Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

General Certificate of Education
Advanced Level Examination
June 2011

Electronics ELEC5

Unit 5 Communications Systems

Friday 10 June 2011 1.30 pm to 3.00 pm

For this paper you must have:
- a pencil and ruler
- a calculator
- a Data sheet.

Time allowed
- 1 hour 30 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.

There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

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

1 (a) A simple radio receiver system consists of the following subsystems.

af amplifier **aerial** **detector** **loudspeaker** **tuned circuit**

Label the diagram below with the subsystems in the correct order.

(5 marks)

1 (b) Which subsystem has an input that is

1 (b) (i) a narrow range of modulated radio frequency signals .....

(1 mark)

1 (b) (ii) a wide range of modulated radio frequency signals .....

(1 mark)

1 (b) (iii) a large amplitude audio frequency signal .....

(1 mark)

1 (b) (iv) a small amplitude audio frequency signal? .....

(1 mark)

1 (c) Describe the function of the detector.

.....

.....

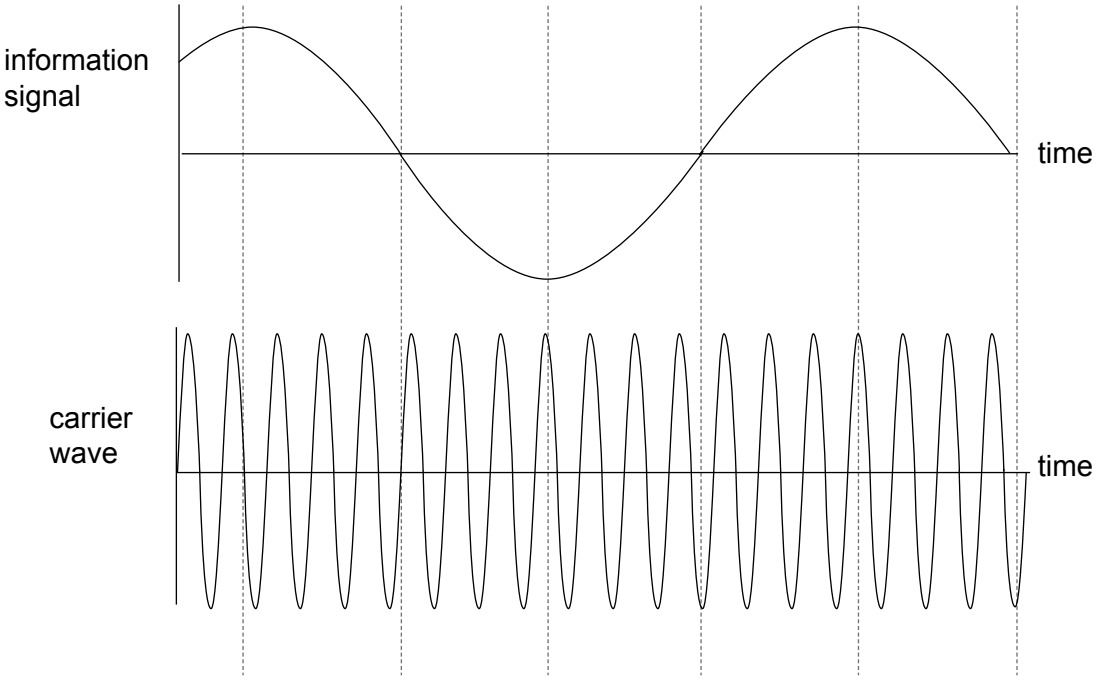
.....

(2 marks)

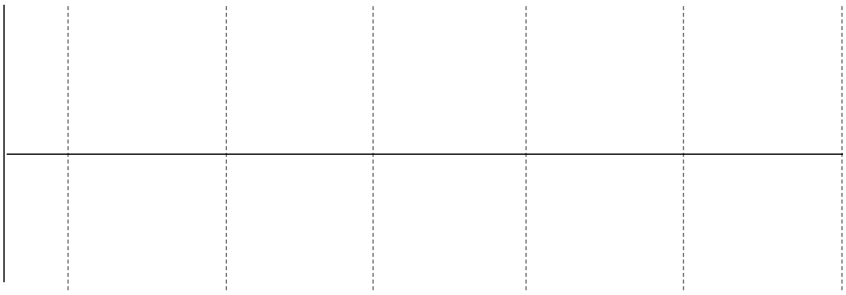
11

Turn over for the next question

2 (a) An information signal and a carrier wave are shown on the axes below.
Show how these can be combined to form
(i) an AM signal
(ii) an FM signal.

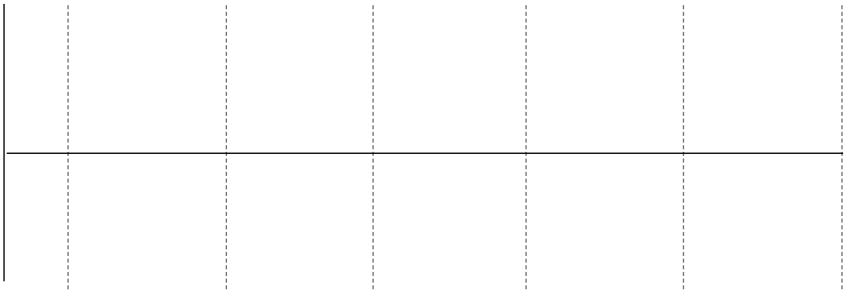


2 (a) (i) AM signal



(3 marks)

2 (a) (ii) FM signal



(3 marks)

2 (b) The information signal has a maximum frequency of 3 kHz.

2 (b) (i) Calculate the bandwidth of the resulting AM signal.

.....

(1 mark)

2 (b) (ii) The maximum frequency deviation of the FM carrier is ± 5 kHz. Calculate the practical bandwidth of the resulting FM signal.

.....

(2 marks)

9

Turn over for the next question

3 The demodulator stage in a radio receiver has an output voltage of 10 mV but can only deliver a very small current. This stage is then connected to an af amplifier.

3 (a) (i) Explain why the af amplifier should have a high input resistance.

.....

.....

.....

(1 mark)

3 (a) (ii) What type of op-amp based circuit should be used for the af amplifier?

.....

(1 mark)

3 (a) (iii) The voltage gain of the af amplifier is to be 28.
Draw a suitable circuit in the space below.
Choose and calculate suitable values for the resistors.
Label these components with their correct values on your diagram and label the input and output connections to the circuit.

(5 marks)

3 (a) (iv) Calculate, using data given earlier in this question the output signal voltage from this circuit.

.....

(2 marks)

3 (b) The op-amp IC used has a gain-bandwidth product of 1 MHz.
Calculate the bandwidth of this af circuit and comment on its suitability for this application.

.....

.....

.....

.....

.....

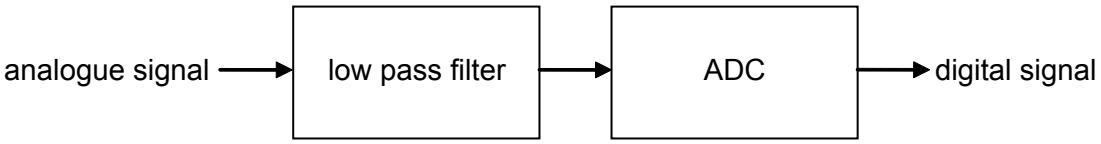
(3 marks)

3 (c) The amplified audio signal is then fed to a push-pull output stage using two MOSFETs.
Draw a suitable circuit in the space below, label the p-channel and n-channel MOSFETs.

(4 marks)

16

4 A system for converting an analogue signal to an 8-bit digital signal is shown below.



The analogue to digital converter (ADC) produces a data rate of 256 kbps.

4 (a) Explain why a low-pass filter is required between the analogue signal and the ADC.

.....

(1 mark)

4 (b) Explain why the required cut off frequency of the low-pass filter is 16 kHz.

.....

.....

(2 marks)

4 (c) Draw in the space below the circuit diagram of an active low-pass filter based on an op-amp.

(4 marks)

4 (d) The value of the feedback resistor is 15 kΩ. Calculate the value of Capacitor required to give a cut off frequency of 16 kHz.

.....

.....

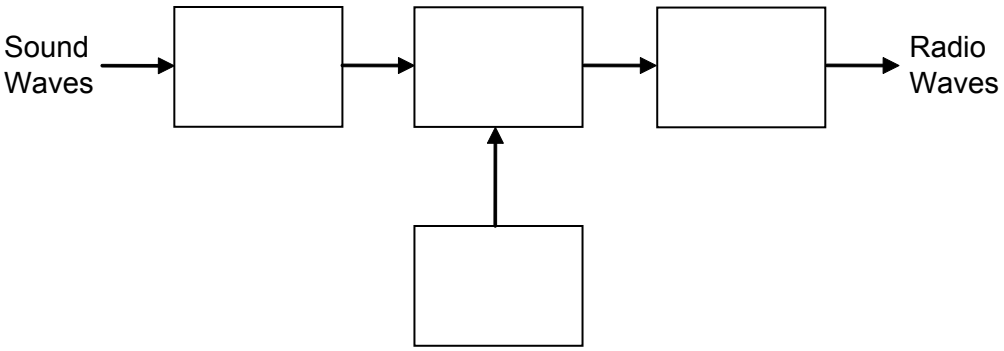
.....

(3 marks)

10

5 (a) A radio transmitter system consists of the four subsystems.

Label the diagram below with the names of each subsystem.



(4 marks)

5 (b) (i) Which **one** of the subsystems above produces an unmodulated rf signal and may contain a tuned circuit?

.....

(1 mark)

5 (b) (ii) The tuned circuit contains a 5 pF capacitor and a 0.1 μH inductor. Calculate the frequency of the signal that the subsystem produces.

.....

.....

.....

(3 marks)

5 (c) A DAB transmitter has a frequency of 227.36 MHz. Calculate the length of a half-wave dipole that would be suitable for use as an aerial for this transmitter.

.....

.....

.....

(2 marks)

10

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6 Logic ICs have applications in digital communications, including Time Division Multiplexing.

6 (a) Explain what is meant by Time Division Multiplexing.

.....

.....

(2 marks)

6 (b) Using only NAND gates, draw below the circuit of a 2-input data multiplexer.

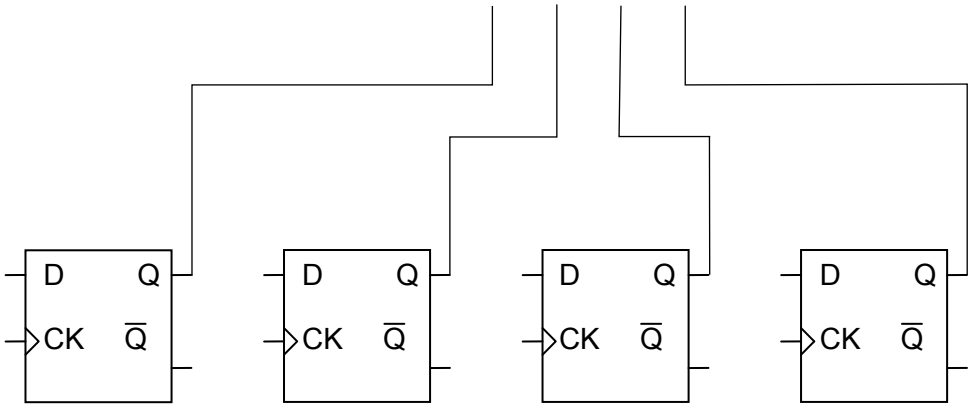
input A ————————

input B ———————— ———————— output

data selector ————————

(3 marks)

6 (c) Complete the diagram below to show how a serial in parallel out shift register is constructed using D-type bistables. Label the data and clock inputs, and the data output for the complete system.



(4 marks)

9

Turn over ▸

7 The Internet is an example of a network that transmits data using packet switching. A packet contains the data to be transmitted as well as other information. Two pieces of information contained in the packet header are a checksum and a destination address.

7 (a) (i) What is the purpose of the checksum?

.....

.....

(1 mark)

7 (a) (ii) What is the purpose of the destination address?

.....

.....

(1 mark)

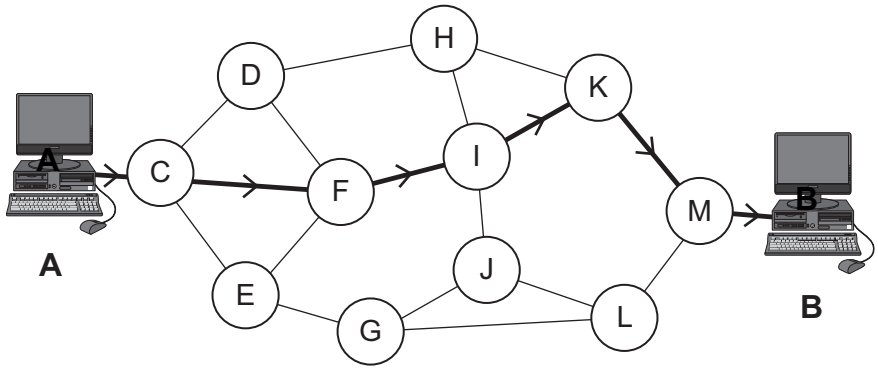
7 (a) (iii) Name **two** other items of information that must be in a packet header.

.....

.....

(2 marks)

7 (b) The diagram represents two computers, A and B, connected by a packet switched network of routers C – M.



Some of the packets of a large file have been sent along the route C-F-I-K-M, as shown.

7 (b) (i) Explain how the rest of the file can be transmitted from A to B by the network if the router F fails.

.....

.....

(1 mark)

7 (b) (ii) During the failure of F, one of the packets did not reach computer B.
Explain how computer B can still ensure that it receives this missing packet.

.....

.....

(1 mark)

7 (c) This ability to cope with a router failure is one advantage of a packet switched network compared with a fixed communication link for transferring data.
State **one** other advantage.

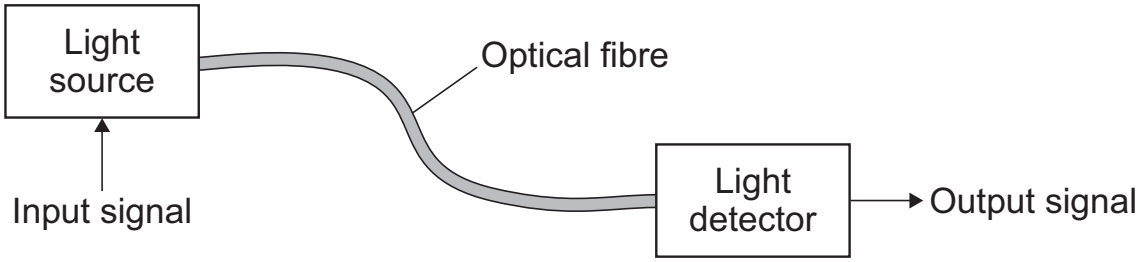
.....

(1 mark)

7

Turn over for the next question

8 A simplified communications system using an optical fibre to link two mobile phone base stations is shown below.



What electronic component would typically be used for

8 (a) (i) the light source .....

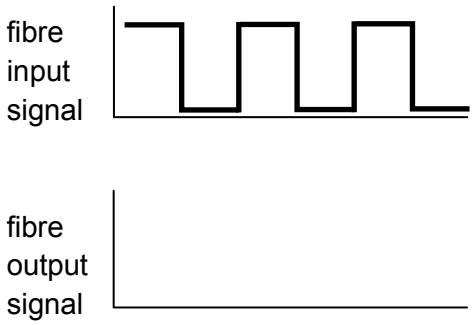
(1 mark)

8 (a) (ii) the light detector? .....

(1 mark)

The diagram below shows the input signal to the fibre from the light source.

8 (b) (i) As the signal passes down the fibre it is affected by attenuation. Show the attenuated signal on the blank axes.



(1 mark)

8 (b) (ii) State **two** possible causes of attenuation.

1 .....

.....

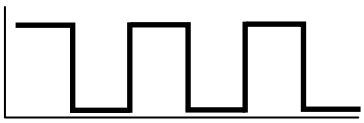
2 .....

.....

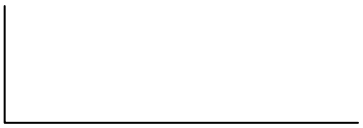
(2 marks)

8 (c) (i) The diagram below shows the input signal to the fibre from the light source, on the blank axes, draw the effect of dispersion as the signal passes down the optical fibre.

fibre input signal



fibre output signal



(1 mark)

8 (c) (ii) State **two** possible causes of dispersion.

1 .....

.....

2 .....

.....

(2 marks)

8

END OF QUESTIONS

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