Data Sheet* is provided on pages 3 and 4. Detach this perforated sheet at the start of the examination.

Information
- The maximum mark for this paper is 72.
- Mark allocations are shown in brackets.
- Any correct electronics solution will gain credit.
- The paper carries 20% of the total marks for Electronics Advanced Level award.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
4			
5			
6			
7			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

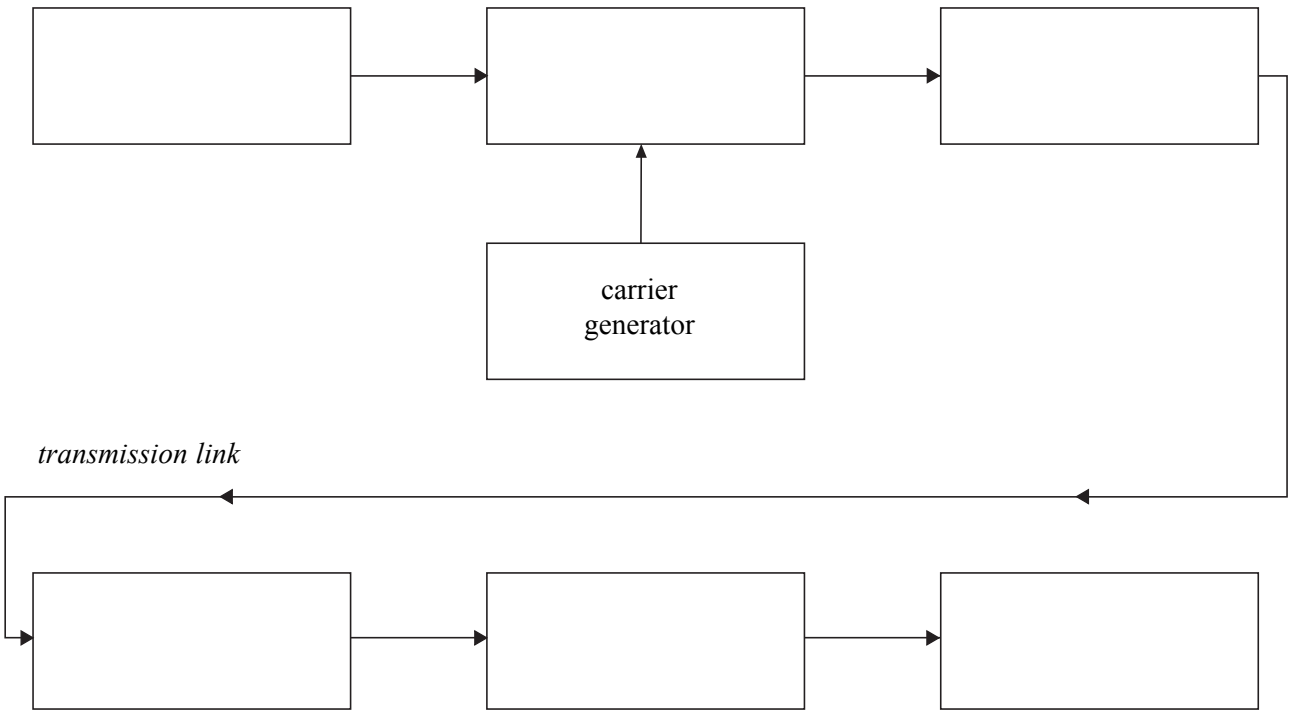
Data Sheet

- A perforated *Data Sheet* is provided on pages 3 and 4 of this question paper.
- This sheet may be useful for answering some of the questions in the examination.
- Detach this perforated sheet at the start of the examination.

Answer **all** questions in the spaces provided.

1 (a) Complete the labelling of the block diagram of a generalised communications system shown below using the following terms:

demodulator	**input transducer**	**modulator**
output transducer	**receiver**	**transmitter**



(6 marks)

(b) Name **three** different media suitable for the transmission link.

1 .....

2 .....

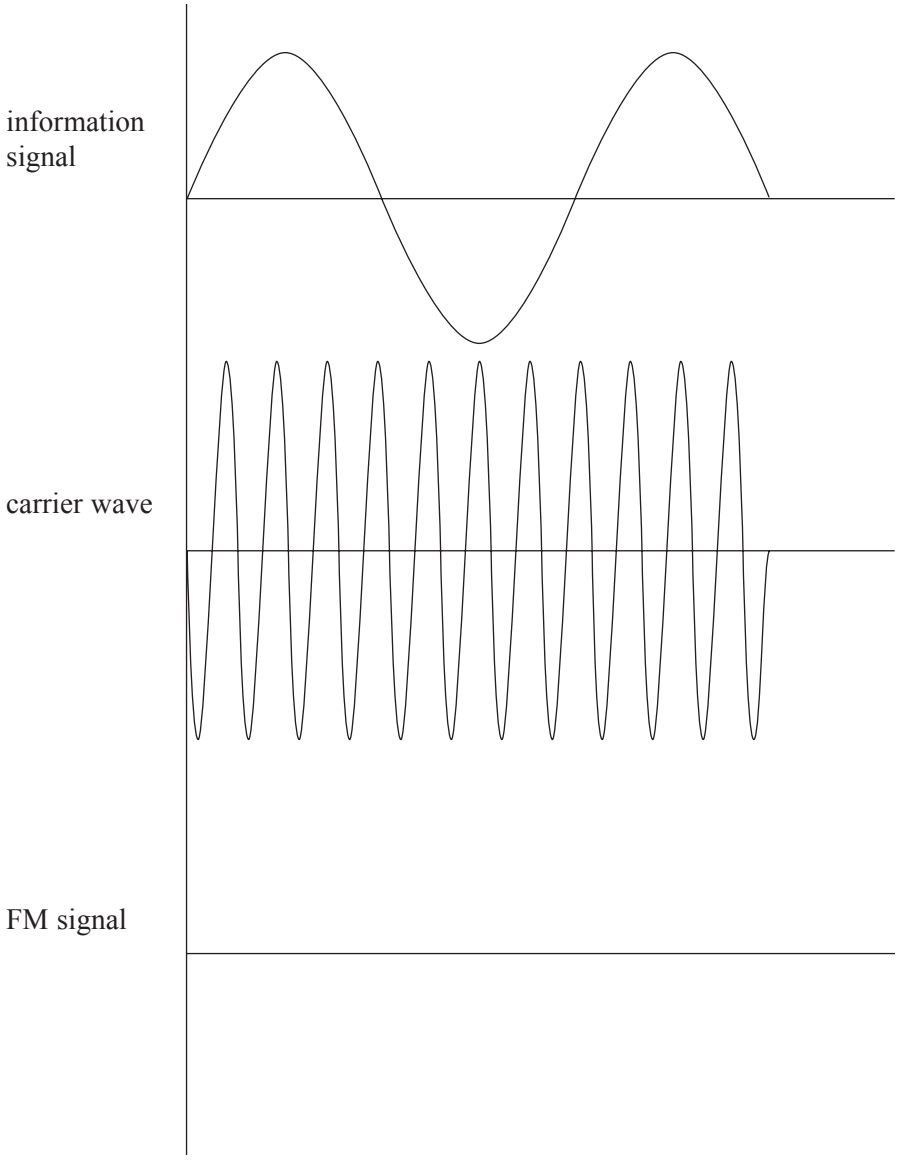
3 .....

(3 marks)

9

2 An information signal and a carrier wave are shown below. These are combined to form an FM signal.

(a) Draw the FM signal produced on the lowest set of axes.



(3 marks)

(b) The information signal has a range of possible frequencies from 20 Hz to 15 kHz. The deviation of the carrier wave is ±75 kHz.
Calculate the approximate bandwidth of the FM signal.

.....

.....

(2 marks)

(c) An antenna suitable for the FM band is designed for a frequency of 100 MHz.

(i) Calculate the optimum length for a half-wave dipole antenna for this signal.

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.....

.....

(ii) The FM receiver and antenna both have an impedance of 75 Ω. What impedance should the feed cable have?

.....

(4 marks)

9

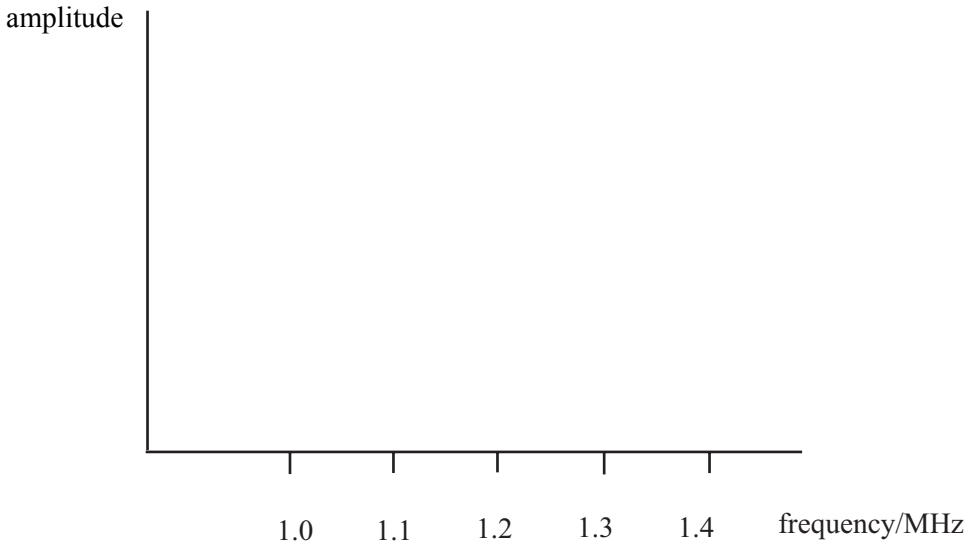
TURN OVER FOR THE NEXT QUESTION

3 (a) Complete the labelling of this block diagram of a simple radio receiver.

(4 marks)

(b) (i) In the space below draw a circuit diagram of a tuned circuit suitable for use in a simple radio receiver.

(ii) The tuned circuit should have a high Q factor. Draw on the axes below the frequency response of a high Q tuned circuit designed to resonate at a frequency of 1.2 MHz.



(iii) The capacitor in the tuned circuit has a value of 500 pF. Calculate the value of the inductor.

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.....

(8 marks)

12

TURN OVER FOR THE NEXT QUESTION

4 In digital communication, shift registers are used as serial to parallel converters. Shift registers can be made using D-type flip-flops.

(a) Draw the symbol for a D-type flip-flop, labelling its inputs and outputs.

(4 marks)

(b) Describe the function of a D-type flip-flop.

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(2 marks)

(c) Describe how several D-type flip-flops are connected to make a shift register.

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(2 marks)

(d) Describe how a shift register can be used as a serial to parallel converter.

.....

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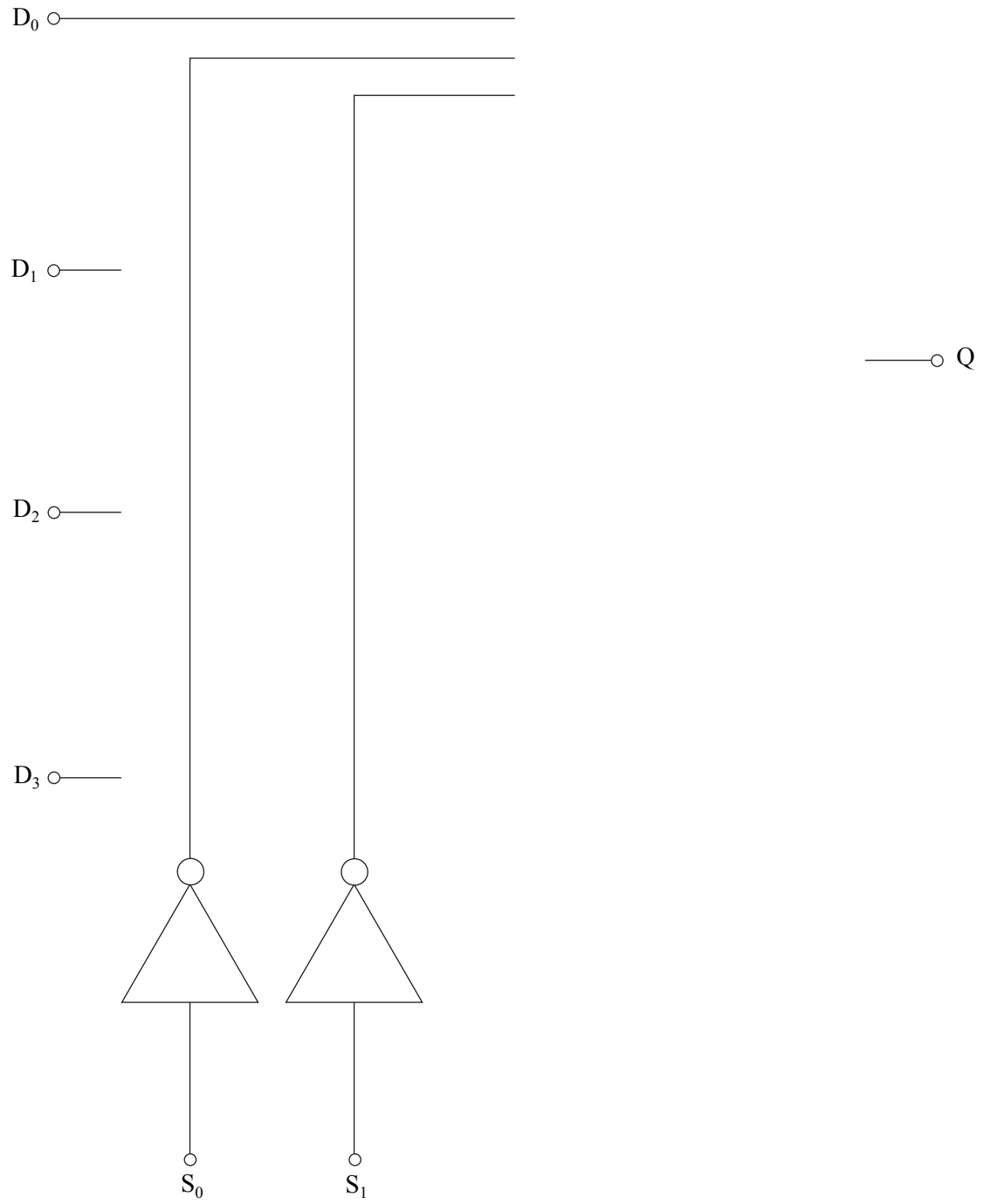
(3 marks)

11

5 The circuit shows part of a 4 to 1 multiplexer. The multiplexer switches data from D_0 to D_3 through to the single output Q when the correct input select code is present on S_0 and S_1. Complete the diagram of the multiplexer.

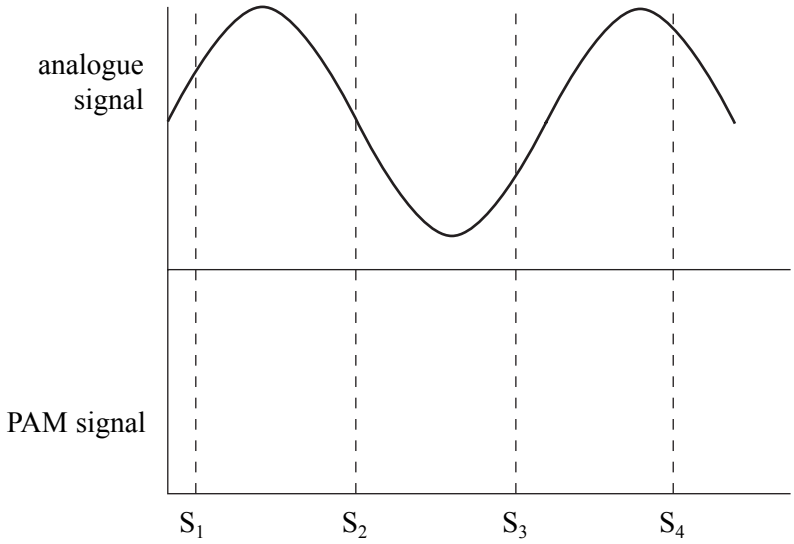


(5 marks)

5

6 An analogue signal is converted into digital form. Sampling points are marked on the diagram below as S_1, S_2, S_3, and S_4.

(a) Draw on the diagram below the resulting signal after it is converted into a pulse amplitude modulation (PAM) signal.



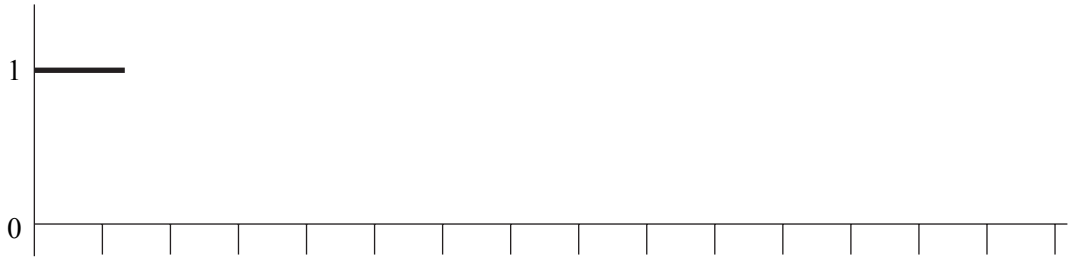
(2 marks)

(b) The resulting PAM signal is then converted into an 8-bit pulse code modulation (PCM) signal.

(i) How many levels can be represented by the resulting PCM signal?

.....

(ii) Draw the complete asynchronous signal that represents the 8-bit sample 11001100. On the diagram label the start, stop and parity bits. (You should assume even parity and two stop bits.)



(6 marks)

8

7 In an optical fibre communication system, an optical signal from a light source is sent down the fibre.

(a) What optoelectronic device is used as the light source?

.....

(1 mark)

(b) The optical fibre is laid on a curved path. By what process does light arrive at the far end of the fibre?

.....

(1 mark)

(c) What optoelectronic device can be used as a detector at the receiver?

.....

(1 mark)

(d) The optical signal at the detector is weaker than at the light source. State **two** reasons why this is the case.

1 .....

2 .....

(2 marks)

QUESTION 7 CONTINUES ON THE NEXT PAGE

(e) The electrical signal from the detector has an amplitude of 25 mV when fed into a load of 10 kΩ.

(i) Draw an op-amp based circuit that has an input resistance of 10 kΩ and will amplify the signal to an amplitude of 1 V. Calculate the values of the resistors and label them on your diagram.

(ii) The signal to be amplified contains high frequencies. What parameter of the op-amp would indicate its suitability for this application?

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(7 marks)

(f) The optical signal is pulse width modulated and the detected signal must be filtered to remove the pulse frequency. An active treble cut (low-pass) filter is required.

(i) Draw the circuit of an active low-pass filter with $R_1 = 10\,k\Omega$, $R_f = 47\,k\Omega$ and $C = 1\,nF$.

(ii) Calculate the breakpoint (cut off) frequency of the filter.

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(6 marks)

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END OF QUESTIONS

THERE ARE NO QUESTIONS PRINTED ON THIS PAGE