OCR
RECOGNISING ACHIEVEMENT

GCE

Electronics

Advanced GCE

Unit **F615:** Communications Systems

Mark Scheme for June 2011

Oxford Cambridge and RSA Examinations

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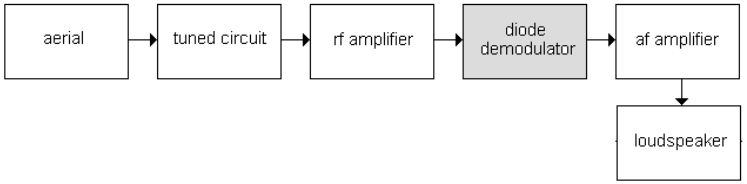
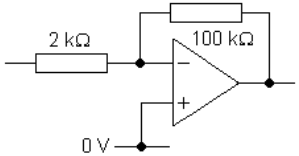
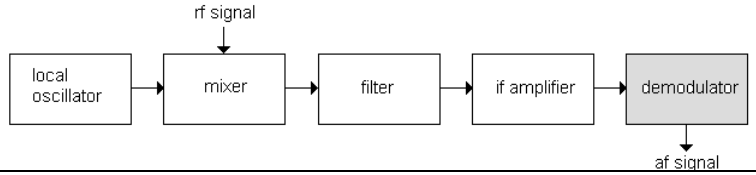
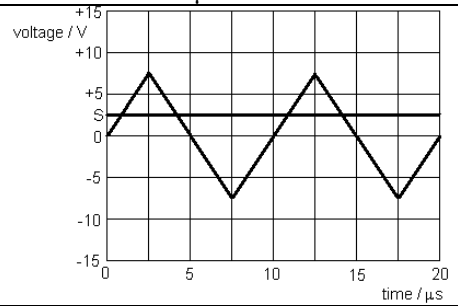
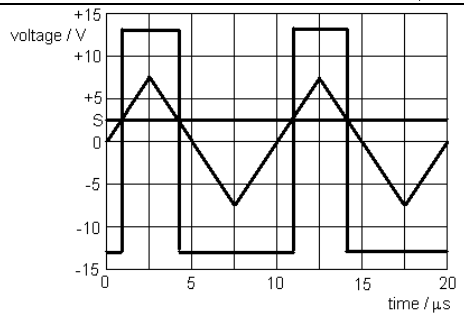
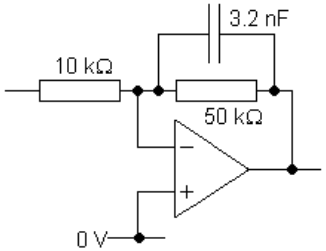
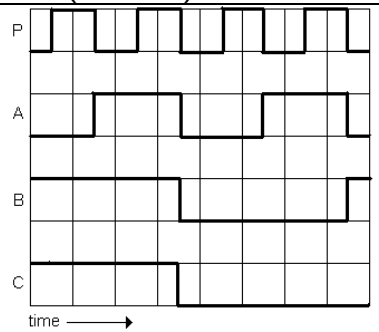
Question			Expected Answer	Mark	Additional Guidance
1	(a)	(i)	red. green and blue (intensity) line (sync) frame (sync)	[1] [1] [1]	 accept descriptions of function instead of name list principle applies to more than five responses
		(ii)	any of the following for [1] each • noise/interference (picked up in transmission) • can be removed at video screen / receiver • using limiters / Schmitt triggers to restore signal • to improve picture quality • allows compression • for faster transmission • and/or less memory for storage • allows encoding/encryption • allows video / sound / text etc. • easier to store (in memory) • easier to edit picture • allows (time-division) multiplexing • allows for error detection/correction	[4]	**not** faster unqualified
	(b)	(i)	$2^5 = 32$	[1]	
		(ii)	pixels per frame = 600 × 850 = 510 000; bits per frame = 510 000 × 5 = 2 550 000;	[1] [1]	 ecf from incorrect pixels per frame
		(iii)	20 Hz to 50 Hz image seen to flickers if frame rate too low (owtte)	[1] [1]	
	(c)		bit rate = $2.55\times10^6 \times 40 = 1.02\times10^8$; bandwidth = $0.5 \times 1.02\times10^8$ = 51 MHz (accept 50 MHz);	[1] [1]	**accept** 102 / 100 MHz for [1] **ecf** incorrect calculated bit rate for [1] **accept** incorrect values for frame rate and/or bits per frame from b(ii) and b(iii) for [2]
	(d)	(i)	reduces bits (per frame / second); smaller bandwidth / less memory required;	[1] [1]	 **accept** faster transmission
		(ii)	loss of quality / data	[1]	**accept** increased time delay / cost more because of extra circuitry

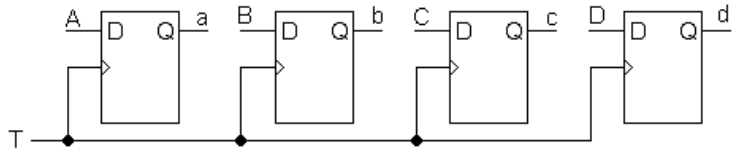
Question			Expected Answer	Mark	Additional Guidance
2	(a)			[4]	first and last blocks correct [1] amplifiers anywhere before and after demodulator [1] af amplifier after demodulator, rf amplifier before [1] tuned circuit anywhere before demodulator [1]
	(b)			[4]	negative feedback with resistor [1] correct inverting amplifier circuit [1] resistors in range 1 kΩ to 10 MΩ [1] correct ratio of 1:50 [1] ecf 1:49 if non-inverting amp **ignore** any capacitors
	(c)	(i)	select signals from just one channel	[1]	**accept** rejects all channels except one **accept** description of filtering action
		(ii)	how well the system rejects signals from other channels	[1] [1]	
		(iii)	allows receiver to pick up weak signals (owtte); THEN accept any two of the following, for [1] each • different aerial / reposition aerial • to increase signal • decrease inductor resistance • to increase Q of tuned circuit / • increase gain of rf amplifier • to increase r.f. signal • insert MOSFET follower • to increase r.f. signals	[3]	look for a change to the circuit [1] explain what that change does [1] how does that improve sensitivity [1]

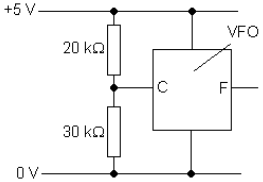
Question			Expected Answer	Mark	Additional Guidance
	(d)	(i)			mixer correct [1] local oscillator correct [1] filter and i.f. amplifier anywhere after mixer [1]
		(ii)	Any four of the following [1] mark each • adjust local oscillator; • to 870 + 350 = 1220 kHz; • modulated by rf signal; • in the mixer; • generating copies of rf signal; • at 1220 ± 870 kHz; • copy at 1220 - 870 = 350 kHz; • passes through filter to demodulator	**[4]**	accept local oscillator at 870 - 350 = 520 kHz

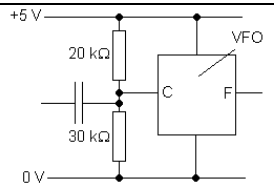
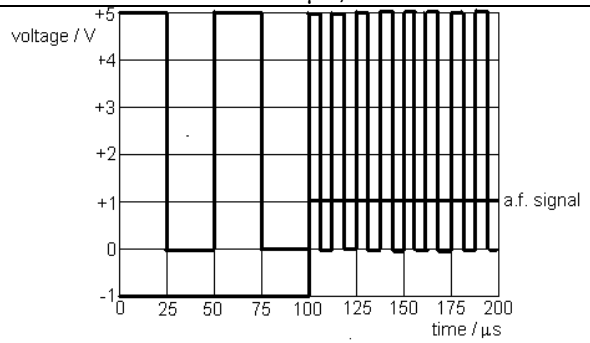
Question			Expected Answer	Mark	Additional Guidance
3	(a)	(i)	$1/100 \times 10^3 = 1 \times 10^{-5}$ s or 10 μs	**[1]**	
		(ii)		**[3]**	correct shape [1] correct amplitude [1] correct period [1] (ecf from i) must go all the way across
		(iii)		**[3]**	square wave which changes each time S crosses T [1] between +13 V and -13 V [1] correct phase [1]

Question			Expected Answer	Mark	Additional Guidance
	(b)	**(i)**		**[5]**	correct circuit [1] resistor ratio 1:5 [1] resistors between 1 kΩ and 10 MΩ [1] *RC* in feedback loop = 160±10 μs [1] substitution into $f = 1/2\pi RC$ to justify *C* [1]
		(ii)	Any three of the following, [1] mark each: • amplitude S less than 7.5 V; • otherwise P is not going to oscillate ; • bandwidth of filter; • only allows a.f. signals below 1 kHz; • frequency of triangle wave; • puts maximum frequency of a.f. signal of 50kHz; • gain of filter; • limits mean value of P to 13/5 = 2.6V	**[3]**	**look for** stated factor [1] explanation of that factor [1] accept three factors with no explanation for [3]

Question			Expected Answer	Mark	Additional Guidance
4	**(a)**		$R = 5.6\times10^{3}\ \Omega$, $C = 2.7\times10^{-9}$ F $2/RC = 1.32\times10^{5}$ Hz (132 kHz)	**[1]** **[1]**	units conversion [1] correct evaluation [1]
	(b)			**[3]**	A changes on any consistent edge of P for [1] A changes on falling edge of P for [2] B changes on same edge of A and C changes on same edge of B for [1]

Question			Expected Answer	Mark	Additional Guidance
	(c)		number of states = 2^4 = 16; 0000 is 0.0 V, 0001 is 0.1 V .... 1111 is 1.5 V;	**[2]**	ecf 0.3 V (ecf for four states) for [1] ecf incorrect number of states, so 1.6 V or 0.4 V for [1]
	(d)			**[3]**	inputs correct and labelled A,B,C and D (any order) [1] ecf input labels: outputs correct [1] clocks in parallel to T (**not** CK)
	(e)		Any four of the following , [1] each • (continuous) clock pulses at P; • for each pulse at P, DCBA goes up by one; • increasing DAC output S by 0.1 V; • if this takes S above input signal U, • op-amp comparator generates rising edge/goes high; • allowing register to latch DCBA at dcba;	**[4]**	look for: effect of oscillator on counter [1] effect of counter on DAC [1] operation of op-amp [1] effect of op-amp on register [1] look for high quality answers
	(f)		EITHER each sample requires 16 pulses at P; so sample rate = 132 / 16 = 8.3 kHz; at least two samples per cycle at U ...; OR 8000 samples per second; need up to 16 pulses per sample; 16x8000 = 128 kHz at P……..;	**[1]** **[1]** **[1]** **[1]** **[1]** **[1]**	

Question			Expected Answer	Mark	Additional Guidance
5	**(a)**	**(i)**	frequency of carrier; determined by voltage of a.f. signal;	**[1]** **[1]**	accept F as carrier **not** amplitude of a.f. signal
		(ii)		**[3]**	voltage divider to hold C at fixed voltage [1] 2:3 ratio and resistor values from 1 kΩ to 10 MΩ [1] valid justification of values [1]

Question			Expected Answer	Mark	Additional Guidance
		(iii)		[1]	
	(b)	(i)	C at +3 - 1 = 2 V; F at 20 kHz and 1 / 20kHz = 50μs;	[1] [1]	**not** just 2 V **accept** reverse calculation
		(ii)		[3]	square wave between 0 V and 5 V [1] two cycles in first 100 μs [1] eight cycles in second 100 μs [1]

Question			Expected Answer	Mark	Additional Guidance
6	(a)	(i)	<table><tr><th>input</th><th>control</th><th>output</th></tr><tr><td>low</td><td>low</td><td>disconnected</td></tr><tr><td>low</td><td>high</td><td>low</td></tr><tr><td>high</td><td>low</td><td>disconnected</td></tr><tr><td>high</td><td>high</td><td>high</td></tr></table>	[1] [1]	output disconnected when control low [1] output same as input when control high [1]
		(ii)	Any three of the following for [1] mark each **input** • doesn't affect signals on cable; • needs to detect incoming signals at all times; **output** • needs isolating when other signals on cable; • to avoid collisions with other signals; • which could corrupt data from other systems;	[1] [1] [1]	
		(iii)	computers wait until no data on the cable; read their own transmissions (to detect a collision); try again later if their transmission is corrupted;	[1] [1] [1]	**not** just time-division multiplexing

Question			Expected Answer	Mark	Additional Guidance
	(b)	(i)		[2]	each bit correct for [1] stop bit must be immediately after D
		(ii)	start bit tells receiver that word is about to arrive; stop bit returns cable to resting state (wtte);	[1] [1]	 **not** tells receiver that word is complete
	(c)	(i)	maximum bit rate = 2 × 4 = 8 Mbits per second; so each bit lasts for $1/8\times10^{-6}$ = 125 ns	[1] [1]	 **accept** reverse calculation **not** 128 ns
		(ii)	each packet lasts for $512 \times 1.25\times10^{-7} = 6.4\times10^{-5}$ s; so packets per second = $1 / 6.4\times10^{-5} = 15.6\times10^{3}$	[1] [1]	**ignore** 10μs delay between packets **accept** 16×10^{3} or 15×10^{3} **allow** ecf from incorrect packet length

Question			Expected Answer	Mark	Additional Guidance
7	(a)		when T at +7.5 V there is 13 V across 52 kΩ (owtte) so current in R_S = 13/52 = 0.25 mA and so R_s = 7.5/0.25 = 30 kΩ	[1] [1] [1]	 **accept** voltage divider calculations **accept** reverse argument assuming value of R_s
	(b)		period = 10 μs, V_{in} is -13 V so T has to ramp from -7.5 V to +7.5 V in 5 μs use of $\Delta V_{out} = -V_{in}\frac{\Delta t}{RC}$ to show R = 92 kΩ	[1] [1] [1]	 accept reverse argument assuming value of R
	(c)		Any four of the following • current in R_T charges capacitor; • so T drops steadily; • until it reaches -7.5 V; • and Schmitt trigger switches; • whereupon S drops to -13 V; • making T rise steadily • until it reaches +7.5 V and S rises to +13 V ...;	[4]	**look for**: T rises and falls steadily [1] S saturates positively or negatively [1] positive S makes T fall and vice versa [1] S changes when T reaches trip points [1]

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.

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