

Complete, fold and seal
(see note 2 below)

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Examination Answer Books

12 Pages

Instructions to Candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

1	Student Number	~~194012~~
2	Title of Examination Paper	Electronics 1
3	Module Code	SGEE4003
4	Date and Time of Examination	15/05/23 9:30
5	Examination Venue	Graig
6	Seat Number	32
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
Part A	30 $\frac{1}{2}$
Part B1	23 $\frac{1}{2}$
Part B3	28
Total	82

(Gweler yr ochr arall am y fersiwn Cymraeg)

82 - mark confirmed



Prysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Llyfr Atebion Arholiadau

CYFENN:

ENW(AU) CYNTAF:

Llenwch, plynwch a se

Cyfarwyddiadau i Ymgeiswyr

12 Judalen

1. Rhwch yr holl wybodaeth y golygwyd amdani yn y blychau isod.
2. Rhwch eich enw yn y lle a ddarparwyd ar y dde, pligwch ef a'i selio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'r enw.

3. Rhaid i'r atebion fod mewn llawysgriften ddarllenadwy. Gall yr Arholwyr naill ai anwybyddu sgript annarllenadwy, neu dreftu iddi gael ei theipio a chael yr ymgeisydd i dalu.
4. Ysgrifennwch eich atebion mewn inc.
5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.
6. Ni ddylid rhwgo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.
7. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyblywr/gwyblyr.
8. Rhaid dychwelyd pob llyfr. Ni chaniateir mynd â llyfrau atebion, wedi eu defnyddio neu heb eu defnyddio, allan o'r lleoliad arholi o dan unrhyw amgylchiadau.

1	Rhif Myfyriwr	
2	Tetl y Papur Arholiad	
3	Cod y Modwl	
4	Dyddiad ac Amser yr Arholiad	
5	Lleoliad yr Arholiad	
6	Rhif Sedd	
7	Nifer y Llyfrau Atebion a gyflwynwyd	

(See the other side for English version)

Rhestrwch rifau'r cwestiynau a ymgelisiwyd gennyh	
At Ddibenion y Swyddfa	

Part A:

1. The atomic number for Silicon is 14, therefore it has 14 neutrons and 14 electrons. 2 in the first orbit, 8 in the second orbit and 4 in the third orbit. A Silicon atom has 4 valance electrons. The addition of Pentavalent materials such as arsenic and antimony create a large amount of free electrons in the crystal. This then produces an n-type semi-conductor. The additional impurities are known as donor impurities.

(5)

$$\begin{aligned}
 2. \quad V_S &= 6V & R_S &= \frac{V_S - V_D}{I_F} \\
 V_D &= 2.2 & & \\
 I_F &= 8mA & R_S &= \frac{6 - 2.2}{8 \times 10^{-3}} \\
 & & R_S &= 475 \Omega \quad \checkmark
 \end{aligned}$$

(3)

$$\begin{aligned}
 3. \quad \beta &= 90 & I_E &= I_C + I_B & \beta &= \frac{I_C}{I_B} \\
 I_B &= 30 \mu A & & & &
 \end{aligned}$$

$$\begin{aligned}
 I_C &= \beta I_B & I_E &= 2.7 \times 10^{-3} + 30 \times 10^{-6} \\
 &= 90 \times 30 \times 10^{-6} & &= 2.73 mA \\
 &= 2.7 mA \quad \checkmark
 \end{aligned}$$

(4)

$$\begin{aligned}
 4. \quad &10 \log(75) \\
 &10 \log(150) \\
 &10 \log(50) \\
 &10 \log(0.5)
 \end{aligned}$$

$$\begin{aligned}
 \text{Gain} &= 54.5 \text{ dB} \quad \checkmark \\
 &= 281250 \quad \checkmark
 \end{aligned}$$

(4)

$$\begin{aligned}
 5. \quad A_v &= - \frac{R_f}{R_i} \\
 &= \frac{30000}{15000} \quad 1500. \\
 &= -2
 \end{aligned}$$

$$\begin{aligned}
 6. \quad R_f &= 330k\Omega \\
 R_i &= 4.7k\Omega \\
 R_2 &= 56k\Omega \\
 R_3 &= 12k\Omega \\
 \text{Input } V &= 200\mu V \quad \times
 \end{aligned}$$

$$\begin{aligned}
 7. \quad f_c &= \frac{1}{2\pi R_f C} \\
 &= \frac{1}{2\pi \times \frac{100k}{100k} \times 0.033 \times 10^{-6}} \quad \checkmark \\
 &= 4842 \quad 4822 \text{ Hz}
 \end{aligned}$$

$$\begin{aligned}
 8. \quad 10001101 &= 141 \text{ (Decimal)} \quad \checkmark \\
 &= 8D \text{ (Hex)} \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 123 &= 0111011 \text{ (Decimal)} \quad \checkmark \\
 &= 7B \text{ (Hex)} \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 B7 &= 1011011 \text{ (Binary)} \quad \checkmark \\
 &= 183 \text{ (Decimal)} \quad \checkmark
 \end{aligned}$$

(2)

(0)

 $2\frac{1}{2}$

(6)

10 $\frac{1}{2}$

$$9. \quad F = \overline{A}B + ABC + A\overline{B}D + A\overline{B}CD$$

AB ^{CD}	00	01	11	10
00	1	1	1	1
01	0	0	0	0
11	0	0	1	1
10	0	1	1	0

$$F = \overline{A}B + \overline{B}D + ABC \quad \checkmark$$

(4)

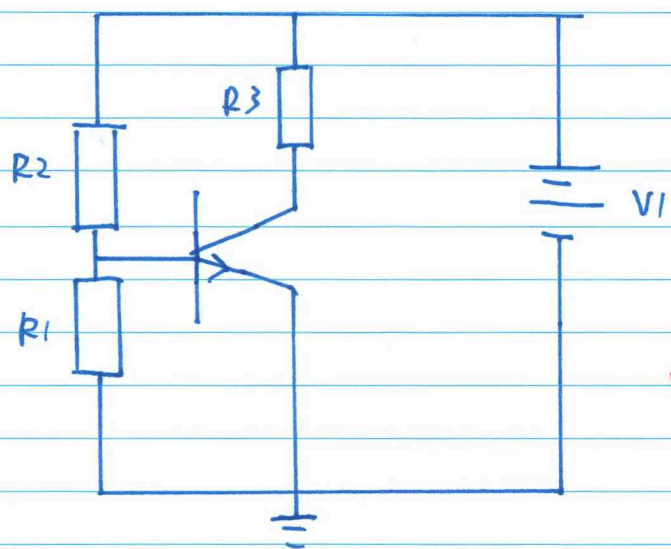
4

PART B1

- a) On a positive input cycle, the capacitor is charged through $d1$ and $d2$, $d3$ and $d4$ being cutoff. On a negative input cycle, the capacitor is charged in the same polarity, through $d3$ and $d4$, $d1$ and $d2$ being cutoff. The capacitor charge is topped up every input cycle.

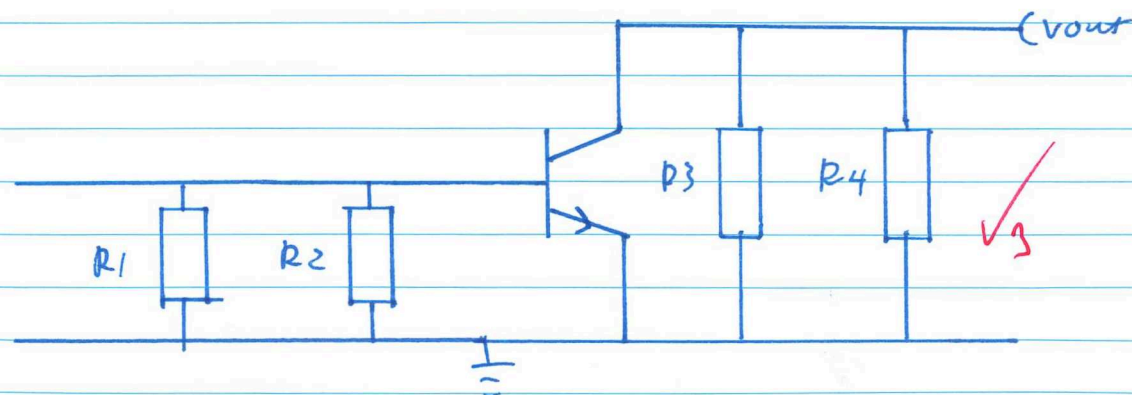
(4)

b) DC:



✓3

AC:



✓3

- c) Set up an oscilloscope and input a frequency of 1k Hz. Adjust the resolution until an undistorted waveform can be seen. X

(6)

- d) $V_{CC} = 14V$
 $I_Q = 2mA$
 $\beta_{FE} = 120$
 Input = 5mVpk
 $f = 25kHz$

$$R_L = \frac{V_C}{I_C} \quad V_C = \frac{1}{2} V_{CC}$$

$$= \frac{7}{2 \times 10^{-3}} = 3.5k\Omega \quad \checkmark$$

$$R_E = \frac{V_E}{I_E}$$

$$= \frac{1.4}{2 \times 10^{-3}} = 700\Omega \quad \checkmark$$

$$I_C \approx I_E$$

$$V_E = 10\% V_{CC} = 1.4V \quad \checkmark$$

$$R_1 = \frac{V_{CC} - V_B}{I_{R1}}$$

$$= \frac{14 - 2.2}{166.67 \times 10^{-6}} = 70800\Omega \quad \checkmark$$

$$V_B = V_E + 0.7$$

$$= 2.2V \quad \checkmark$$

$$I_{R1} = I_{R2} = I_B \times 10$$

$$I_B = \frac{I_{CQ}}{\beta_{FE}} = \frac{16.67 \mu A \times 10}{120} = 1.39 \mu A$$

$$I_B = \frac{2 \times 10^{-3}}{120} = 16.67 \mu A \quad \checkmark$$

(6)

10

(10)

$$R = \frac{V_B}{I_{R2}}$$

$$= \frac{2.2}{167.67 \times 10^{-6}}$$

$$= 13121.2 \checkmark \text{ c.c.}$$

C1, C2 and C3 have low reactance at required frequency, so assuming $X_C = X_L$

$$C = \frac{1}{2\pi \times 25 \times 10^3 \times 1}$$

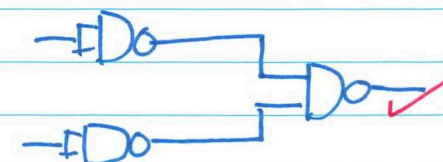
$$C = 6.37 \mu F \checkmark$$

PART B3

a) NOT:



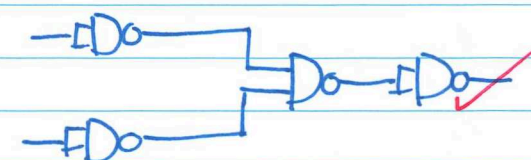
(iii) OR:



(ii) AND:



(iv) NOR:



13 1/2

4

b)	J	K	Q	Q ⁺	Comments
	0	0	0	0	No change ✓
	0	0	1	1	
	1	0	0	1	Set ✓
	1	0	1	1	
	0	1	0	0	Reset ✓
	0	1	1	0	
	1	1	0	1	Toggle ✓
	1	1	1	0	

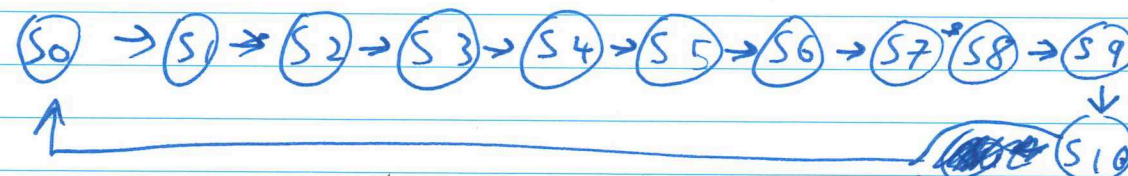
4

c) Count 1 $\rightarrow$ 11

$S_0 = 1$
 $S_1 = 2$
 $S_2 = 3$
 $S_3 = 4$
 $S_4 = 5$
 $S_5 = 6$
 $S_6 = 7$
 $S_7 = 8$
 $S_8 = 9$
 $S_9 = 10$
 $S_{10} = 11$

11 States

3 flip flops = 8 states
 4 flip flops = 16 states



Current +	Next	Current +				Next				W	X	Y	Z
		Q _A	Q _B	Q _C	Q _D	Q _A	Q _B	Q _C	Q _D				
S ₀	S ₁	0	0	0	0	0	0	0	1	0	0	0	1
S ₁	S ₂	0	0	0	1	0	0	1	0	0	0	1	0
S ₂	S ₃	0	0	1	0	0	0	1	1	0	0	1	1
S ₃	S ₄	0	0	1	1	0	1	0	0	0	1	0	0
S ₄	S ₅	0	1	0	0	0	1	0	1	0	1	0	1
S ₅	S ₆	0	1	0	1	0	1	1	0	0	1	1	0
S ₆	S ₇	0	1	1	0	0	1	1	1	0	1	1	1
S ₇	S ₈	0	1	1	1	1	0	0	0	1	0	0	0
S ₈	S ₉	1	0	0	0	1	0	0	1	1	0	0	1
S ₉	S ₁₀	1	0	0	1	1	0	1	0	1	0	1	0
S ₁₀	S ₀	1	0	1	0	0	0	0	0	1	0	1	1
S ₁₁	X	X	X	X	X	X	X	X	X	X	X	X	X
S ₁₂	Y	X	X	X	Y	X	X	X	X	X	X	X	X
S ₁₃	Y	X	Y	Y	Y	X	X	X	X	X	Y	X	X
S ₁₄	Y	X	Y	Y	Y	X	X	X	Y	Y	Y	Y	X
S ₁₅	X	X	Y	X	X	X	X	X	X	X	X	X	X

 Q_A^+

AB ^{CD}	00	01	11	10
00	0	0	0	0
01	0	0	1	0
11	X	X	X	X
10	1	1	X	0

$$Q_A^+ = A\bar{C} + BCD$$

 Q_B^+

AB ^{CD}	00	01	11	10
00	0	0	1	0
01	0	1	0	1
11	X	X	X	X
10	0	0	X	0

$$Q_B^+ = \bar{B}CD + B\bar{C} + B\bar{D}$$

 Q_C^+

AB ^{CD}	00	01	11	10
00	0	1	0	1
01	0	1	0	1
11	X	X	X	X
10	0	1	X	0

$$Q_C^+ = \bar{C}D + A\bar{C}D$$

 Q_D^+

AB ^{CD}	00	01	11	10
00	1	0	0	1
01	1	0	0	1
11	X	X	X	X
10	1	0	X	0

$$Q_D^+ = \bar{C}D + B\bar{D} + \bar{B}CD$$

W

AB ^{CD}	00	01	11	10
00	0	0	0	0
01	0	0	1	0
11	X	X	X	X
10	X	1	X	1

$$W = A\bar{D} + A\bar{C} + BCD$$

X

AB ^{CD}	00	01	11	10
00	0	0	1	0
01	1	1	0	1
11	X	X	X	X
10	0	0	X	0

$$X = B\bar{C} + B\bar{D} + \bar{B}CD$$

Y

Z

AB ^{CD}	00	01	11	10
00	0	1	0	1
01	0	1	0	1
11	x	x	x	x
10	0	0	x	1

AB ^{CD}	00	01	11	10
00	1	0	0	1
01	1	0	0	1
11	x	x	x	x
10	1	0	x	x

$$Y = \bar{C}D + C\bar{D}$$

$$Z = \bar{D}$$

20

20