

SURNAME: Jones

FORENAME(S): Sean

Examination Answer Books

12 Pages

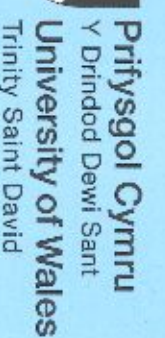
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List the numbers of the questions you have attempted	Office Use
A1	4
A2	1
A3	0
A4	0
A5	0
A6	0
A7	0
A8	6
A9	0
A10	0
B2	9
B3	11
Total	31

1	Student Number	1602826/1
2	Title of Examination Paper	Electronics 2
3	Module Code	PSDE 5006
4	Date and Time of Examination	9:30 15/5/18
5	Examination Venue	Graig G25
6	Seat Number	
7	Number of Answer Books handed in	

(Gweler yr ochr arall am y fersiwn Cymraeg)



Llyfr Atebion Arholiadau

12 Tudalen

Cyfarwyddiadau i Ymgeiswyr

1. Rhwch yr holl wybodaeth y gofynnir andani yn y blychau isod.
2. Rhwch eich enw yn y lle a ddarparwyd ar y dde, plygwch ef at i selio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.
3. Rhaid i'r atebion fod mewn llawysgrifen ddarlledadwy. Gall yr Atholwyr naill ai anwybyddu sgrïpt annallenedadwy, neu drefnu 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 drydyddynt.
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 gwyllwyr/gwyllwyr.
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.

Llenwch, plygwch a seliwch
(aweler nodwch 2 isod)

CYFENW:

ENW(AU) CYNTAF:

1	Rhif Myfyrwr	
2	Teitl y Papur Arholiad	
3	Cod y Moddwl	
4	Dyddiad ac Amser yr Arholiad	
5	Lleoliad yr Arholiad	
6	Rhif Sedd	
7	Nifer y Llyfrau Atebion a gyflwynwyd	

[illegible]

(See the other side for English version)

(B2)

a

5th order will be made from 3 Stages | 1st order and 2 2nd orders

Stage	a:	b:
1	5.6334	0
2	0.7620	2.6530
3	0.1172	1.0686

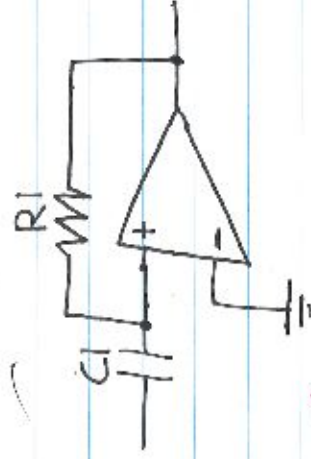
$$C1 = 330 \text{ pF}$$

$$R1 = \frac{a1}{2\pi f_c C1}$$

$$= \frac{5.6334}{2\pi (50 \times 10^3) (330 \times 10^{-12})}$$

$$R1 = 54.38 \text{ K}\Omega$$

4



Stage 2

$$C1 = 330 \text{ pF}$$

$$C2 > \frac{C1 \times 4b}{a2}$$

$$C2 > \frac{330 \text{ pF} \times 4(2.6530)}{0.7620}$$

$$C2 > 4.595 \text{ nF}$$

$$C2 = 4.6 \text{ nF}$$

3

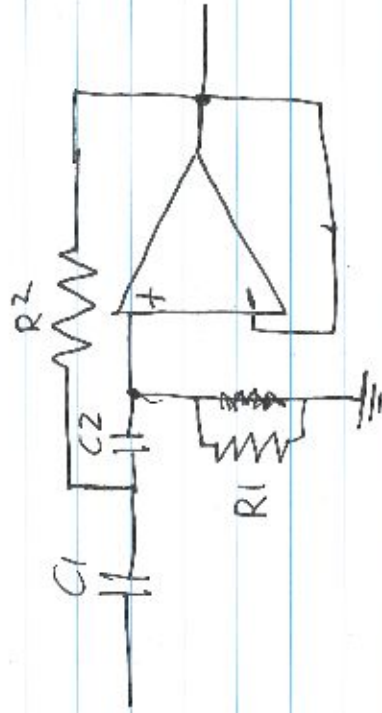
$$R1 = \frac{a1 C2 + \sqrt{a1^2 C2^2 - 4b1 C1 C2}}{4\pi f_c C1 C2}$$

$$= \frac{0.7620 \times 4.6 \text{ nF} + \sqrt{0.7620^2 (4.6 \times 10^{-9})^2 - 4(2.6530)(330 \times 10^{-12})(4.6 \times 10^{-9})}}{4\pi (50 \times 10^3) (330 \times 10^{-12}) (4.6 \times 10^{-9})}$$

2

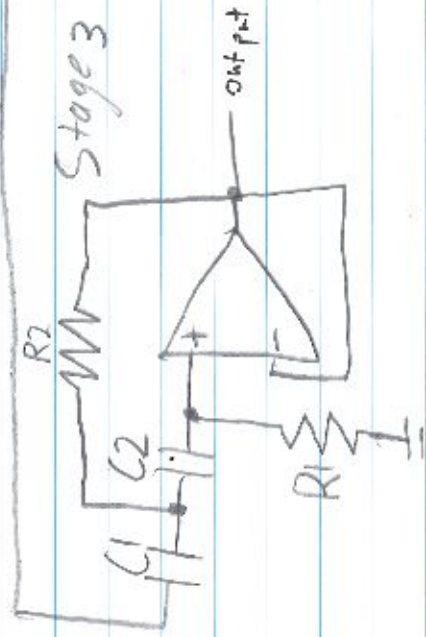
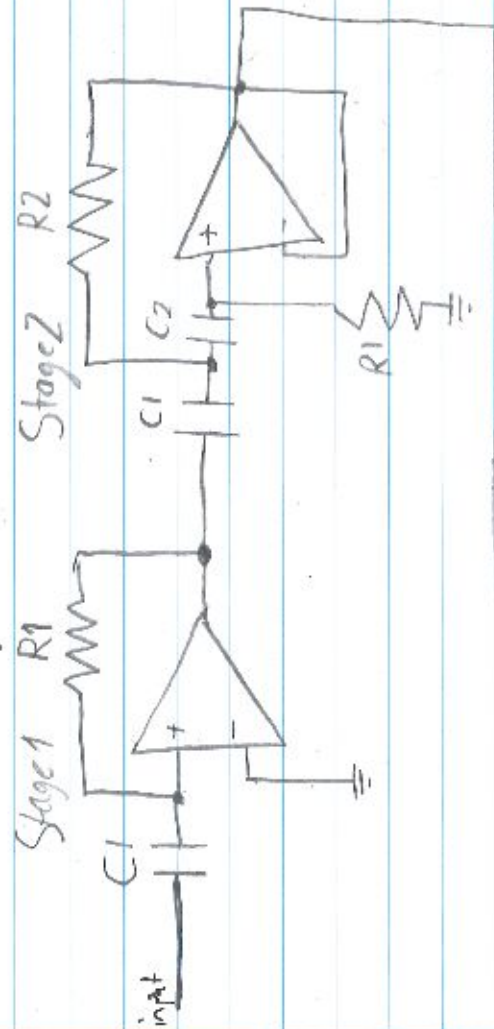
$$= 3.5052 \text{ n} + \sqrt{0.000}$$

$$R2 = \frac{a_1 C_2 - \sqrt{a_1^2 C_2^2 - b_1 C_1 C_2}}{4\pi f C_1 C_2}$$

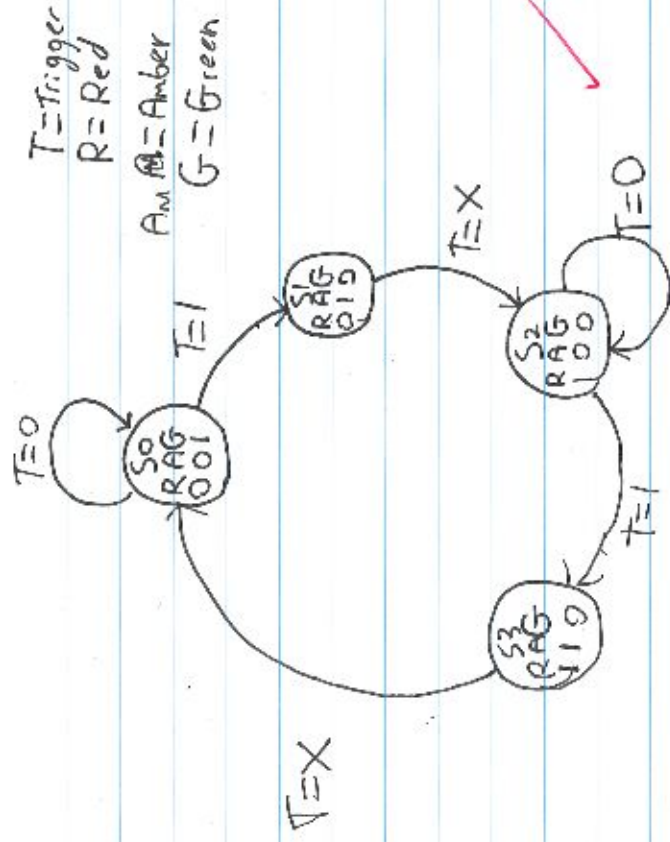


Stage 3

Same as Stage 2 except a_3 and b_3 values used.

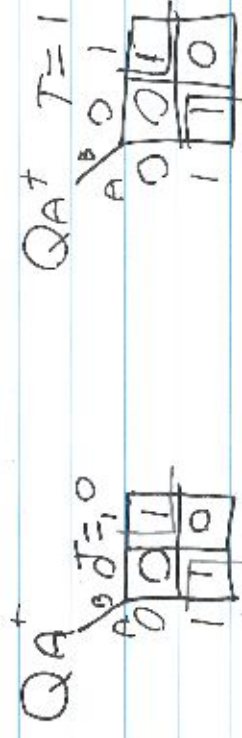


9



4

Current	T=0	T=1	T=0	T=1
S0	S0	S1	S0	S0
S1	S2	S2	S1	S1
S2	S2	S3	S2	S2
S3	S0	S0	S3	S3

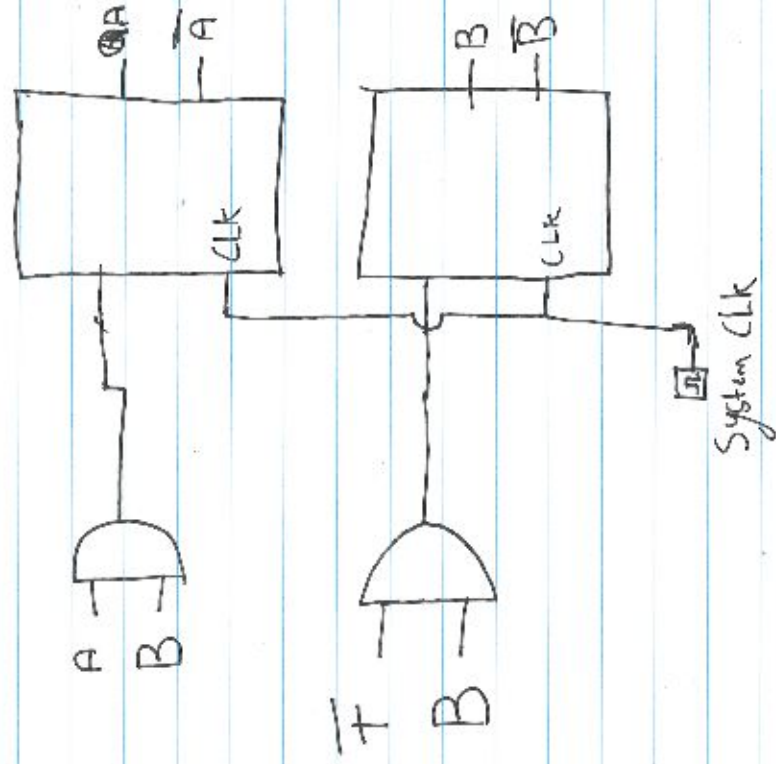


$$QA^+ = AB$$



$$QB^+ = AB$$

2

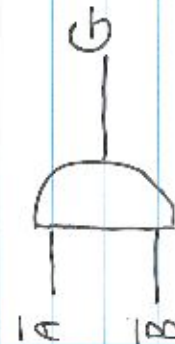


		A		B	
R	A	0	1	0	1
		0	0	0	1
A	B	0	1	0	1
		0	0	1	0

$$R = A \quad A_n = B \quad G = \bar{A}B$$

$$A \text{ --- } R$$

$$B \text{ --- } A_n$$



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SURNAME: MILNEK

FORENAME(S): CHARIS

Examination Answer Books

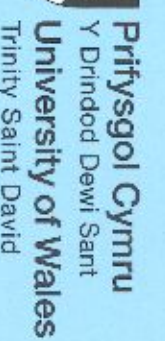
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12 Tudalen

Cyfarwyddiadau i Ymgeiswyr

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7. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwybwr/gwybwr.
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Llerwch, plygwch a seliwch
(aweler nodyn 2 isod)

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ENW(AJ) CYNTAF: _____

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

[illegible]

(See the other side for English version)

A1. a. 750 $20 \log(750) = 57.5 \text{ dB}$ ✓

b. 2000 $10 \log(2000) = 33.01 \text{ dB}$ ✓

2. 40 W $P_{10} = \frac{P_{out}}{\text{cable log}(10)} = \frac{40}{100000} = 400 \text{ nW}$ ✓
 8Ω
 50 dB

3. 1000

4. A Colpitts oscillator uses

5. A quartz crystal when vibrating is equivalent to an RLC circuit. An equivalent circuit is an RLC shunted by a capacitor



6. $L1 = 1.5 \mu\text{H}$ $2000 = \frac{1}{2\pi f \sqrt{LC}}$
 200 MHz

$C = \left(\frac{1}{2000^2} \right) \frac{1}{2\pi f \sqrt{LC}} = \frac{1}{f \times 2\pi \sqrt{LC}} = 1$
 $\frac{1}{2\pi \sqrt{LC}} = \frac{1}{f}$
 $\sqrt{LC} = \frac{1}{f}$
 $LC = \left(\frac{1}{f} \right)^2$
 $C = \frac{1}{4222.17 \times 10^9} = 422.2 \text{ nF}$

7. 5 kHz
 75 kHz

$BV = \frac{f_o}{Q}$ $Q = \frac{f_o}{BW}$ $\frac{5 \times 10^3}{75 \times 10^3} = 66.66$ ✓

8. $f = 20\text{ kHz}$
 $C = 1\text{ nF}$

$R_1 = \frac{1}{4\pi f C} = \frac{1}{4\pi \times 20 \times 10^3 \times 1 \times 10^{-9}} = 1947.9\Omega$

$R_2 = \frac{1}{4\pi f C} = \frac{1}{4\pi \times 20 \times 10^3 \times 1 \times 10^{-9}} = 1947.9\Omega$

9.

10.

Inputs = A, B, C, D ✓
Output = Y ✓



iii

A	B	C	D	Y	ABCDY
0	0	0	0	0	10010
0	0	0	1	0	10100
0	0	1	0	0	10110
0	0	1	1	0	11000
0	1	0	0	0	11010
0	1	0	1	0	11100
0	1	1	0	0	11111
0	1	1	1	0	
1	0	0	0	0	

14

B2 a) 1st stage

$R = 5.6334 \times 330 \times 10^{-12} \pm \sqrt{5.6334^2 \times (330 \times 10^{-12})^2 - 4 \times 0 \times (330 \times 10^{-12})^2}$

$4\pi \times 50 \times 10^3 \times 330 \times 10^{-12} \times 330 \times 10^{-12}$

$R = \frac{1.86 \times 10^{-9} \pm \sqrt{3.46 \times 10^{-18} - 0}}{6.84 \times 10^{-14}}$

$R = 54387.5 \Omega$ $54\text{ k}\Omega$ ✓

2nd stage $C2 = ?$

$R = \frac{0.7620 \times 330 \times 10^{-12} \pm \sqrt{0.7620^2 \times (330 \times 10^{-12})^2 - 4 \times 0 \times (330 \times 10^{-12})^2}}{2.653}$

$4\pi \times 50 \times 10^3 \times 330 \times 10^{-12} \times 330 \times 10^{-12}$

$R = \frac{2.51 \times 10^{-10} \pm \sqrt{6.323 \times 10^{-20} - 1.155 \times 10^{-18}}}{6.84 \times 10^{-14}}$

frequency number. Change C_2 to 330 nF $\sqrt{6.323 \times 10^{-14} - 1.155 \times 10^{-18}}$
 $R = 77845284 \Omega$ $77.8\text{ k}\Omega$

$R = 3.68\text{ k}\Omega$ ✓

3rd stage.

$R = 0.1172 \times 330 \times 10^{-12} \pm \sqrt{0.1172^2 \times (330 \times 10^{-12})^2 - 4 \times 1.0686 \times 330 \times 10^{-12}}$

$R = 3.87 \times 10^{-11} \pm \sqrt{1.496 \times 10^{-21} - 4.654 \times 10^{-16}}$

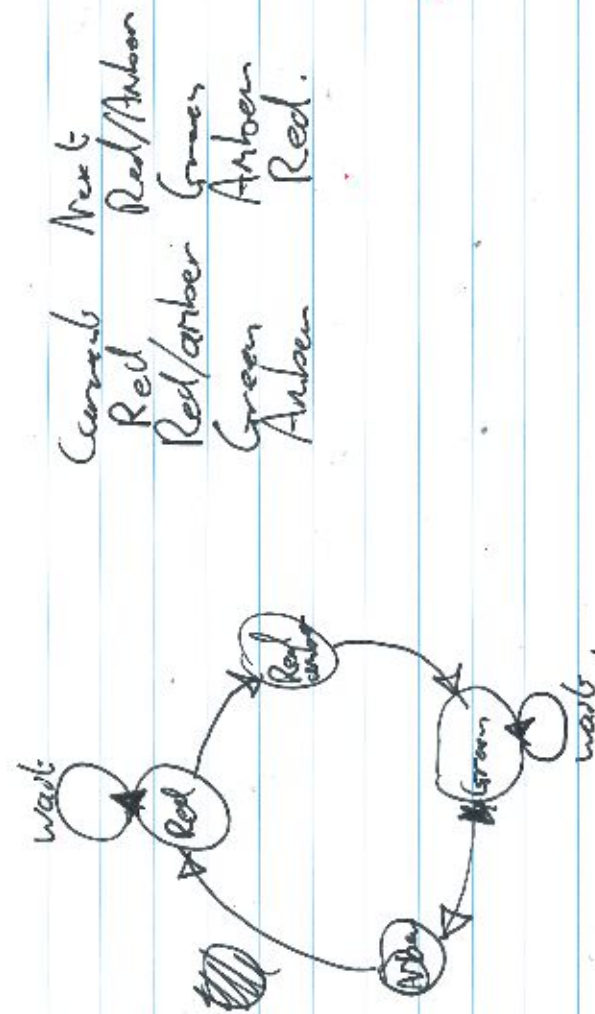
frequency number $C_2 = 330\text{ nF}$

$R = \frac{3.87 \times 10^{-11} \pm \sqrt{1.496 \times 10^{-21} - 4.654 \times 10^{-16}}}{6.84 \times 10^{-14}}$

$R = 31.12\text{ M}\Omega$

b).

B3a.

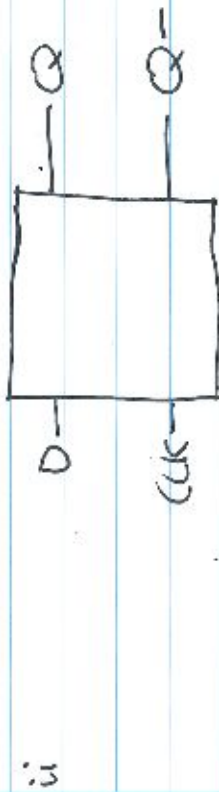


Current	Next
Red	Green
1	0
1	1
0	0
0	1
0	0

QA	QB	QA ⁺	QB ⁺
0	0	0	1
0	1	1	0
1	0	1	1
1	1	0	0

2

b.i Give 2 inputs = $\text{Parb}(D)$, CLK ✓
 Give 2 outputs = Q , Q_{neg} ✓



D	CLK	Q	Q-
0	0	0	1
0	1	0	1
1	0	0	1
1	1	1	0

If the rising edge of CLK is present and D is high, the output Q and $Q-$ switch over state.

4

(See the other side for English version)

A1. a) Voltage gain of 750

$$20 \log(750) = 57.5 \text{ dB}$$

$$10 \log(2000) = 33 \text{ dB}$$

A2.

A3.

A4. Colpitts Oscillator

The principle operation of a Colpitts oscillator is once it's turned on it begins to charge the capacitors C_1 and C_2 . Once the capacitors reach full charge they will be discharged across the inductor L and this sets up oscillation. The output voltage in the circuit is developed across C_1 , while the feedback voltage is developed across C_2 .

A5.

$$A6. F = \frac{1}{2\pi\sqrt{LC}} \quad Q = \frac{f}{2\pi L^2} = \frac{200 \text{ MHz}}{2\pi \cdot 1.5 \mu\text{H}^2}$$

$$A7. BW = \frac{f_0}{Q}$$

$$Q = \frac{f_0}{BW} = \frac{75 \text{ KHz}}{6 \text{ MHz}} = 0.0125$$

$$Q = \frac{f_0}{BW} = \frac{5 \text{ MHz}}{75 \text{ KHz}} = 66.6 \checkmark$$

A8. Cut off frequency = 120 kHz capacitor 1 nF

$$a = 1.3617 \quad b = 0.6180$$

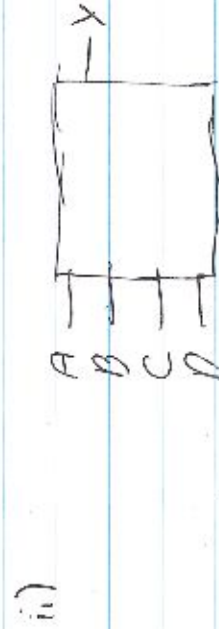
$$R1 = \frac{1}{\pi f_c \times C \times a} = \frac{1}{\pi (120\text{ kHz}) (1\text{ nF}) (1.3617)} = 1947.99 \Omega$$

$$R2 = \frac{1}{4\pi f_c \times C \times b} = \frac{1}{4\pi (120\text{ kHz}) (1\text{ nF}) (0.6180)} = 1073 \Omega$$

$$R1 = \frac{1}{2\pi f_c \times C} = \frac{1}{2\pi (120\text{ kHz})}$$

A9. The main features of the Butterworth filter type is that it has the maximum flat passband that makes it ideal for use in anti-aliasing filters that are often used in data converter applications that require precise signals. It has a roll off of 20 dB/decade .

A10. i) The inputs in gate 1 are A, B, C and D, while the output is Y.



ii) The operation of gate 1 is that it is a 4-input AND gate.

B1 - Special amplifiers

- a) First stage $20\log(350) = 50.9\text{ dB}$
 Second stage $20\log(100) = 40\text{ dB}$
 Third stage $20\log(175) = 44.9\text{ dB}$
 Total = 135.8 dB

b) i) $V_{in} \times \text{Voltage gain} = 1.5 \times 10^{-3} \times A_{v1} \log(175/20) = 8.4\text{ V}$
 ii) $V_{out} = 8.4 \times 2000 = 0.0353\text{ mW}$

c) $V_{ce} = (R1 + R2) = 15 + 12\text{ k}\Omega = 123\text{ uA}$
 $123\text{ uA} \times 22\text{ k}\Omega = 2.7\text{ V}$
 $2.7 - 0.7 = 2\text{ V}$
 $2 + 4700 = 426\text{ uA}$

$$V_{ce} = 426\text{ uA} \times 22\text{ k}\Omega = 5.63\text{ V}$$

$$5.63 - 0.7 = 4.93\text{ V}$$

$$4.93 \div 10\text{ k}\Omega = 493\text{ uA}$$

$$15 - (493\text{ uA} \times 10\text{ k}\Omega) = 10.07\text{ V}$$

d) $A_{v8} = \frac{A_v}{1 + A_v \text{ mV}} = \frac{2200}{1 + (2200)(0.015)} = 64.7$

e)

Frequency Response	RC	transducer	direct
Cost	Excellent	Not good	best
Impedance matching use	Less	more	best
	not good	Excellent	best
	Voltage amplification	power amplification	Amplification at lower frequencies

f) $\frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{(35\text{ nH})(0.22\text{ uF})}} = 181\text{ Hz}$

g) $f_{BW} = \frac{f_o}{Q} = \frac{3\text{ MHz}}{120} = 25\text{ kHz}$

Upper frequency = $3\text{ MHz} + 12.5\text{ kHz} = 3012.5\text{ kHz}$
 Lower frequency = $3\text{ MHz} - 12.5\text{ kHz} = 2987.5\text{ kHz}$

BZ - Filter and Oscillator design

a) Stage 1 $a = 5.6334$ $b = 0$ $F = 50 \text{ kHz}$ $C = 330 \text{ pF}$

$$R1 = a1 = \frac{5.6334}{2\pi f C1} = \frac{543 \mu}{330 \times 10^{-10}} = 54k$$

Stage 2 $a = 0.7620$ $b = 2.6530$

$$C2 = \frac{C1 \times 4b}{a^2} = \frac{(330 \times 10^{-10})(4)(2.6530)}{0.7620^2} = 6.03 \times 10^{-7}$$

$$C2 = 6.1 \times 10^{-7}$$

$$R = \frac{a1 C2 \pm \sqrt{a^2 C^2 - 4b C1 C2}}{4\pi f C1 C2} = \frac{(0.7620)(6.1 \times 10^{-7}) \pm \sqrt{(0.7620^2)(6.1 \times 10^{-7})^2 - 4(2.6530)(330 \times 10^{-10})(6.1 \times 10^{-7})}}{4\pi(50 \text{ kHz})(330 \times 10^{-10})(6.1 \times 10^{-7})}$$

$$= \frac{4.6482 \times 10^{-7} \pm \sqrt{2.16058 \times 10^{-13} - 2.1361456 \times 10^{-8}}}{1.264805262 \times 10^{-8}}$$

$$R1 = 40 \quad R2 = 32$$

Stage 3 $a = 0.1172$ $b = 1.0686$

$$C2 = \frac{C1 \times 4b}{a^2} = \frac{(330 \times 10^{-10})(4)(1.0686)}{(0.1172)^2} = 1.027 \times 10^{-5}$$

$$C2 = 1.03 \times 10^{-5}$$

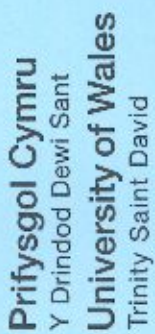
$$R = \frac{a1 C2 \pm \sqrt{a^2 C^2 - 4b C1 C2}}{4\pi f C1 C2} = \frac{(0.1172)(1.03 \times 10^{-5}) \pm \sqrt{(0.1172^2)(1.03 \times 10^{-5})^2 - 4(1.0686)(330 \times 10^{-10})(1.03 \times 10^{-5})}}{4\pi(50 \text{ kHz})(330 \times 10^{-10})(1.03 \times 10^{-5})}$$

$$= \frac{1.20716 \times 10^{-6} \pm \sqrt{1.457235266 \times 10^{-12} - 1.45286856 \times 10^{-12}}}{2.135654686 \times 10^{-7}}$$

$$R1 = 5.96 \quad R2 = 5.34$$

b)

6)



SURNAME: DANIELS

FORENAME(S): TRYSTAN JOHN

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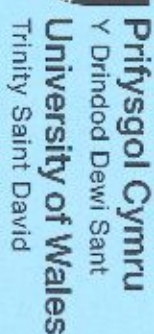
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A10	4
B1	6
B2	16
Total	36%

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7. Os defnyddir mwy nag un llyfr, rhwygynnwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwylyllwr/gwylwyr.
8. Rhaid dychwynyd pob llyfr. Ni chaniateir mynd â llyfrau atebion, wedi eu defnyddio neu heb eu defnyddio, allan o'r lleoliad arholi o dan unrhyw amgylchiadau.

Llenwch, plygwch a seliwch
(gweler nodyn 2 isod)

CYFENW:

ENW(AU) CYNTAF-

ENW(AU) CYNTAF:

1	Rhif Mlyfrywr	
2	Teitl 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	

[illegible]

(See the other side for English version)

A1.

$$a) 20 \log_{10}(750) = 57.5 \text{ dB} \checkmark$$

$$b) 20 \log_{10}(2000) = 66 \text{ dB} \times$$

A2.

40W

8Ω

$$\text{antilog}(49\%) = 10000$$

$$10000 \div 50 = 200 \times$$

A3.

$$1000 \div 20 = 20$$

A4.

$$A7. BW = \frac{f_o}{Q}$$

$$Q = \frac{f_o}{BW}$$

$$= \frac{5M}{75kHz}$$

$$= 66.6 \checkmark$$

A10.

Gate 1 inputs:

A

B

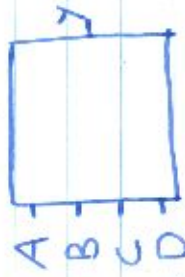
C

D

Outputs:

Y

Entity



(ii)

iii) For an output at 'Y', A and B and C and D must be giving an input. Just like a 4 input AND Gate

$$A8.) R_1 = \frac{1}{\pi f_c \times C_{in2}}$$

$$= \frac{1}{(\pi)(120 \times 10^6)(1 \times 10^{-9})(1.3617)}$$

$$= 1.95 \text{ } \mu\text{s}$$

$$R_2 = \frac{C_2}{4\pi f_c \times C_{in2}}$$

See ~~Equation~~

$$= \frac{1.3617}{(4)(\pi)(120 \times 10^6)(1 \times 10^{-9})(0.6180)}$$

$$= 1.46 \text{ } \mu\text{s}$$

B2

a) $330 \text{ pF } (330 \times 10^{-12})$

1 Stage

$$R_1 = \frac{a_1}{2\pi f_c C_1}$$

$$R_1 = \frac{5.6334}{(2)(\pi)(50 \times 10^6)(330 \times 10^{-12})}$$

$$= 54.34 \text{ } \mu\text{s}$$

2nd Stage

$$C_2 > \frac{C_1 \times 4b}{a^2}$$

$$= \frac{(330 \times 10^{-12}) \times (4)(2.6530)}{0.7620^2}$$

$$= 6.03 \times 10^{-9}$$

$\therefore$ Make $C_2 = 6.5 \times 10^{-9}$

$$R_1, R_2 = \frac{a_1 C_2 \pm \sqrt{a_1^2 C_2^2 - 4b_1 C_1 C_2}}{4\pi f_c C_1 C_2}$$

$$R_1 = \frac{(0.7620)(6.5 \times 10^{-9}) \pm \sqrt{(0.7620)^2(6.5 \times 10^{-9})^2 - (4)(2.6530)(330 \times 10^{-12})(6.5 \times 10^{-9})}}{(4)(\pi)(50 \times 10^6)(330 \times 10^{-12})(6.5 \times 10^{-9})}$$

$$R_1 = \frac{(0.7620)(6.5 \times 10^{-9}) + \sqrt{1.769469 \times 10^{-18}}}{1.347743248 \times 10^9}$$

$$= 4.66 \text{ } \mu\text{s}$$

$$R_2 = \frac{(0.7620)(6.5 \times 10^{-9}) - \sqrt{1.769469 \times 10^{-18}}}{1.347743248 \times 10^9}$$

$$= 2.69 \text{ } \mu\text{s}$$

2nd Stage

$$C27 \frac{C_1 \times 4b}{a^2}$$

$$= \frac{330 \times 10^{-12} \times 4 \times 1.0686}{0.1172^2}$$

$$= 102.69 \times 10^{-9}$$

$$R_1, R_2 = \frac{\omega C_2 \pm \sqrt{\omega^2 C_2^2 - 4bC_1C_2}}{(4)(\pi)(f)(C_1)(C_2)}$$

$$R_1 = \frac{(0.1172)(102.69 \times 10^{-9}) + \sqrt{(0.1172)^2(102.69 \times 10^{-9})^2 - (4)(1.0686)(330 \times 10^{-12})(102.69 \times 10^{-9})}}{(4)(\pi)(f)(C_1)(C_2)}$$

$$(4)(\pi)(50 \times 10^6)(330 \times 10^{-12})(102.69 \times 10^{-9})$$

$$= \frac{(0.1172)(102.69 \times 10^{-9}) + \sqrt{1.909048176 \times 10^{-21}}}{2.129226987 \times 10^{-8}}$$

$$R_1 = 0.57 \Omega$$

$$R_2 = 0.56 \Omega$$

(16)

$$\begin{aligned} \text{Stage 1} &= 20 \log(350) = 50.88 \text{ dB} \\ \text{Stage 2} &= 20 \log(100) = 40 \text{ dB} \\ \text{Stage 3} &= 20 \log(175) = 44.86 \text{ dB} \end{aligned}$$

$$\text{Total gain} = 135.74 \text{ dB}$$

B1/a)

(4)

b)

(2)

$$g) BW = \frac{f_o}{Q}$$

$$= \frac{3 \text{ MHz}}{120}$$

$$= 25 \text{ kHz}$$

(2)

Complete, fold and seal
(see note 2 below)

SURNAME: Edgell

FORENAME(S): Aled Charles

Examination Answer Books

12 Pages

Instructions to Candidates

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(See the other side for English version)

1	Rhif Myfyrwr	
2	Tell 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	

Rhestrwch ffau'r cwestiynau a ymgaiswyd gennych	At Ddiwedd y Swyddfa
Cyfanswm	

List the numbers of the questions you have attempted	Office Use
A1	4
A2	3
A3	3
A4	0
A5	0
A6	1
A7	3
A8	0
A9	3
A10	4
B2	18
B3	9
Total	48%

1	Student Number	16028311
2	Title of Examination Paper	Electronic 2
3	Module Code	P5DE5006
4	Date and Time of Examination	15/05/2018 9:30 - 11:30
5	Examination Venue	G25
6	Seat Number	
7	Number of Answer Books handed in	

(Gweler yr ochr arall am y fersiwn Cymraeg)

Llyfr Atebion Arholiadau

12 Tudalen

Cyfarwyddiadau i Ymgaiswyr

- Rhowch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
- Rhowch eich enw yn y lle a ddarparwyd ar y dde, plygwch ef a'i selio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.
- Rhaid i'r atebion fod mewn llawysgrifen ddarlennadwy. Gall yr Arholiwr naill ai anwybyddu sgrifft annarlennadwy, neu drefnu iddi gael ei threipio a chael yr ymgaisydd i dalu.
- Ysgrifennwch eich atebion mewn inc.
- Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.
- Ni ddylid rhwngo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.
- Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyliwr/gwyliwyr.
- 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.

Llenwch, plygwch a seliwrch
(gweler nodyn 2 isod)

CYFENW:

ENW(AU) CYNTAF:

Part A

Question No.

A1

$$a) \text{ voltage gain of } 150 = 20 \log(150) = 57.5 \text{ dB} \checkmark$$

$$b) \text{ Power gain of } 2000 = 10 \log(2000) = 33.01 \text{ dB} \checkmark$$

A2

$$P_{in} = 40 \div \text{antilog}(50/10) = 4 \times 10^{-4} \text{ W} \checkmark$$

A3

$$A_{vf} = \frac{A_v}{1 + A_{vav}} = \frac{1000}{1 + 1000 \times 0.99} = 0.02 \checkmark$$

A4

contains 2 inductors in series with a capacitor

$$f = \frac{1}{2\pi\sqrt{LC}}$$

A5

A6

$$f = \frac{1}{2\pi\sqrt{LC}}$$

Rearrange to find C

$$C = \frac{1}{L(2\pi f)^2}$$

$$C = \frac{1}{1.5 \times 10^{-6} (2\pi \times 200 \times 10^3)^2} = 5.3 \mu\text{F}$$

Achieving uniting

Final Question

A7

$$Q = f \div B_w$$

$$Q = 5 \times 10^9 \div 75 \times 10^3$$

$$Q = 66666.6 \quad \text{or } 66666.67 \quad \checkmark$$

2/3

A8

$$a_1 = 1.3617 \quad b_1 = 0.6180$$

$$C_2 > \frac{C_1 \times 4b}{a^2}$$

$$C_2 > \frac{1 \times 10^{-9} \times 2.472}{1.854}$$

$$C_2 > 1.3 \text{ nF}$$

QUESTION 13
HIGH PASS, ANSWER
IS LOW PASS

$$R_1, R_2 = \frac{a_1^2 C_2^2 + 4b_1 C_1 C_2}{4\pi L C_1 C_2}$$

$$R_1, R_2 = \frac{1.3617^2 \times 1.3 \times 10^{-9} + \sqrt{1.3617^2 \times 1.3 \times 10^{-9} - 4 \times 0.618 \times 1 \times 10^{-9} \times 1.3 \times 10^{-9}}}{4\pi \times 120 \times 10^3 \times 1 \times 10^{-9} \times 1.3 \times 10^{-9}}$$

$$+ = 15.8 \text{ k}\Omega$$

$$- = 5.9 \text{ k}\Omega$$

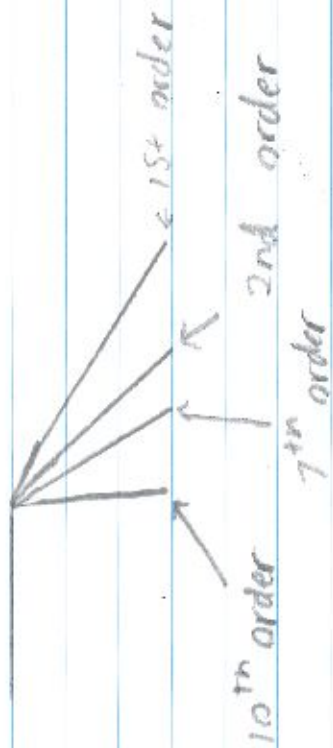
$$R_1 = 15.8 \text{ k}\Omega$$

$$R_2 = 5.9 \text{ k}\Omega$$

2/3

A9

roll off = 20 dB/decade ✓



Has a ~~smooth~~ smooth pass characteristic before cut off making it useful for high accuracy circuits

3

A10

i) inputs = A, B, C and D ✓

outputs = Y ✓

ii)



iii)

This is an and gate all inputs must be high for an output to be active. Truth table located on other side of page.

4

In				Out
A	B	C	D	Y
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

Part B question B2

- a) The fifth order filter will be created with the first stage being a first order and the second and third stage being a second order.

Stage 1:

$$R1 = \frac{1}{2\pi f_c C_1} = \frac{5.6334}{2\pi \times 50 \times 10^3 \times 10^{-12}}$$

$$R1 = 54.3 \text{ k}\Omega$$

4

Stage 2:

$$C2 > \frac{C1 \times 4b2}{a2} = \frac{330 \times 10^{-12} \times 10.612}{0.581}$$

$$C2 > 6.1 \text{ nF}$$

$$R1, R2 = \frac{a2 C2 \pm \sqrt{a2^2 C2^2 - 4b2 C1 C2}}{4\pi f_c C1 C2}$$

$$R1, R2 = \frac{0.581 \times 6.1 \times 10^{-9} \pm \sqrt{(0.581 \times 6.1 \times 10^{-9})^2 - 4(2.653)(330 \times 10^{-12})(6.1 \times 10^{-9})}}{4\pi \times 50 \times 10^3 \times (330 \times 10^{-12})(6.1 \times 10^{-9})}$$

$$R1 = 4291 \Omega = 4.3 \text{ k}\Omega$$

$$R2 = 3058 \Omega = 3 \text{ k}\Omega$$

Stage 3:

$$C2 > \frac{C1 \times 4b3}{a3^2} = \frac{330 \times 10^{-12} \times 4.274}{0.0137}$$

$$C2 > 10.3 \mu\text{F}$$

$$R1, R2 = \frac{a3 C2 \pm \sqrt{a3^2 C2^2 - 4b3 C1 C2}}{4\pi f_c C1 C2}$$

$$R1, R2 = \frac{0.0137 \times 10.3 \times 10^{-6} \pm \sqrt{(0.0137 \times 10.3 \times 10^{-6})^2 - 4(1.0686)(330 \times 10^{-12})(10.3 \times 10^{-6})}}{4\pi \times 50 \times 10^3 \times (330 \times 10^{-12})(10.3 \times 10^{-6})}$$

$$R1 = 1126 \Omega \text{ or } 1.1 \text{ k}\Omega$$

$$R2 = 3.566 \Omega \text{ or } 4 \Omega$$

18

b)

$$f = \frac{1}{2\pi RC}$$

re arrange to find C

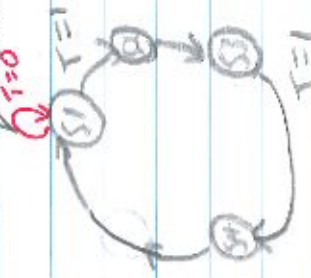
$$C = \frac{1}{L(2\pi f)}$$

$$C = \frac{1}{3 \times 10^{-3} (2\pi \times 2.2 \times 10^4)} = 241 \mu F$$

$$C_2 = C_1 \times 5 = 241 \times 10^{-6} \times 5 = 1.2 \text{ mF}$$

$$C_1 = \frac{C_2}{4} = 30 \text{ mF}$$

Part B question B3



S1 = Red light waiting for trigger
 S2 = Red/Amber lights
 S3 = Green light waiting for trigger
 S4 = Amber light, then back to S1

4

Current Step		Next step		Trigger		Out	
QA	QB	QA ⁺	QB ⁺	T=0	T=1	R	A G
0	0	0	1	0	1	1	0 0
0	1	1	0	1	1	1	1 0
1	0	1	1	0	1	0	0 1
1	1	0	0	1	1	0	1 0



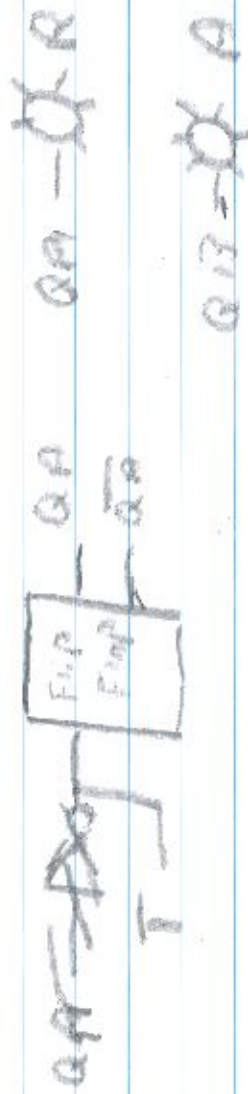
$$R = \overline{QA}$$

$$A = QB$$



* other simplified expressions on other page

$$G = QA \overline{QB}$$



5

* QA/QB

0	0	1	1
1	1	0	0

$$QA^+ = \overline{QA} \oplus QB$$

QA/QB

0	0	1	1
1	1	0	0

$$QB^+ = \overline{QA} \oplus QB$$

b)

- i) 0 and CLK are inputs, ✓
Q and Qneg are outputs ✓

ii)



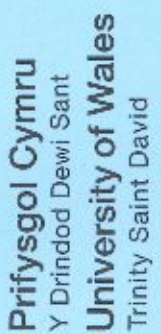
iii)

If the clock is increasing and $D=1$ then Q is either 1 or 0 and $Qneg=0$ then $Q=0$ but if $Qneg=1$ then nothing happens

D	CLK	Q	Qneg
0	0	0	0
0	1	0	x
1	0	0	0
1	1	x	0

4

x



**Complete, fold and seal
(see note 2 below)**

SURNAME: Lnca

FORENAME(S): Daniel

Examination Answer Books

12 Pages

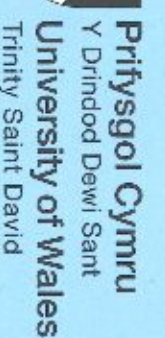
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A1	4
A2	3
A3	2
A4	3
A5	0
A6	3
A7	3
A8	6
A9	5
A10	0
B2	25
B3	20
Total	74%

1	Student Number	1602836/1
2	Title of Examination Paper	Electronics II
3	Module Code	PDES006
4	Date and Time of Examination	15/5/18 9:30
5	Examination Venue	G25
6	Seat Number	
7	Number of Answer Books handed in	

(Gweler yr ochr arall am y fersiwn Cymraeg)



Llyfr Atebion Arholiadau

12 Tudalen

Cyfarwyddiadau i Ymgeiswyr

1. Rhowch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
2. Rhowch eich enw yn y lle a ddarparwyd ar y dde, plygwch ef at sello i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.
3. Rhaid i'r atebion fod mewn llawysgrifen ddarlennadwy. Gall yr Arholwyr naill ai anwybyddu sgrïpt annarlennadwy, neu drefnu iddi gael ei theipio a chael yr ymgaisydd i dalu.
4. Ysgrifennwch eich atebion mewn inc.
5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fräs nodiadau yn y llyfr atebion a thynnwch llinell drwyddynt.
6. Ni ddylid rhwgo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.
7. Os defnyddir mwy nag un llyfr, rhwygennwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwylwyr/gwylwyr.
8. Rhaid dychwelyd pob llyfr. Ni chaniateir mynd a llyfrau atebion, wedi eu defnyddio neu heb eu defnyddio, allan o'r lleoliad arholi o dan unrhyw amgylchiadau.

**Llenwch, plygwch a seliwch
(gweler nodyn 2 isod)**

CYFENW:

ENW(AU) CYNTAF:

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5	Lleoliad yr Arholiad	
6	Rhif Sedd	
7	Nifer y Llyfrau Atebion a gyflwynwyd	

[illegible]

(See the other side for English version)

PART A

A1.

$$a, 20 \log(750) = 57.5 \text{ dB}$$

b,

$$10 \log(2000) = 33.01 \text{ dB}$$

A2.

40W output. 8Ω speaker. Power gain 50dB.

$$P_{in} = \frac{P_{out}}{\text{gain}} \quad \text{so } \text{antilog}\left(\frac{50}{10}\right) = 100000$$

$$P_{in} = \frac{40}{100000} = 400 \mu\text{W}$$

A3.

gain = 1000 negV gain = 50 feedback fraction = ?

$$A_{vf} = \frac{A_v}{1 + A_v M_v} \rightarrow \frac{A_v + \Delta v_f}{A_v A_{vf}} = M_v$$

$$50 = \frac{1000}{1 + 1000 \times M_v} \rightarrow \frac{1000 + 50}{1000 \times 50} = 0.021$$

$$M_v = 0.021$$

A4.

Colpitts Oscillator.

CIRCUIT - PARALLEL SERIES

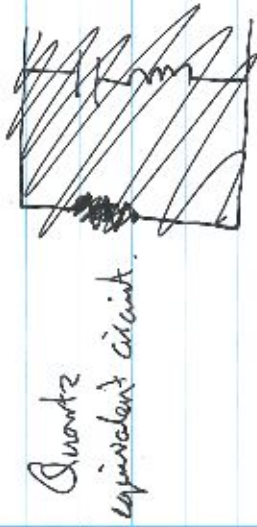
Consists of two capacitors in parallel and an inductor in series. Capacitors are changed when circuit is switched on and discharge through the coil. The two capacitors are tapped off in between in a voltage divider.

The voltage across C_1 is the voltage output.

The voltage across C_2 is the feedback voltage. Those two voltages are 180° out of phase.

The transistor causes the other 180° phase shift to make the oscillations created by the LC circuit phase shift neutralized.

A5.



equivalent circuit.

Acts similar to an LC circuit as the electrical voltage produced by the crystal causes oscillations.

A6.

~~Find the capacitance~~ Find the capacitance, LC oscillator.

Inductance $\rightarrow L = 1.5 \mu\text{H}$ $f = 200 \text{ MHz}$

$$\text{Use } f = \frac{1}{2\pi\sqrt{LC}} \quad \text{rearrange} \quad C = \frac{1}{(2\pi f)^2 L}$$

$$\rightarrow \frac{1}{(2\pi \times 200 \times 10^6)^2 \times 1.5 \times 10^{-6}} = 0.422 \times 10^{-12} \text{ F}$$

$$C = 0.422 \text{ pF}$$

A7.

Tuned Amplifier. $f = 5 \text{ MHz}$ $\text{BW} = 75 \text{ kHz}$

Find Q factor.. $\text{BW} = \frac{f_0}{Q}$

so... $\rightarrow Q = \frac{f_0}{\text{BW}}$

$$Q = \frac{5 \times 10^6}{75 \times 10^3} = 66.6$$

A8.

2nd Order High-pass 3dB filter. cut-off freq of 120 kHz. Cap of 100 pF is available.

Use: $R_1 = \frac{1}{\pi f_c C \times a_2}$ and $R_2 = \frac{a_2}{4\pi f_c C \times b_2}$

So.. $R_1 = \frac{1}{\pi \times 120 \times 10^3 \times 1 \times 10^{-9} \times 1.3617} = 1947.99 \Omega$

$$R_2 = \frac{1.3617}{4 \times \pi \times 120 \times 10^3 \times 1 \times 10^{-9} \times 0.6180} = 1461.17 \Omega$$

A9.

Butterworth.

Best passband linearity across whole range. No ripples like Chebyshev.

Roll off rate is 20dB per decade. (per order)

Useful for applications that require precise signals across the whole range.



1st order = 20dB/decade

2nd order = 40dB/decade

3rd order = 60dB/decade

Bode Plot

A10. VHDL

...

Question B2

B2a.

Design 5th order Butterworth low pass filter. $f_c = 50 \text{ kHz}$. 330pF cap.

Stage 1. Use: $R_1 = \frac{a}{2\pi f_c C_1}$

$$R_1 = \frac{5.6334}{2\pi \times 50 \times 10^3 \times 330 \times 10^{-12}} = 54338.39 \Omega$$

Stage 2.

Use: $C_2 > \frac{C_1 \times 46}{R_1^2} \rightarrow \frac{330 \times 10^{-12} \times 4 \times 2.653}{0.762^2} \rightarrow C_2 > 6.03 \mu\text{F}$

Take C_2 as $6.1 \mu\text{F}$

Using general formula.

$$R_1 = \frac{0.762 \times 6.1 \times 10^{-9} \pm \sqrt{(0.762^2 \times (6.1 \times 10^{-9})^2 - 4 \times 2.653 \times 330 \times 10^{-12} \times 6.1 \times 10^{-9}}}{4 \times \pi \times 50 \times 10^3 \times 330 \times 10^{-12} \times 6.1 \times 10^{-9}}$$

$$R_2 = 4065.42 \Omega \quad (\text{pos outcome})$$

$$R_3 = 3284.64 \Omega \quad (\text{neg outcome})$$

Stage 3. Using $C_2 > \frac{C_1 \times 46}{\alpha^2}$ $C > \frac{330 \times 10^{-12} \times 4 \times 1.0686}{0.1172^2}$

$C > 102.69 \text{ nF}$ ($102.64 \times 10^{-9} \text{ F}$)

Take C as 103 nF .

Using general formula.

$$R = \frac{0.1172 \times 103 \times 10^{-9} \pm \sqrt{(0.1172)^2 \times (103 \times 10^{-9})^2 - 4 \times 1.0686 \times 330 \times 10^{-12} \times 103 \times 10^{-9}}}{4 \times 11 \times 50 \times 10^3 \times 330 \times 10^{-12} \times 103 \times 10^{-9}}$$

$R_4 = 596.183 \Omega$ (Pos)

$R_5 = 534.299 \Omega$ (neg)

Therefore overall:

Stage 1. $C_1 = 330 \times 10^{-12} \text{ F}$ $R_1 = 54338.39 \Omega$

Stage 2. $C_2 = 6.1 \times 10^{-9} \text{ F}$ $R_2 = 1065.42 \Omega$
 $C_3 = 6.1 \times 10^{-9} \text{ F}$ $R_3 = 3284.64 \Omega$

Stage 3. $C_3 = 103 \times 10^{-9} \text{ F}$ $R_4 = 596.183 \Omega$
 $R_5 = 534.299 \Omega$

5th order.

b, Colpitts capacitor calc. 3rd inductor available. $f = 2.2 \text{ MHz}$ $M_V = 0.2$

Use $M_V = \frac{C_1}{C_2} \rightarrow 0.2 = \frac{C_1}{C_2}$ So, $C_1 = 0.2 C_2$ ✓
 Therefore, $C_2 = 5 C_1$

Using: $\frac{1}{2\pi f \sqrt{LC}} \xrightarrow{\text{Rearrange}} C = \frac{1}{(2\pi f)^2 L} \rightarrow \frac{1}{(2 \times \pi \times 2.2 \times 10^6)^2 \times 3 \times 10^{-3}}$

$C_T = 1.7445 \times 10^{-12}$ ✓
 As capacitors are in parallel: $C_T = \frac{C_1 + C_2}{C_1 \times C_2}$ Rearrange.

$C_2 = \frac{C_1}{1 + C_1 C_T} \xrightarrow{\text{Sub}} \frac{0.2 C_2}{1 + 0.2 C_2 \times C_T}$

$C_2 = \frac{1.7445 \times 10^{-12}}{1 + 0.2} = 1.454 \times 10^{-12} \text{ F}$

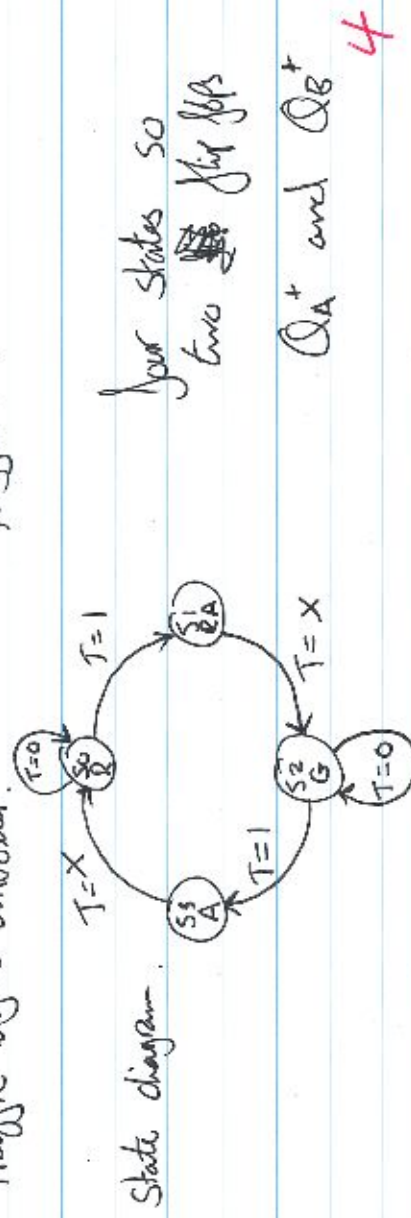
As $C_1 = 0.2 C_2$

$C_1 = 0.2 \times 1.454 \times 10^{-12}$

$C_1 = 0.291 \times 10^{-12} \text{ F}$

Question B3 - FSM

B3 a. Traffic light Controller. Trigger = T



State table

Current	Next T=0 T=1	Next T=0 T=1		Output	
		Q_A^+	Q_B^+	R	A G
S_0	S_1	0	0	1	0 0
S_1	S_2	1	0	1	1 0
S_2	S_3	1	1	0	0 1
S_3	S_0	0	0	0	1 0

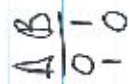
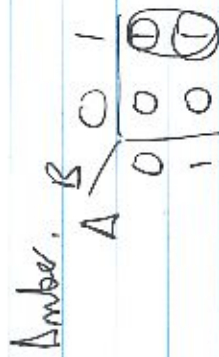
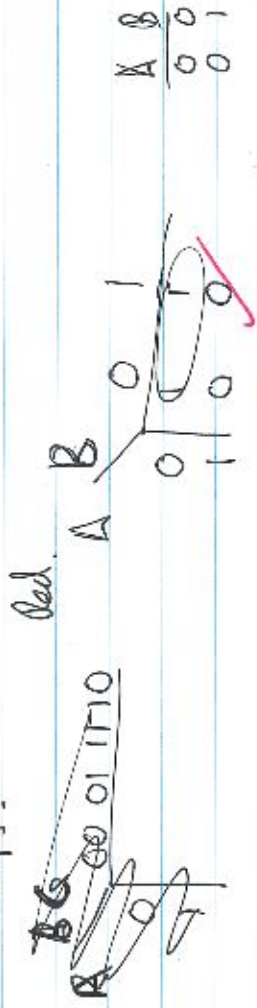
Karnaugh Maps

Q_A^+	Q_B^+	A	B	T	Q_B^+	A	B	T
0	0	0	0	0	0	0	0	0
0	0	0	0	1	0	0	0	0
0	1	0	0	0	1	0	0	0
0	1	0	0	1	1	0	0	0
1	0	0	1	0	0	1	0	0
1	0	0	1	1	0	1	0	0
1	1	0	1	0	1	1	0	0
1	1	0	1	1	1	1	0	0

$Q_A^+ = T B + T \bar{A} B + T \bar{A} \bar{B}$

$Q_B^+ = T \bar{B}$ ✓

Output K-Maps.



Outputs:

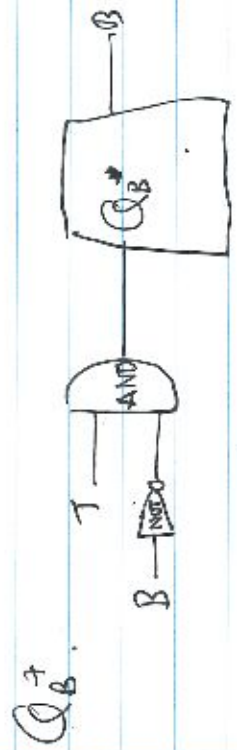
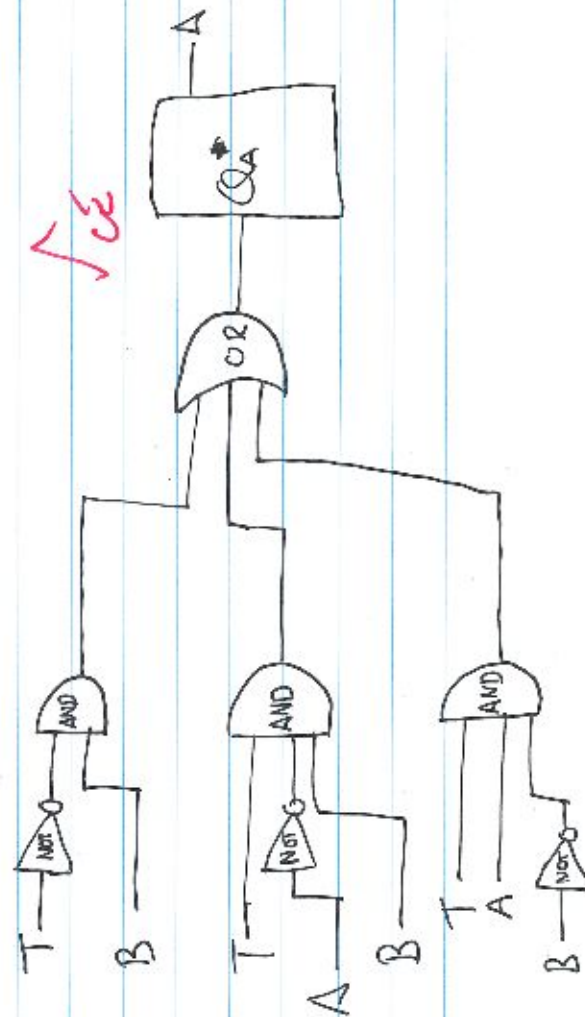
Red = $\bar{A}$ ✓
 Amber = $\bar{A}B + A\bar{B}$ ✓
 Green = $A\bar{B}$ ✓

Flip flops:

$Q_A^+ = \bar{T}B + \bar{A}B + T\bar{A}B$

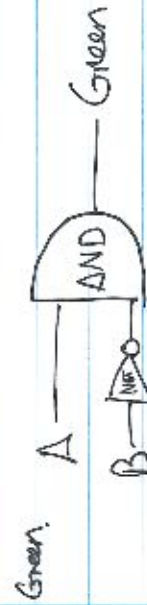
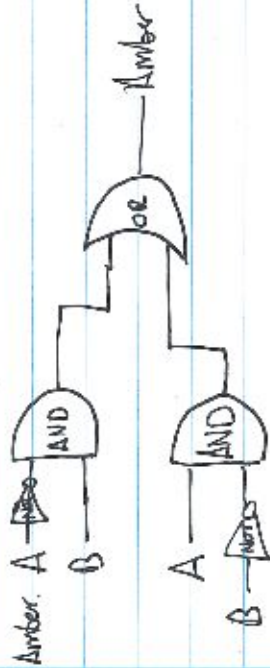
$Q_B^+ = T\bar{B}$

Q_A^+



Outputs

Red. A → Not → Red



Q3
b. VHDL