GCE

Electronics

Advanced GCE

Unit **F614:** Control Systems

Mark Scheme for June 2012

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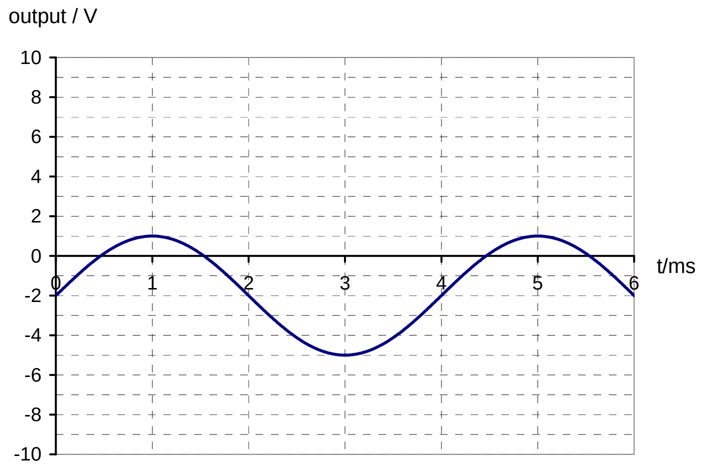
Question			Answer	Marks	Guidance
1	(a)		V across resistor is -2- -15 = 13V I = 13/330 (use of 330Ω resistor) I=0.039A calculation using Ohm's law 39mA (conversion to mA)	1 1 1 1	
	(b)		capacitor between input and circuit capacitor connected to gate	1 1	
	(c)		Max 2 of • To connect high impedance/low current sources • to lower impedance/higher current circuits • dc offset	2	Reference to current [1] amplification of current (for next block) [1]
	(d)		output same shape and in phase same amplitude offset by -2V	1 1 1	
2	(a)		ring around thermistor	1	
	(b)		Total R = $9.1x10^3+8.2x10^3 = 17.3\ x10^3$ I = $15/(9.1x10^3+8.2x10^3) = 8.67x10^{-4}$A V = $8.67x10^{-4}$ x $8.2x10^3$ = 7.1V	1 1 1	or any potential divider formula with correct answer [3]

Question			Answer	Marks	Guidance
	(c)		Any 4 of following: • non-inverting input > inverting input • output (saturated) high (OR +13V) • VGS>threshold • MOSFET conducting OR MOSFET has low resistance (wtte) • current in heater OR voltage across heater (wtte)	4	
	(d)	(i)	Any 4 of following: • Turns off when too hot/turns on when too cold • Explanation of why heater turn off reference to voltages in circuit • It takes time for soldering iron to warm/cool • It takes time for the thermistor to respond • Soldering iron keeps cooling/warming for some time even when heater off/on • Reference to hunting • Repeatedly turning on and off / On/off system • Explanation of thermistor effect on V_X	4	
	(d)	(ii)	X hunts around 7V Y saturates +/-13V in time with X	1 1 1 1	any amplitude and period (not nec. constant)
3	(a)		5 address lines $2^5 = 32$	1 1	
	(b)		$1111_2 = 15$	1	
	(c)		$A_4 – A_0$ = 0V, 0V, 0V, 5V, 5V $\overline{CE} = 0V$ $\overline{Read} = 0V$ $\overline{Write} = 5V$	2 1 1 1	Accept 00011 for [1] Accept any combination of 5V and 0V for [1] Only penalise using “1” instead of “5V” once.

Question			Answer	Marks	Guidance
	(d)		Any 5 of the following: • Start with ce, write and read all high • $A_4 - A_0 = 00100$ • $D_3 - D_0 = 0010$ EITHER • enable pulled low • write pulsed low • enable pulled high OR • write pulled low • enable pulsed low • write pulled high	5	order of address and data unimportant 1 mark for correct order (data and address set-up before writing /write+/ce=0)
	(e)		2 memory modules data lines connected together four address lines connected together fifth used to direct CE CE directed correctly read and write connected together	1 1 1 1 1 1	Only 1 module [0] A_5 used to select module in some way
4	(a)		Any 3 of the following: • collection of wires • connecting CPU to memory (and ports) • to select location in memory (or port) • to write to/read from • Unidirectional	3	
	(b)		Any 4 of the following: • in CPU • register/store • for address of instruction • next to be accessed • increments • reference to changing with jump/ret/reset	4	

Question			Answer	Marks	Guidance
	(c)		4 D-type flip-flops clocks connected together inputs to Ds output from Qs	1 1 1 1	
	(d)		Makes PC=0 when activated/make the program start from the <u>beginning</u>	1	
5	(a)		Any 5 of the following: • zener diode reverse biased • A = 5V • if output too low B goes high • B = 8V • turning MOSFET on • op-amp tries to keep both inputs at same V (wtte) • 9V dropped across MOSFET	5	
	(b)		use of 1.2k and 5V $5/1.2 \times 10^3 = 0.0042$A	1 1	Beware 13.6/3.6=3.78mA [0]
	(c)		14-5=9V conversion from mA $9 \times 4.2 \times 10^{-3}$ [4×10^{-3}] = 0.0375W [0.036W] ecf	1 1 1	
	(d)		mention current because op-amp has limited output/ supplies direct from car battery/ amplifying current/acts as power amplifier	1 1	
	(e)		3V lost in MOSFET 2V lost in op-amp	1 1	B must be at least 8V to turn MOSFET on so op-amp supply rail must be 8+2=10V accept less current in zener diode [1] so V across zener<5V [1] Any reference to headroom for op-amp or MOSFET [1]

Question			Answer	Marks	Guidance
6	(a)		set up mask (for door fully open sensor) get values from all input devices check if door fully open get inputs again if door not fully open (turn off door opener but leave) red LED on return to main program	1 1 1 1 1 1	
	(b)		Any 4 of the following: • turn on green LED • for 10s • then turn yellow LED for 10s • then turn red LED • explanation of left shift	4	
	(c)		switcha: MOVI Sn, 01 IN Sm, I AND Sn, Sm JZ switcha [loop back to IN statement or above] RET	1 1 1 1 1	 n not the same as m
	(d)		wait10s: MOVI S0, 28 (set up counter) wait250ms: MOVI S1, FA back: RCALL wait1ms DEC S1 JNZ back DEC S0 JNZ wait250ms RET Use of nested loops At least 2 labels correct product of counters = 10000 Whole subroutine works	1 1 1 1 1 1	Values must be less than 256
7	(a)		1 correct label rest of labels correct	1 1	

Question			Answer	Marks	Guidance
	(b)		two numbers from correct line e.g. 30mA, 1V $1/30\times10^{-3}=33\Omega$ (30Ω–35Ω)	1 1	
	(c)		$R_{DS}=3/90=33\Omega$ $I_{DS}=0.8/(47+33)=0.01A$ amplitude = 0.33V	1 1 1	
	(d)		for small voltages the MOSFET behaves as resistor as the V proportional to R for large voltages I does not depend on V	1 1	
	(e)		Any 2 of the following: • for small voltages the MOSFET behaves as resistor (as the V proportional to R) • for large voltages I does not depend on V (does not behave like a resistor) • at large input signal there is a constant voltage between input and output/output no longer proportional to input	2	Allow MOSFET saturates [1]
	(f)		Any 4 of the following: • amplitude of sound signal out increases linearly • over a restricted range • until sound signal out reaches amplitude = 3V • when MOSFET saturates • and sound signal in 7.2V • then sound signal continues to rise non-linearly	4	Accept MOSFET stops being a resistor/becomes current sink

APPENDIX 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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