Mark Scheme for June 2010

General advice to Assistant Examiners on the procedures to be used

YOU WILL BE REQUIRED TO UNDERTAKE PRACTICE AND STANDARDISATION SCRIPTS BEFORE STARTING TO MARK LIVE SCRIPTS, YOU WILL BE ADVISED OF THE AMOUNT OF SCRIPTS PRIOR TO THE MARKING PERIOD.

1   The schedule of dates for the marking of this paper is very important. It is vital that you meet these requirements. If you experience problems then you must contact your Team Leader (Supervisor) without delay.

2   An element of professional judgement is required in the marking of any written paper. Candidates often do not use the exact words which appear in the detailed sheets which follow. If you are in doubt about the validity of any answer then consult your Team Leader (Supervisor) by phone, the messaging system within SCORIS or e-mail.

3   Some questions may have a 'Level of Response' mark scheme. Any details about these will be in the rationale.

4   If an answer has been crossed out and no alternative answer has been written then mark the answer crossed out.

5   In addition to the award of 0 marks, there is a NR (No Response) option on SCORIS.

   Award 0 marks

   •   if there is any attempt that earns no credit (including copying out the question or some crossed out working)

   Award NR (No Response)

   •   if there is nothing written at all in the answer space
      OR
   •   if there is any comment which does not in any way relate to the question being asked (eg 'can't do', 'don't know')
      OR
   •   if there is any sort of mark which is not an attempt at the question (eg a dash, a question mark)

6   Abbreviations, annotations and conventions used in the detailed Mark Scheme. These vary from paper to paper, you will be advised in advance of the correct abbreviations, annotations and conventions to be used.

   Highlighting is also available to highlight any particular points on the script.

7   The Comments box
   The comments box will be used by your PE to explain their marking of the practice scripts for your information. Please refer to these comments when checking your practice scripts. You should only type in the comments box yourself when you have an additional object of the type described in Appendix B of the Handbook for Assistant Examiners and Subject Markers.
   Please do not use the comments box for any other reason.
   Any questions or comments you have for your team leader should be communicated by phone, SCORIS messaging system or e-mail.

8 Abbreviations, annotations and conventions that are used in this Mark Scheme vary from paper to paper. The following annotations are available for this paper.

(SO to add any others)

✓and ✖
BOD - Benefit of doubt
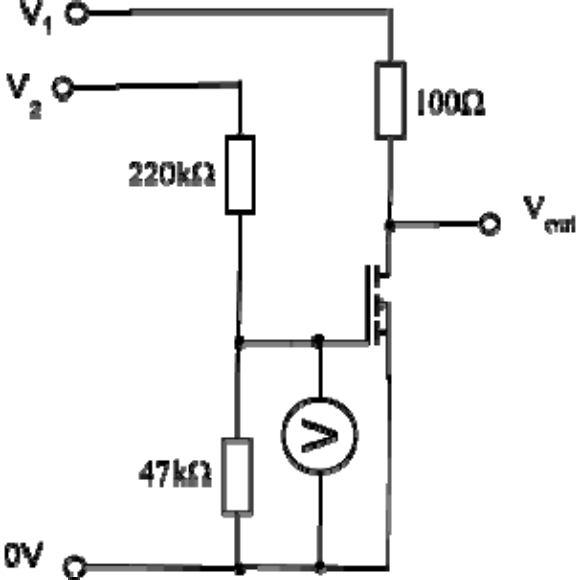**NBOD** – No benefit of doubt
TV - Too Vague
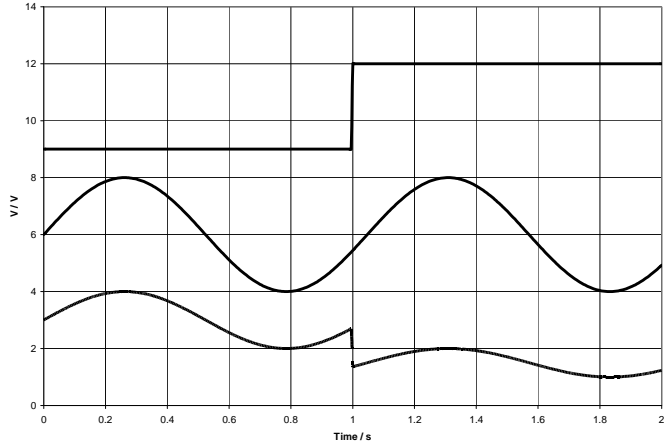
Highlighting is also available to highlight any particular points on the script.

Question	Grade	Expected answer	Mark	Additional guidance
1 (a)	E E E C	6 blocks Use of Ds in parallel as inputs Use Qs in parallel as outputs Use clocks all connected together as clock	1 1 1 1	Any block correct d-type not necessary
(b)	E C	correct sequence 10011 Leading zero to make six bits 010011	1 1	
(c)	 E D B	011001 last two digits correct 0110**01** third digit correct 011**0**01 first three digit correct **011**001	 1 1 1	
(d)	B B A	Correct conversion of 14 to binary 001110 Complement of binary 110001 ecf Addition of 1 to get answer 110010 ecf	1 1 1	
(e)	D E C A	Explain that subtraction is same as addition of negative number 19-14=19+(-14) 19 – 14 = 010011 + 110010 ecf Correct answer 000101 Explanation leading zero indicates +ve OR 101 indicates 5	1 1 1 1	
2 (a)	E C C D D E E	CPU correct Data bus correct Address bus correct Input port Output port Memory Clock	1 1 1 1 1 1 1	(If address and data bus wrong way around 1 mark)

Question	Grade	Expected answer	Mark	Additional guidance
(b)	E	Group of wires/connections	1	
	E	Bi-directional	1	
	D	Carrying information to/from CPU/all devices	1	
(c)	E	Memory/store	1	
	D	in CPU	1	
	D	storing results of calculations/ for moving data/quick access	1	
(d)	D	CPU fetches instruction	1	
	C	from memory (pointed at by PC)	1	
	C	Increment PC	1	
	E	Execute instruction	1	
	B	Sequence correct (Fetch, increment, execute)	1	
3 (a) (i)	E	Rectifier, Bridge rectifier/Full-wave rectifier	1	
(ii)	E	Output in phase with positive V_A and similar shape	1	
	E	Output in antiphase with negative V_A and similar shape	1	
	D	Amplitude between 7V and 8V	1	
	C	Flat section between half cycles	1	
(iii)	E	Capacitor in parallel with V_B	1	
(iv)	D	Amplitude same as 3aii	1	
	D	Line all positive and non-zero	1	
	C	decay from peak until next peak	1	
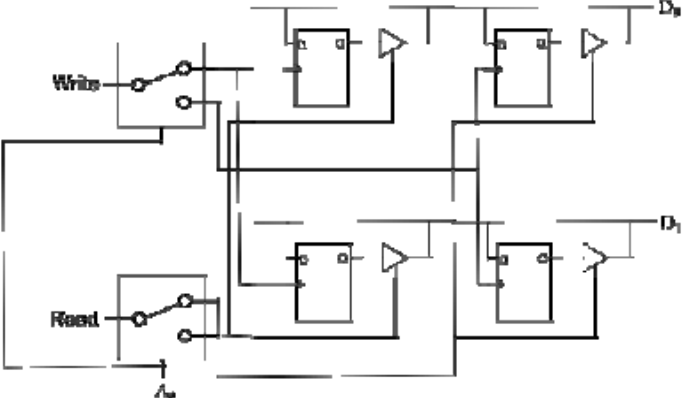
Question	Grade	Expected answer	Mark	Additional guidance
(b) (i)	E E E E	Correct zener symbol Resistor in series with zener and junction connected to non-inverting input Zener between non-inverting input and 0v Zener reverse biased	1 1 1 1	
(ii)	C D B	Correct V=7v Correct units conversion Correct answer 0.42W or 420mW (ecf)	1 1 1	0.72W [2]
(iii)	AABB	Up to a max of 4 of the following: • As battery voltage increases, current falls because • Inverting input tries to rise • So Vout goes down • So V_{GS} falls • Making I_D go down (R_{DS} go up) • Keeping V constant	4	

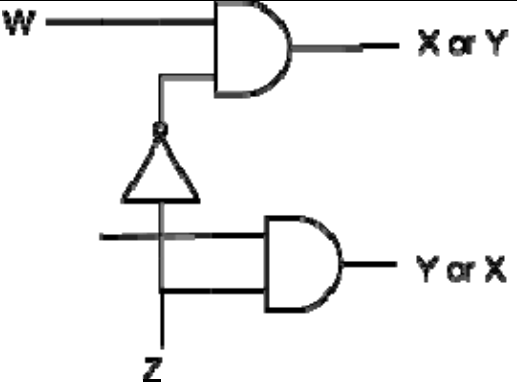| Question	Grade	Expected answer	Mark	Additional guidance
4 (a)	E E	Voltmeter connected between two MOSFET terminals Connected between G and S	1 1	 2 marks
(b)	E E E	Correct use of any rule Correct substitution e.g. $I = \dfrac{V}{R} = \dfrac{12}{(220+47)} == 0.0454 \text{ A} = 45.4\text{mA}$ $V = IR = 0.0454 \times 47 \times 10^{3} = 2.11\text{V}$ Correct answer 2.11 v	1 1 1	Look for 12/a resistance value (units must be consistent) for 1 mark.
(c) (i)	D D D	Pair of numbers from VGS=2V line (eg 3V, 60mA) Correct conversion from mA to A Correct answer (50Ω)	1 1 1	
(ii)	C C B	Attempt to use voltage divider formula Use of resistance from 4ci in calculation (ecf) Correct answer 1V	1 1 1	

Question	Grade	Expected answer	Mark	Additional guidance
(iii)	B A	Vout will increase Because RDS gets larger as VGS gets smaller	1 1	
(iv)	A* A* A*	Half V1 when V2=9V Quarter V1 when V2=12V Vout in phase with V1 with step changes in V2 transistions 	1 1 1	
5 (a)	E C	40 AND S4, S5 (or AND S5, S4)	1 1	

Question	Grade	Expected answer	Mark	Additional guidance
(b)	E	Set S0 equal to 8 and S6 to 0	1	
	E	Set up loop counter/make 8 loops OR to clear S6 for outputting wtee	1	
	A	Toggle/change the MSB (wtte) in S6	1	
	C	Output S6 to turn LED on/off	1	
	C	Subtract 1 from S5 to count number of time delays (wtte)	1	
			1	
	B	Jump back to count down if S5>0	1	
	C	Return to the main program		
(c)	A	wait250ms: MOVI Sn, FA	1	Any register apart from S0 or S1
	C	lock: RCALL wait1ms (not including label)	1	
	C	DEC Sn	1	Sn matches first line
	A	JNZ lock (including label placing)	1	
	E	RET	1	Not loop, switch
(d) (i)	E	01100101	1	
(ii)	D	65 ecf	1	
6 (a)	E	(-)5V	1	
(b)	E	Any op-amp circuit	1	
	E	Correct use of negative feedback to produce amplifier	1	
	C	component values at least 1kΩ	1	
	C	Voltage gain = 2 or -2	1	

Question	Grade	Expected answer	Mark	Additional guidance
(c)				
	A **A**	P goes towards 2.5v in first 6 squares then goes up towards 10v to end of graph	**1**	
	E **C** **A**	E starts at -5v E tends to 0v in first 6 squares E jumps to 10v at end of 6th square then tends to 0v by end	**1** **1** **1**	
	E **A**	D starts at -10v (ecf from E) D saturates at +13v at for first part of 7th square	**1** **1** **1**	

Question	Grade	Expected answer	Mark	Additional guidance
7 (a)	E	Contents lost when power is turned off (wtte)	1	
(b)	E	Allows the Data line to be bidirectional OR Allows more than one memory cell to be connected to the same data line	1	
(c)				
	B	4 memory cells used	1	
	A	D0 and D1 each connected to the data of two modules	1	
	A*	AO to control	1	
	A*	Completed working circuit	1	

Question	Grade	Expected answer	Mark	Additional guidance
(d)	E E E	correct circuit for $X\,(or\;Y)=W\cdot Z$ correct circuit for $Y\,(or\;X)=W\cdot\overline{Z}$ Correct truth table a demultiplexer (no ecf)	1 1 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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