OCR
RECOGNISING ACHIEVEMENT

GCE

Electronics

Advanced GCE **F615**

Communications Systems

Mark Scheme for June 2010

Oxford Cambridge and RSA Examinations

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of pupils of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, OCR Nationals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by Examiners. It does not indicate the details of the discussions which took place at an Examiners' meeting before marking commenced.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

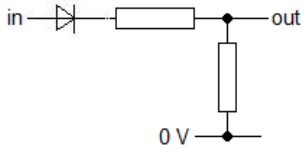
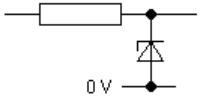
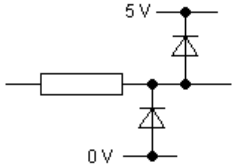
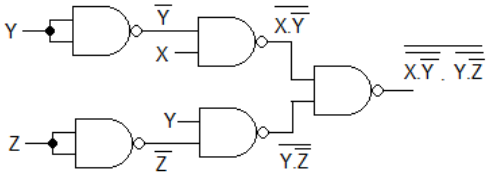
Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

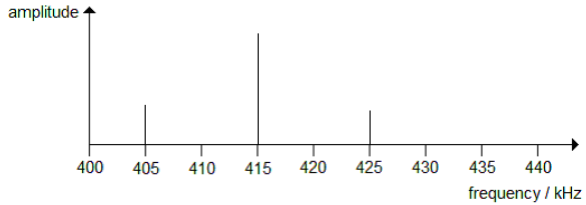
OCR will not enter into any discussion or correspondence in connection with this mark scheme.

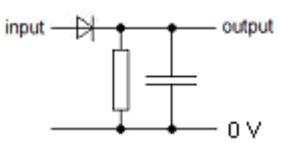
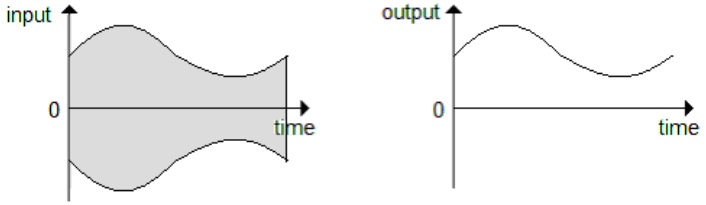
Any enquiries about publications should be addressed to:

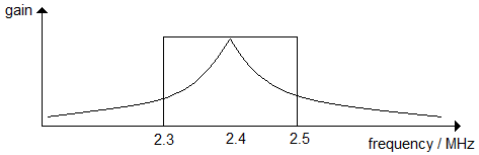
OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

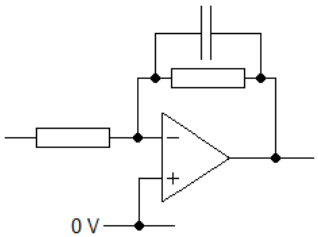
Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

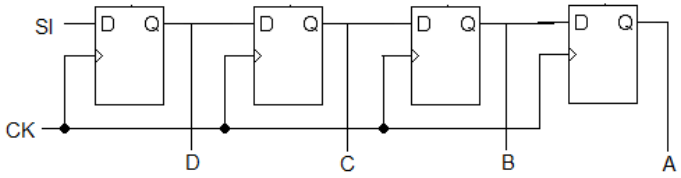
Question	Grade	Expected Answer	Mark	Additional Guidance
1 (a)	E E	resistor chain between supply rails junctions connected to 3 V, 2 V and 1 V	1 1	
1 (b)	E E A	voltage divider to reduce voltage diode to cut out negative signals resistors in correct ratio 15:10 (**accept** 16:10) 	1 1 1	**ignore** size of resistors **accept** Zener diode and series resistor for [2]:  **accept** clamp diodes and series resistor for [1] 
1 (c) (i)	D D	Second row is only time Y is 1 and Z is 0 Third row only time that X is 1 and Y is 0	1 1	
1 (c) (ii)	D C B A	NAND gate to generate output NAND gates as NOT gates correct circuit correct algebra at inputs and outputs of all gates 	1 1 1 1	both inputs joined or one held high **accept** pairs of redundant NOT gates
1 (c) (iii)	C	B = Y	1	

Question	Grade	Expected Answer	Mark	Additional Guidance
1 (d)	C	range is difference between largest and smallest voltages which can be coded	1	
	E	3 V	1	**accept** below 1V to above 3V
	A	resolution is voltage difference between adjacent codes	1	
	E	1 V	1	
2 (a) (i)	D	amplitude of (carrier) at S	1	
	C	determined by voltage of signal at M	1	
2 (a) (ii)	C	spike at 415 kHz	1	
	B	smaller same-height spikes at 405 kHz and 425 kHz  	1	
2 (b)	B	8.08 kΩ (accept 8.0 or 8.1)	2	correct answer for [2] otherwise look for correct method for [1]
	A	EITHER $I = (15 - 2.2) / 47\times10^{3} = 2.72\times10^{-4}$ A $R = 2.2 / 2.72\times10^{-4}$ ... OR $(15-2.2) / 2.2 = 47k/R_2$ ... OR $2.2 = 15 \times \frac{R_2}{47 + R_2}$ ...		
2 (c)	D	op-amp set up as amplifier for S;	1	
	C	gain depends on resistance of MOSFET;	1	
	B	which is determined by voltage at gate;	1	
	A	so gain of amplifier altered by M;	1	

Question	Grade	Expected Answer	Mark	Additional Guidance
2 (d) (i)	**E** **D**	correct symbols for resistor, capacitor, diode circuit as shown below  	**1** **1**	
2 (d) (ii)	**E** **D** **C** **B**	diode rectifies signal / removes negative part of signal RC network filters out high frequency components sketch of AM signal at input sketch of matching demodulated signal at output  	**1** **1** **1** **1**	**accept** smoothes signal **accept** output signal centred on zero
3 (a)	**E**	(108 - 87.5)/0.2 = 102.5 or 102	**1**	**accept** reverse calculation: 100 stations gives 205 kHz
3 (b) (i)	**E** **D**	FM bandwidth is $5f_s$, AM bandwidth is $2f_s$ = 80 kHz channels = (108 - 87.5)/0.08 = 256	**1** **1**	ecf incorrect AM bandwidth between 10 and 100 kHz
3 (b) (ii)	**C** **B** **A** **E**	noise added to signal in transmission can be removed from FM by Schmitt trigger / limiter but not possible for AM	**1** **1** **1** **1**	**accept** alternative answer: • AM codes with amplitude [1] • FM codes with frequency [1] • noise affect amplitude more than frequency [1]
3 (c) (i)	**B** **D** **A**	manipulation of rule: $C = \frac{1}{4\pi^2 L f_0^{\,2}}$ μ is 10^{-6}, M is 10^{6}, p is 10^{-12} C = 200 pF	**1** **1** **1**	**accept** values substituted instead of algebra ecf incorrect units conversion

Question	Grade	Expected Answer	Mark	Additional Guidance
3 (c) (ii)	**E** **E** **E** **C** **B** **A**	R - no change of resistance with frequency C - reactance decreases with increasing frequency L - reactance increases with increasing frequency R usually bigger than L or C so output small except when L, C have the same reactance when their joint resistance greater than R	**1** **1** **1** **1** **1** **1**	
3 (d) (i)	**E**	peak at 2.4 MHz, sloping down above and below, as shown  	**1**	**not** two straight lines **accept** any bandwidth
3 (d) (ii)	**E** **E** **C**	three filters in series with buffer amplifiers between	**1** **1** **1**	
3 (d) (iii)	**B** **A**	each has slightly different centre frequency buffer amplifiers stop loading from affecting bandwidth	**1** **1**	**accept** resonant frequency
4 (a)	**E** **D** **C**	PSC takes binary word and feeds out bits one after the other down the link SPC takes bits off the link and puts them on parallel lines to make a binary word DAC outputs a voltage according to the binary word at its inputs.	**1** **1** **1**	**not** just poarallel-to-serial converter **not** just serial-to-parallel converter **not just** digital-to-analogue converter
4 (b) (i)	**E** **D**	4200 Hz need to sample at least twice in each cycle	**1** **1**	
4 (b) (ii)	**D** **C**	informs the SPC that the word is about to arrive	**1** **1**	

Question	Grade	Expected Answer	Mark	Additional Guidance
4 (b) (iii)	A E C	each word is 6+2=8 bits bit rate = 8400 × 8 = 67 200 s^{-1} bandwidth = 67 200 / 2 = 33.6 kHz	1 1 1	 ecf: 6 bits gives 50 400 s^{-1} for [1] and 25 kHz for [1]
4 (c)	A*	packet contains words which codes for • signal voltage • input signal channel address • output signal channel address • checksum/parity bits each channel allowed access to link many times a second, in turn; decoded signal sent to output channel according to output signal address, via multiplexers;	 1 1 1 1 1 1	 **accept** data payload **accept** source address **accept** destination address
5 (a)	E E	0 V negative feedback	1 1	**not** virtual earth **accept** description of negative feedback
5 (b)	A*	0001 gives -0.2 V out $I = 0.2/27\times10^{3} = 7.41\times10^{-6}$ A in feedback resistor $R_A = 5 / 7.41\times10^{-6} = 675$ kΩ $R_B = 338$ kΩ, $R_C = 169$ kΩ, $R_D = 84.4$ kΩ	1 1 1 1	 **accept** 680 kΩ, 340 kΩ, 170 kΩ and 85 kΩ ecf incorrect R_A: $R_A = 2R_B = 4R_C = 8R_D$ for [1]
5 (c)	C E E D E	correct circuit resistors in range 1 kΩ to 1 MΩ feedback resistor 4 times input resistor $RC = 3.8\times10^{-5}$ s for feedback loop use of break frequency formula  	1 1 1 1 1	

Question	Grade	Expected Answer	Mark	Additional Guidance
5 (d) (i)	D C	SI accepts data one bit at a time clock pulses at CK synchronise capture of bits	1 1	**accept** serial input and clock input for [1]
5 (d) (ii)	E C E E	Q to D of next flip-flop clocks joined to CK first D to SI Q outputs to DCBA or ABCD 	1 1 1 1	**not** Q_n
6 (a)	E E	line sync frame sync	2	correct pattern for [2] one mistake for [1]
6 (b)	E C	intensity determined by voltage / amplitude of red, green and blue signals	1 1	**ignore** references to colour of pixel
6 (c)	E D D	during (raster) scan of pixels line sync indicates when to move to next line frame sync indicates when to start a new frame	1 1 1	**accept** description of raster scan
6 (d)	E C A	pixels per frame = 512×1024 = 524288 pixels per second = 524288×50 = 26.2×10^6 s^{-1} ecf: bandwidth = pixel rate / 2 = 13.1 MHz	1 1 1	
7 (a)	D E D E	infrared along optical fibre electrical (signal) / voltage / current along cable / wire / metal / twisted pair	1 1 1 1	**accept** light
7 (b) (i)	C B	noise is random signal (from components) interference is signal from other electrical systems	1 1	

7 (b) (ii)	**E**	intensity decreases	**1**	**accept** attenuation
7 (c)	**E** **B** **A**	optical fibre any two of the following, [1] each • no random light in the fibre • stray light can't get in / no reaction to electricity • low absorption / attenuation so long distance	**1** **2**	 no ecf for incorrect method

Quality of Written Communication

3 The candidate expresses complex ideas extremely clearly and fluently. Sentences and paragraphs follow on from one another smoothly and logically. Arguments are consistently relevant and well structured. There will be few, if any, errors of grammar, punctuation and spelling.

2 The candidate expresses straightforward ideas clearly, if not always fluently. Sentences and paragraphs may not always be well connected. Arguments may sometimes stray from the point or be weakly presented. There may be some errors of grammar, punctuation and spelling, but not such as to suggest a weakness in these areas.

1 The candidate expresses simple ideas clearly, but may be imprecise and awkward in dealing with complex or subtle concepts. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling may be noticeable and intrusive, suggesting weaknesses in these areas.

0 The language has no rewardable features.

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

14 – 19 Qualifications (General)
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553