OCR
RECOGNISING ACHIEVEMENT

GCE

Electronics

Advanced GCE

Unit **F614:** Control Systems

Mark Scheme for June 2011

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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.

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<table>
<tr><th colspan="2">Question</th><th>Expected answer</th><th>Mark</th><th>Additional guidance</th></tr>
<tr><td>1</td><td>(a)</td><td>
<table>
<tr><th>A</th><th>E</th><th>Q</th></tr>
<tr><td>0</td><td>0</td><td>High impedance</td></tr>
<tr><td>0</td><td>1</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>High impedance</td></tr>
<tr><td>1</td><td>1</td><td>1</td></tr>
</table>
all combinations of A and E</td><td>[1]
[1]
[1]
[1]</td><td></td></tr>
<tr><td></td><td>(b)</td><td>EITHER
to allow more than one device to be connected to the databus
OR
to allow the databus to be bidirectional (owtte)</td><td>[1]</td><td></td></tr>
<tr><td></td><td>(c)</td><td>Read kept low
make data high [or 1 or 5V]
make write high [or 1 or 5V] (turning on tri-state)
(output of the tri-state) charges the capacitor to Y=5V
Y = 5V so MOSFET on and Z pulled low.
NOT gate inverts Z to make X high
[max 3 marks]</td><td>[1]
[1]
[1]
[1]
[1]</td><td>Some points may be in answer (d)</td></tr>
<tr><td></td><td>(d)</td><td>make read high [or 1 or 5V]
to turn tri-state on so data goes high to be read
capacitor holds charge
Write kept high
max 3</td><td>[1]
[1]
[1]</td><td>Some points may be in answer (c)</td></tr>
</table>

Question		Expected answer	Mark	Additional guidance
2	(a)	Ramp generator	[1]	Allow integrator
	(b)	immediately negative	[1]	
		increasing	[1]	
		increasing	[1]	
		zero	[1]	
		zero	[1]	
		constant	[1]	
			[1]	
			[1]	
			[1]	
			[1]	
	(c)	correct units conversion of R and C	[1]	
		change in V= (-)9x2/($10x10^{6}x470x10^{-9}$) = (-)3.8 (ecf)	[1]	
		minus sign in ΔV	[1]	-3.8V gets 3 marks
		Vout = 5 – 3.8 = 1.2V (ecf)	[1]	

Question		Expected answer	Mark	Additional guidance
3	(a)	Path showing flow of information from output back to oscillator (wtte)	[1]	
	(b)	The output of an open loop system does not change when the conditions change.	[1]	
		Closed loop systems automatically adjust to keep the output at the desired level (owtte)	[1]	
	(c)	correct rectifier	[1]	
		correct polarity of output	[1]	
		capacitor for smoothing on dc output	[1]	
	(d)	LED	[1]	
		photo-transistor	[1]	
		LED give out light when current/voltage present	[1]	
		photo-x switches on/conducts when receives light		
	(e)	to prevent accidents/electrocution/damage	[1]	
		if high voltage signals connect to	[1]	
		low voltage output	[1]	
		to allows comparator to control oscillator		
		turn on/off oscillator when V to high/low		
		no electrical connection (owtte)		
		up to max 3 marks		

Question		Expected answer	Mark	Additional guidance
	(f)	<u>Top graph:</u>		
		continues rising to 12V	**[1]**	
		stabilises	**[1]**	
		hunts around stable voltage	**[1]**	
		<u>bottom graph:</u>		
		square wave	**[1]**	
		high until smoother voltage stabilises	**[1]**	
		changes each time smoother voltage crosses 12V	**[1]**	
	(g)	an accurate reference would not be produced	**[1]**	
		until the smoother voltage was >12V	**[1]**	
		output does not switch at correct voltage		
		correct comments comparing voltage from potential divider with voltage from zener		
		smoothed output would be too large (>12V)		

Question			Expected answer	Mark	Additional guidance
4	(a)		blue LED glows	[1]	
			first two lines send 08H to output port	[1]	
			makes output 00001000 so **Q_3 high**	[1]	
	(b)		dry: MOVI Sn, 88	[2]	1 mark for MOVI Sn and 1 mark for 88
			OUT Q, Sn	[1]	
			RET	[1]	
			(n is any integer between 0 and 7)		
	(c)		MOVI S0, 80	[1]	
			JZ skip	[2]	
	(d)		turn off blue LED	[1]	turn everything off 2 marks
			and heater&motor	[1]	
			toggle lsb	[1]	
			store 100 decimal in S7; do nothing for 1ms	[1]	
			take away 1 from S7; keep going back until S7=0	[1]	
			makes the yellow LED	[1]	
			flashes	[1]	
			continuously	[1]	
			everything else off (implied)	[1]	
	(e)	(i)	code can be tested in small chunks	[1]	
			code can easily be reused from other projects	[1]	
			code can be used several times in the same program saving memory		
			saves development time		
			makes program easier to understand		
			max 2		

Question			Expected answer	Mark	Additional guidance
		(ii)	program counter loaded with return address	[1]	
			from top of	[1]	
			stack	[1]	
			stack pointer decremented/incremented		
			return address stored on stack		
			[max 3]		
	(f)		<u>resets</u> program counter to 0/makes program go to line 0	[1]	
			lights blue LED and waits for hands to be sensed	[1]	
			which stops the yellow LED flashing/cancels fault/everything else off	[1]	

Question		Expected answer	Mark	Additional guidance
5	(a)	input connected to gate	[1]	
		through capacitor	[1]	
		output connected to drain	[1]	
		through capacitor	[1]	
	(b)	$I = \frac{V_S - V_D}{R} = \frac{15-3}{680\times10^3} = 1.8\times10^{-5}\,A$		
		$R = \frac{V}{I} = \frac{3}{1.8\times10^{-5}} = 167000\Omega$		
		Correct calculation of pd across 680k resistor	[1]	
		Calculation of I dividing by 680k (ecf)	[1]	
		Calculation of R by diving 3 by I (ecf)	[1]	
	(c)	I=40mA	[1]	7.2V for 2 marks
		V across 180Ω resistor is 0.04x180=7.2V	[1]	
		V_D=15-7.2=7.8V	[1]	
	(d)	To allow V_D to wobble up and down (owtte)	[1]	Allow above half maintains pd across MOSFET for second mark.
		allows maximum (7V) amplitude at output (owtte)	[1]	
	(e)	2.6V	[1]	
	(f)	correct conversion of mA to A for ΔI	[1]	$1X10^nS$ for 1 mark
		correct calculation of gradient of sloping graph g_m=0.1S	[1]	
		Identification of 180Ω resistor		
		Calculation of gain = $-g_m xR$ = -0.1x180=-18		

Question		Expected answer		Mark	Additional guidance
5	(g)	The new MOSFET has different characteristics		[1]	
		Either			
		g_m is larger	threshold voltage is lower	[1] [1]	
	(h)	Drawing of MOSFET amplifier with resistor connected between gate and drain.		[1]	
		Correctly drain biased MOSFET amplifier		[1]	

Question		Expected answer	Mark	Additional guidance
6	(a)	8x2=16	[1]	
	(b)	number of addresses 2^3=8	[1]	
		each bit needs its own wire to get data in and out	[1]	
	(c)	each A from a module to a corresponding A on bus	[1]	
		each control line to corresponding control bus line	[1]	
		data lines from 1st module to 2 different data-bus lines	[1]	
		data lines from 2nd module to 2 different data-bus lines from 1st module	[1]	
	(d)	read and write from each module to read and write bus	[1]	
		D_1 & D_0 from each modules to data bus	[1]	
		A_2-A_0 on each module to A_2-A_0 on bus	[1]	
		CE on each module connected to some logic/demultiplexer fro A_3/CE bus	[1]	
		A_3 correctly decoded to turn on one module when high one when low	[1]	
		CE decoded to control access to combined modules	[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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