



SURNAME: BEDNER

FORENAME(S): ADAM KRZYSZTOF

12 Pages

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1	Student Number	1708165
2	Title of Examination Paper	ELECTRONICS <u>II</u>
3	Module Code	SGEE5000
4	Date and Time of Examination	14/05/2019 9:30
5	Examination Venue	C27
6	Seat Number	24
7	Number of Answer Books handed in	1 of 2

List the numbers of the questions you have attempted	Office Use
~~54~~ A	29
A 2	
A 3	
A 4	
A 5	
A 8	
~~B1-B1~~	29 $\frac{1}{2}$
B1- ~~B2~~	30
B1-c	
B1-d	
B1-e	
B1-f	
Total	88 $\frac{1}{2}$

88 1/2 %

7	Nifer y Llyfrau Atebion a gyllwynwyd
---	---

1	Rhif Myfyriwr	
2	Tell 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	

Rhestrwch niau'r ymgestynau a gennych	
At Ddibenion y Swyddfa	Cyfeirnod

1. Rhaid i'r atebion fod mewn llawysgriften ddarlennadwy. Gall yr Arholwyr naill ai anwybyddu sgrïpt annarllennadwy, neu drefnu iddi gael ei theipio a chael yr ymgaisydd i dalu.
2. Ysgrifennwch eich atebion mewn inc.
3. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.
4. Ni ddylid rhwygo unrhyw ran o'r llyfr. Hwn; rhaid ei gyflwyno yn gyfan.
5. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyllwr/gwyfwr.
6. 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. Rhwch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
2. Rhwch eich enw yn y lle a ddarparwyd ar y dde, plynwch et all iello i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.

Cyfarwyddiadau i Ymgeiswyr

12 Tudalen

Llyfr Atebion Arholiadau



Prifysgol Cymru
University of Wales
Trinity Saint David

Llenwch, plygwh a seliwh
(gweler nodyn 2 isod)

CYFENN:

ENW(AU) CYNTAF:

A1

Stage 1 gain = 150

$$\text{Gain (dB)} = 20 \log 150 = \underline{43.5 \text{ dB}}$$

Stage 2 gain = 200

$$\text{Gain (dB)} = 20 \log 200 = \underline{46 \text{ dB}}$$

Stage 3 gain = 125

$$\text{Gain (dB)} = 20 \log 125 = \underline{41.9 \text{ dB}}$$

Total voltage gain of the amplifier in dB

$$\text{Total gain (dB)} = \text{Stage 1 Gain (dB)} + \text{Stage 2 (dB)} + \text{Stage 3 Gain (dB)}.$$

$$\text{Total gain (dB)} = 43.5 + 46 + 41.9 = \underline{131.4 \text{ dB}}$$

(4)

PART A

PART A

A 2.

$$P_{out} = 150 \text{ W} \quad R_{load} = 8 \Omega$$

$$i) \text{ Power Gain} = 10^{(45/10)} = 31,622.77$$

$$P_{out} = P_{in} \times \text{Gain} \rightarrow P_{in} = \frac{P_{out}}{\text{Gain}}$$

$$P_{in} = \frac{150}{31,622.77} = 4.74 \times 10^{-3} \text{ W} = 4.74 \text{ mW}$$

$$P_{in} = 4.74 \text{ mW} \quad \checkmark$$

$$ii) \text{ Voltage gain} = 10^{(30/20)} = 31.62$$

$$V_{out} = I_{out} \times R_{load}$$

$$P_{out} = \frac{(V_{out})^2}{R_{load}} \rightarrow V_{out} = \sqrt{P_{out} \times R_{load}}$$

$$\therefore V_{out} = \sqrt{150 \times 8} = 20\sqrt{3} \text{ V}$$

$$20\sqrt{3} \text{ V} = 34.64 \text{ V}$$

$$V_{out} = V_{in} \times \text{Gain} \rightarrow V_{in} = \frac{V_{out}}{\text{Gain}}$$

$$V_{in} = \frac{34.64 \text{ V}}{31.62} = 1.09 \text{ V} \quad \checkmark$$

(6)

A 3

$$\text{Stage 1 } X_{L_{out}} = 20 \text{ k}\Omega$$

$$\text{Stage 2 } X_{L_{in}} = 1.5 \text{ k}\Omega$$

$$f = 600 \text{ Hz}$$

$$X_L = 2\pi f L$$

$$L = \frac{X_L}{2\pi f}$$

Primary of the transformer (connected to out of stage 1)

$$L = \frac{20,000}{2\pi \times 600} = 5.3 \text{ H} \quad \checkmark$$

Secondary of the transformer (connected to in of stage 2)

$$L = \frac{1,500}{2\pi \times 600} = 397.9 \text{ mH} \quad \checkmark$$

(5)

A 4. ① Circuit's Stability

The ~~circuit~~ negative feedback, in most cases, is built using a potential divider (Resistor network). And that being built with resistor, it ~~stays~~ is not affected by ambient temperature changes, frequency or transistor's properties (as long as the gain of the transistor is higher than the gain of the circuit).

② Lower non-linear Distortions.

In large signal amplifiers, the gain can vary at different points of the cycle creating non-linear distortions. When negative feedback is applied, the gain becomes more stable by a factor of $1 + A_v m_v$. That is proven by:

$$D_{vf} = \frac{D_v}{1 + A_v m_v}$$

where: $D_v \rightarrow$ ^{non-linear} Distortion of amp without negative feedback

$D_{vf} \rightarrow$ Distortion of amp with negative feedback.

③ Improved Bandwidth.

As explained in ①, the negative feedback is usually achieved with a potential divider. That being a resistor network, is not affected by the frequency, which allows for wider bandwidth without affecting the circuit's gain.

✓ ⑥

A6

$$L_1 = 5 \mu H$$

$$f = 20 MHz$$

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

$$f(2\pi\sqrt{LC}) = 1$$

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

$$\sqrt{LC} = \frac{1}{f2\pi}$$

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

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

$$\therefore C = \frac{1}{(2\pi \times 20 \times 10^6)^2 \times 5 \times 10^{-6}} = 12.6 \times 10^{-12}$$

$$C = 12.6 pF$$

A6

A7

④

⑤

⑥

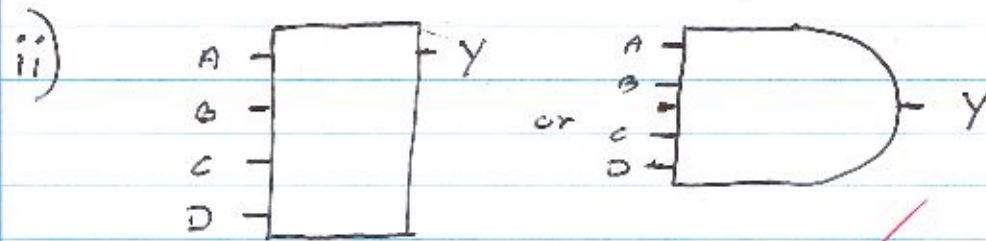
A 8

i) Inputs for Gate 1 are:

- A
- B
- C
- D

Outputs for Gate 1 are:

- Y



iii)

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

a) $R_{LOAD} = 2k\Omega$ $V_{gain(dB)} = 75dB$
 $V_{in} = 1.2mV$

i) $V_{out} = V_{in} \times \text{Gain}$

$$V_{gain} = 10^{(75/20)} = 5623.41$$

$$V_{out} = 1.2 \times 10^{-3} \times 5623.41 = 6.75V$$

ii) $P_{out} = \frac{(V_{out})^2}{R_{LOAD}}$

$$P_{out} = \frac{6.75^2}{2,000} = 0.02278W$$

$$P_{out} = 22.78mW$$

(4)

(4)

b)

$$V_{CC} = 15V$$

$$R_{1+2} = 122k\Omega$$

$$I_{R_{1+2}} = \frac{V_{CC}}{R_{1+2}} \rightarrow I_{R_{1+2}} = \frac{15}{122,000} = 122.95 \mu A$$

~~Base~~

$$V_{B_1} = V_{R_2} = I_{R_{1+2}} \times R_2 \rightarrow V_{R_2} = 122.95 \times 10^{-6} \times 22,000 = 2.7049V$$

$$V_{E_1} = V_{B_1} - 0.7V = 2.7049V - 0.7V = 2.0049V$$

$$I_{E_1} = I_{C_1} = \frac{V_{E_1}}{R_4} \rightarrow I_{E_1} = \frac{2.0049}{4,700} = 426.57 \mu A$$

$$V_{C_1} = V_{CC} - V_{R_3} = V_{CC} - R_3 \times I_{R_3} \rightarrow$$

$$\rightarrow V_{C_1} = 15 - 22,000 \times 426.57 \times 10^{-6} = 15 - 9.3845 = 5.6154V$$

$$V_{C_1} = V_{B_2} = 5.6154V$$

$$V_{E_2} = V_{B_2} - 0.7V \rightarrow V_{E_2} = 5.6154 - 0.7 = 4.9154V$$

$$I_{E_2} = I_{C_2} = I_{R_5} = \frac{V_{E_2}}{R_6} \rightarrow I_{E_2} = \frac{4.9154}{10,000} = 491.54 \mu A$$

$$V_{C_2} = V_{CC} - V_{R_5} = V_{CC} - I_{C_2} \times R_5 \rightarrow$$

$$\rightarrow V_{C_2} = 15 - 10,000 \times 491.54 \times 10^{-6} = 15 - 4.9154 = 10.0846V$$

Therefore: (Answers ↓)

$$V_{B_1} = 2.7049V ; V_{E_1} = 2.0049V ; V_{C_1} = 5.6154V$$

$$V_{B_2} = 5.6154V ; V_{E_2} = 4.9154V ; V_{C_2} = 10.0846V$$

11

c)

$$BW = \frac{f_0}{Q} \quad Q = 100 ; f_0 = 2MHz$$

$$BW = \frac{2,000,000}{100} = 20,000 Hz = 20kHz$$

$$\omega_{C_1} = f_0 + \frac{1}{2} BW = 2MHz + 20kHz = 2.02MHz$$

or
2,020 kHz

~~$$\omega_{C_2} = f_0 - \frac{1}{2} BW = 2MHz - 20kHz = 1.98MHz$$~~

$$\omega_{C_2} = f_0 - \frac{1}{2} BW = 2MHz - 20kHz = 1.98MHz$$

or
1,980 kHz

22

d) Gain w/o fb = 2,400 = A_v m_v = 0.02.

$$A_{vf} = \frac{A_v}{1 + A_v m_v}$$

$$\therefore A_{vf} = \frac{2,400}{1 + 2,400 \times 0.02} = 48.98.$$

The gain of the amplifier with the negative feed back is 48.98.

(3)

e) Selective Operating frequencies.

A Tuned amplifier can be designed with a very narrow bandwidth, amplifying only one specific frequency. Therefore, if a mix of frequencies is applied to the input, only the tuned frequency will be amplified and the rest of the frequencies will be ignored.

Lower V_{cc} supply required

The amp's collector circuit uses reactive component (Capacitors & Inductors) which has less resistance against the DC V_{cc} voltage. If these components were substituted by a high value Resistor, the V_{cc} voltage would have to be much higher to operate the circuit.

Higher efficiency.

As the amp amplifies only a specific frequency and has reactive components in its collector circuit, it is more efficient than a standard amp.

(6)

f)

$$C = 0.33 \mu F, \quad L = 47 \text{ mH.}$$

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

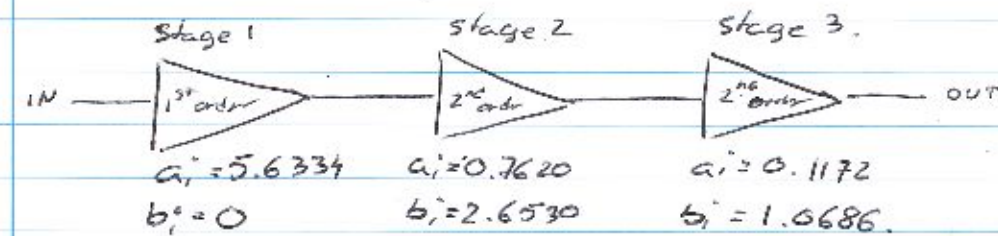
$$f = \frac{1}{2\pi\sqrt{0.33 \times 10^{-6} \times 47 \times 10^{-3}}} = 1277.95 \text{ Hz}$$

$$\text{or} \\ 1.28 \text{ kHz.} \checkmark$$

(3)

a) $C_1 = 220 \mu F$ $C = 5 nF$ & $70 nF$ available.
 $f_c = 100 kHz$

~~SEA~~ 5th order low pass filter. ~~Therefore~~ Therefore, there will be three stages.



STAGE 1 $R_1 = \frac{a_1}{2\pi f_c C_1}$
 $C_1 = 220 \mu F$
 $f_c = 100 kHz$
 $a_1 = 5.6334$

$$R_1 = \frac{5.6334}{2\pi \cdot 100 \times 10^3 \times 220 \times 10^{-6}} = 40,753.8 \Omega$$

$$R_1 = 40.75 k\Omega$$

4

PART B2

PART B2

a)

STAGE 2

continuation

$$C_1 = 220 \text{ pF}$$

$$f_c = 100 \text{ kHz}$$

$$a_i = 0.7620$$

$$b_i = 2.6530$$

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

$$C_2 > \frac{C_1 \times 4b_i}{a_i^2}$$

$$C_2 > 4.02 \text{ nF}$$

$$\therefore C_2 = 5 \text{ nF is ok.}$$

$$R_1, R_2 = \frac{0.7620 \times 5 \times 10^{-9} \pm \sqrt{0.7620^2 (5 \times 10^{-9})^2 - 4 \times 2.6530 \times 220 \times 10^{-12} \times 5 \times 10^{-9}}}{4\pi \times 100 \times 10^3 \times 220 \times 10^{-12} \times 5 \times 10^{-9}}$$

$$= \frac{3.81 \times 10^{-9} \pm \sqrt{1.45161 \times 10^{-17} - 1.16732 \times 10^{-17}}}{1.3823 \times 10^{-12}}$$

$$= \frac{3.81 \times 10^{-9} \pm 1.686 \times 10^{-9}}{1.3823 \times 10^{-12}}$$

$$R_2 = \frac{3.81 \times 10^{-9} + 1.686 \times 10^{-9}}{1.3823 \times 10^{-12}} = 3975.98 \Omega = 3.9 \text{ k}\Omega$$

$$R_1 = \frac{3.81 \times 10^{-9} - 1.686 \times 10^{-9}}{1.3823 \times 10^{-12}} = 1536.57 \Omega = 1.5 \text{ k}\Omega$$

$$R_1 = 1.5 \text{ k}\Omega \text{ and } R_2 = 3.9 \text{ k}\Omega$$

a)

STAGE 3

continuation

$$C_1 = 220 \text{ pF}$$

$$f_c = 100 \text{ kHz}$$

$$a_i = 0.1172$$

$$b_i = 1.0686$$

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

$$C_2 > \frac{C_1 \times 4b_i}{a_i^2}$$

$$C_2 > 68.46 \times 10^{-9}$$

$$\therefore C_2 = 70 \text{ nF is ok.}$$

$$R_1, R_2 = \frac{0.1172 \times 70 \times 10^{-9} \pm \sqrt{0.1172^2 (70 \times 10^{-9})^2 - 4 \times 1.0686 \times 220 \times 10^{-12} \times 70 \times 10^{-9}}}{4\pi \times 100 \times 10^3 \times 220 \times 10^{-12} \times 70 \times 10^{-9}}$$

$$= \frac{8.204 \times 10^{-9} \pm \sqrt{6.73 \times 10^{-17} - 6.582 \times 10^{-17}}}{1.935 \times 10^{-11}}$$

$$= \frac{8.204 \times 10^{-9} \pm 1.216 \times 10^{-9}}{1.935 \times 10^{-11}}$$

$$R_2 = \frac{8.204 \times 10^{-9} + 1.216 \times 10^{-9}}{1.935 \times 10^{-11}} = 486.82 \Omega$$

$$R_1 = \frac{8.204 \times 10^{-9} - 1.216 \times 10^{-9}}{1.935 \times 10^{-11}} = 361.137 \Omega$$

$$R_2 = 486.82 \Omega$$

$$R_1 = 361.137 \Omega$$

20

b) $f_0 = 30 \text{ MHz}$ $m_v = 0.25$ $L = 20 \mu\text{H}$

$$f = \frac{1}{2\pi\sqrt{LC_T}} \rightarrow C_T = \frac{1}{L(2\pi f)^2}$$

$$m_v = \frac{C_1}{C_2}$$

$$C_T = \frac{C_1 C_2}{C_1 + C_2} \quad \text{--- (i)}$$

$$0.25 = \frac{C_1}{C_2}$$

$$\therefore C_1 = 0.25 C_2 \quad \text{--- (ii)}$$

$$C_T = \frac{1}{20 \times 10^{-6} (2\pi \times 30 \times 10^6)^2} = 1.4 \times 10^{-12}$$

Substituting (ii) in (i)

$$1.4 \times 10^{-12} = \frac{0.25 C_2 \times C_2}{0.25 C_2 + C_2}$$

$$1.4 \times 10^{-12} = \frac{0.25 C_2^2}{1.25 C_2}$$

$$1.4 \times 10^{-12} = \frac{0.25}{1.25} C_2$$

$$C_2 = \frac{1.25}{0.25} \times 1.4 \times 10^{-12} = 7 \times 10^{-12}$$

$$C_2 = 7 \text{ pF} \quad \text{--- (iii)}$$

Substituting (iii) in (ii)

$$C_1 = 0.25 \times 7 \times 10^{-12}$$

$$C_1 = 1.75 \text{ pF}$$

$$C_2 = 7 \text{ pF} \quad \checkmark$$

$$C_1 = 1.75 \text{ pF} \quad \checkmark$$

⑦

c) $L_1 = 47 \mu\text{H}$; $C_1 = 300 \text{ pF}$

$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

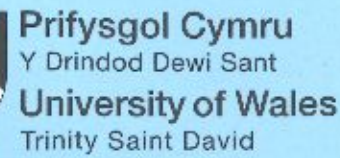
$$f_0 = \frac{1}{2\pi\sqrt{47 \times 10^{-6} \times 300 \times 10^{-12}}} = 1,340,326.41 \text{ Hz}$$

or
1.34 MHz.

$$f_0 = 1.34 \text{ MHz} \quad \checkmark$$

③

30



12 Pages

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2	Title of Examination Paper	ELECTRONICS II
3	Module Code	SGEE 5000
4	Date and Time of Examination	Tuesday 14 th May 9:30 → 12:00
5	Examination Venue	C27 Coleg Sir gar greig
6	Seat Number	
7	Number of Answer Books handed in	

(Gweler yr ochr arall am y fersiwn Cymraeg)

SURNAME: Wood

FORENAME(S): THOMAS OLIVER

List the numbers of the questions you have attempted	Office Use
A1	18
A2	
A3	
A4	
A5	
A6	
A8	
B1	23 $\frac{1}{2}$
B2	25
Total	16 $\frac{1}{2}$

66 1/2 %

(See the other side for English version)

1	Rhif Myfyriwr	
2	Tefl 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	

Rhestrwch rhai'r cwestiynau a ymgaiswyd gennydh	
At Ddiwedd y Swyddfa	

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2. Ysgrifennwch eich atebion mewn inc.
3. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.
4. Ni ddylid rhwgo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.
5. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyllwtr/gwylwyr.
6. 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. Rhwch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
2. Rhwch eich enw yn y lle a ddarparwyd ar y dde, plygwch et a'i selio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.

Cyfarwyddiadau i Ymgeiswyr

12 Tudalen

Llyfr Atebion Arholiadau



Prifysgol Cymru
y Brindod Dewi Sant
University of Wales
Trinity Saint David

Lienwch, plygwh a seliwch
(gweler nodyn 2 isod)

CYFENW:

ENW(AU) CYNTAF:

PART A

Question No.

Examiner Only

A1. $20 \log(150) = 43.5$
 $20 \log(200) = 46$
 $20 \log(125) = 41.9$

Therefore, total gain in db = $43.5 + 46 + 41.9$
 $= \underline{131.4 \text{ dB}}$

4

A2. $P = 150 \text{ m}$ $R = 8 \Omega$

(i) $P_{\text{in}} = P_{\text{out}} \times \text{Antilog} \left(\frac{45/10}{20/10} \right) = 150 \times \text{Antilog} \left(\frac{45/10}{20/10} \right) = \underline{4.74 \text{ MW}}$

(ii) $A_v = \text{Antilog} \left(\frac{30/10}{20/10} \right) = \underline{32}$

$V_{\text{out}} = \sqrt{P \times R} = \sqrt{150 \times 8} = 34.6$

$V_{\text{in}} = V_{\text{out}} / A_v = \frac{34.6}{32} = \underline{1.08 \text{ V}}$

6

A3. $Z_0 = 20 \text{ k}\Omega$ $Z_I = 1.5 \text{ k}\Omega$ $f = 600 \text{ Hz}$

$Z = 2\pi fL$

$L = \frac{Z}{2\pi f} = \frac{20}{2\pi \times 600} =$

Author's name

Examiner's name

A4.

• Steady gain

feedback allows for the gain to be regulated using less power making it more efficient.

• Stability

• NO heat loss

A5.

$$L_1 = 50\text{H} \quad F = 20\text{MHz}$$

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

$$C_1 = \frac{1}{L(2\pi f)^2} = \frac{1}{50\text{H} (2\pi \times 20\text{MHz})^2}$$

$$C_1 = 1.59\text{mf}$$

E

A6.

The Colpitts Oscillator works through the use of two capacitors (C_1 and C_2) and one inductor. The capacitors are centre tapped. When switched on the capacitors charge, when fully charged they discharge through the inductor which causes oscillations.

The capacitors themselves are 180° out of phase, this allows for steady oscillations to be created.

A8.

(i)

Inputs are A, B, C and D

Outputs are Y

(ii)



(ENTITY)

(iii)

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

It can be seen from the truth table that Gate 1 is an 4 input and gate. This is evident as the output only being triggered when every input was on.

PART B

Question No.

B1

a. $R = 2k$ $V_{in} = 750\mu V$ $V_{out} = 1.2mV$

i) $V_{in} \times \text{Antilog}(\frac{75}{20}) = 1.2mV \times \text{Antilog}(\frac{75}{20}) = 222\mu V$ $6.75V$

ii) $P = V^2 / R = \frac{6.75^2}{2000} = 3.38mW$

6. $V_{cc} = 15V$

$I_2 = V_{cc} / (R_1 + R_2) = 15 / (100k + 22k) = 123\mu A$

$V_2 = I_2 \times R_2 = 123\mu A \times 22k\Omega = 2.7V$

$V_E = 2.7 - 0.7 = 2V$

$I_4 = \frac{V_E}{R_4} = 425\mu A$

$V_3 = V_{cc} - I_4 \times R_3 = 15 - 425\mu A \times 22k\Omega$

$V_3 = 5.65V$

~~$V_E = 2.7 - 0.7 = 2V$~~

~~$I_4 = \frac{V_E}{R_4} = 425\mu A$~~

$V_{E2} = 5.65 - 0.7 = 4.95V$

$I_6 = \frac{V_{E2}}{R_6} = 495\mu A$

$V_5 = V_{cc} - I_6 \times R_5 = 15 - 495\mu A \times 10000\Omega$

$V_5 = 10.05V$

C. $Q = 100$ $F = 2MHz$

$BW = \frac{F}{Q} = \frac{2MHz}{100} = 20000Hz$

Lower Bandwidth = $f_0 - \frac{1}{2} BW = 2MHz - 10kHz$

Lower Bandwidth = $1.99MHz$

Higher Bandwidth = $f_0 + \frac{1}{2} BW = 2MHz + 10kHz$

Higher Bandwidth = $2.01MHz$

Examiner Only

4

11

3

Artiwl yn unig Rhif y Cwestiwn

Question No.

d.

$V_G = 2400$ $M_V = 0.02$

$A_{vf} = \frac{A_v}{1 + A_v M_V}$

$A_{vf} = \frac{2400}{1 + 2400 \times 0.02}$

$A_{vf} = 48.98$

e.

f. $C = 0.33\mu F$ $L = 47mH$

$f = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{47mH \times 0.33\mu F}}$

$f = 1340Hz$ 1280

Examiner Only

3

2

Artiwl yn unig Rhif y Cwestiwn

(B2)

a. 220pf ALL (5th 70nt → 2 and 3)
5th order low pass filter $f_c = 100 \text{ kHz}$

$$a_1 = 0.7620 \quad b_1 = 2.6530$$

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

$$R_1 = \frac{0.7620}{2 \times \pi \times 100 \text{ kHz} \times 220 \text{ pf}} = 5512 \Omega$$

2nd stage: $C_2 = 5 \text{ nf}$

$$R_{1,2} = \frac{a_1 \times C_2 \pm \sqrt{a_1^2 \times C_2^2 - 4b_1 \times C_1 \times C_2}}{4 \times \pi \times f_c \times C_1 \times C_2}$$

$$R_{1,2} = \frac{0.7620 \times 5 \text{ nf} \pm \sqrt{0.7620^2 \times 5 \text{ nf}^2 - 4 \times 2.6530 \times 220 \text{ pf} \times 5 \text{ nf}}}{4 \times \pi \times 100 \text{ kHz} \times 220 \text{ pf} \times 5 \text{ nf}}$$

$$R_1 = 3976 \Omega \quad \checkmark$$

$$R_2 = 1536 \Omega \quad \checkmark$$

3rd stage

$$C_2 = 70 \text{ nf}$$

$$R_{1,2} = \frac{0.762 \times 70 \text{ nf} \pm \sqrt{0.762^2 \times 70 \text{ nf}^2 - 4 \times 2.653 \times 220 \text{ pf} \times 70 \text{ nf}}}{4 \times \pi \times 100 \text{ kHz} \times 220 \text{ pf} \times 70 \text{ nf}} \quad \checkmark$$

$$R_1 = 5432 \Omega \quad +$$

$$R_2 = 80 \Omega \quad +$$

Correct method
wrong coefficients $\checkmark$

(17)

4th stage

$$C_2 > \frac{C_1 \times 46}{a_2^2} = \frac{220 \text{ pf} \times (4 \times 2.6530)}{0.7620^2}$$

$$C_2 = 4.02 \text{ nf}$$

$$R_1, R_2$$

$$C_2 = \frac{220 \text{ pf} \times (4 \times 2.6530)}{5.5339^2} = 628 \text{ nf}$$

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

$$R_2 = 6.4 \Omega$$

5th stage

$$C_2 > \frac{C_1 \times 46}{a_2^2} = \frac{220 \text{ pf} \times (4 \times 2.6530)}{0.7620^2} = 4.02 \text{ nf}$$

$$R_1 = 19 \text{ k}\Omega$$

$$R_2 = 114 \Omega$$

6. Colpitts $f_0 = 30 \text{ MHz}$ $M_V = 0.25$

$$M_V = \frac{C_1}{C_2}$$

$$M_V = 0.25 \therefore C_2 = 4C_1 \quad L = 20 \mu\text{H}$$

$$C_T = \frac{C_1 \times C_2}{C_1 + C_2}$$

$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

$$C_T = \frac{1}{L(2\pi f)^2} = \frac{1}{20 \mu\text{H} (2\pi \times 30 \text{ MHz})^2}$$

$$C_T = 1.4 \text{ pF}$$

$$C_T = \frac{C_1 C_2}{C_1 + C_2}$$

$$(C_2 = 4C_1)$$

$$C_T = \frac{C_2}{\frac{C_2}{C_1} + 1} = \frac{C_2}{4 + 1}$$

$$\therefore C_2 = 1.4 \text{ pF} \times 5 = 5.6 \text{ pF}$$

$$C_1 = \frac{5.6}{4} = 1.4 \text{ pF} \quad \checkmark \quad \checkmark$$

5

C. $L_1 = 47 \mu\text{H}$ $C_1 = 300 \text{ pF}$ find f_0

$$f = \frac{1}{2\pi\sqrt{LC}} = 1.34 \text{ MHz} \quad \checkmark \quad \checkmark$$

3

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.
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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	1503510
2	Title of Examination Paper	Electronics II
3	Module Code	SGEE5000
4	Date and Time of Examination	Tuesday 14 th May 9:30 → 12:00
5	Examination Venue	C27
6	Seat Number	
7	Number of Answer Books handed in	

(Gweler yr ochr arall am y fersiwn Cymraeg)

List the numbers of the questions you have attempted	Office Use
A1 <i>A</i>	<i>18</i>
A2 <i>81</i>	<i>19</i>
A3 <i>83</i>	<i>2081</i>
A5	
A8	
B1a	
B1b	
B1c	
B1d	
B1f	
B3.a	
B3.b	
Total	<i>1628</i>

Complete, fold and seal
(see note 2 below)

SURNAME: Devoy

FORENAME(S): Nicholas

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

(See the other side for English version)

- guddio'ch enw.
- Rhaid i'r atebion fod mewn llawysgriften ddarlennadwy. Gall yr Arholwyr naill ai anwybyddu sgrïpt annarllenadwy, neu drefnu iddi gael ei theipio 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 rhwgo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.
 - Os defnyddir mwy nag un llyfr, rhwyngwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyllyw/gwylwyr.
 - 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. Rhwch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
2. Rhwch eich enw yn y lle a ddarparwyd ar y dde, plygchw e'r a'i sello i lawr (gan ddefnyddio'r label a ddarparwyd)!

Cyfarwyddiadau i Ymgeiswyr

12 Tudalen

Llyfr Atebion Arholiadau



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

Llenwch, plygwch a seliwch
(gweir nodyn 2 isod)

CYFENN:

ENW(AU) CYNTAF:

A1.

$$\text{Gain stage 1} = 20 \log(150) = 43.5 \text{ dB}$$

$$\text{Gain stage 2} = 20 \log(200) = 46 \text{ dB}$$

$$\text{Gain stage 3} = 20 \log(125) = 41.9 \text{ dB}$$

$$\text{Total voltage gain} = 131.4 \text{ dB}$$

(4)

A2.

~~Power is lost in the load~~

$$P_{\text{out}} = \text{antilog}(45/10) = 150 \text{ W}$$

$$= 0.0047$$

$$= 4.7 \text{ mA}$$

$$A_v = \text{antilog}(30/20)$$

$$= 31.6$$

$$V_{\text{out}} = \sqrt{P \times R}$$

$$= 34.6 \text{ V}$$

$$V_{\text{in}} = V_{\text{out}} / A_v$$

$$= 34.6 / 31.6$$

$$= 1.09 \text{ V}$$

(6)

A3

$$\text{Primary} = Z_{\text{out}}$$

$$Z_{\text{out}} = 2 \pi f L_p$$

$$L_p = 20000 / (2 \pi \times 600)$$

$$= 5.3 \text{ H}$$

$$\text{Secondary} = Z_{\text{in}}$$

$$Z_{\text{in}} = 2 \pi f L_s$$

$$= 1500 / (2 \pi \times 600)$$

$$= 0.4 \text{ H}$$

(5)

A4.

Control

A8.

Inputs = A, B, C, D

output = Y



This device is a 4 input and 1 output AND gate

PART B

B1a.

$$\begin{aligned} \text{The output voltage} &= 1.2 \times \text{antilog}(75/20) \\ &= 1.2 \times 5623.41 \\ &= 6.75\text{V} \end{aligned}$$

$$\begin{aligned} \text{The load power} &= V_{\text{out}}^2 / R \\ &= 45.6 / 2\text{k} \\ &= 22.8\text{mW} \end{aligned}$$

B1b

First stage

$$\begin{aligned} I_{R1} &= V_{CC} / (R1 + R2) = 15 / (100\text{k} + 22\text{k}) = 123 \mu\text{A} \\ V_{B1} &= I_{R1} \times R2 = 2.7\text{V} \\ V_{E1} &= V_{B1} - 0.7 = 2\text{V} \\ I_{R4} &= V_{E1} / R4 = 425 \mu\text{A} \end{aligned}$$

$$\begin{aligned} \text{Assume } I_{R4} &= I_{C1}, \quad V_{CC} - (I_{C1} R3) \\ &= 15 - (9.35) \\ V_{C1} &= 5.65\text{V} \end{aligned}$$

Second stage

$$\begin{aligned} V_{B2} &= V_{C1} = 5.65\text{V} \\ V_{E2} &= V_{B2} - 0.7 = 4.95\text{V} \\ I_{R6} &= V_{E2} / R6 = 4.95 / 10 = 495 \mu\text{A} \end{aligned}$$

$$\begin{aligned} \text{Assume } I_{R6} &= I_{C2}, \quad V_{C2} = V_{CC} - (I_{C2} R5) \\ V_{C2} &= 15 - (4.95) \\ &= 10.05\text{V} \end{aligned}$$

B1c

$$B_W = \frac{f_c}{Q}$$

$$= \frac{2000000}{100}$$

$$= 20000\text{Hz}$$

$$\begin{aligned} \text{Low cut off} &= f - \frac{1}{2} B_W \\ &= 2000000 - 10000 \\ &= 990000 \\ &= 0.99\text{MHz} \end{aligned}$$

$$\begin{aligned}
 \text{High cut-off} &= f + \frac{1}{2} BW \\
 &= 2000000 + 10000 \\
 &= 2010000 \\
 &= \underline{2.01 \text{ MHz}} \quad \checkmark
 \end{aligned}$$

B1d.

$$A_{vf} = \frac{A_v}{1 + A_v m_v}$$

$$= \frac{2400}{1 + 2400 \times 0.02}$$

$$= \underline{49} \quad \checkmark$$

L8

B1e

- Consistent accurate gain
- Thermal
- Consistent accurate feedback

B1f

B1f

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

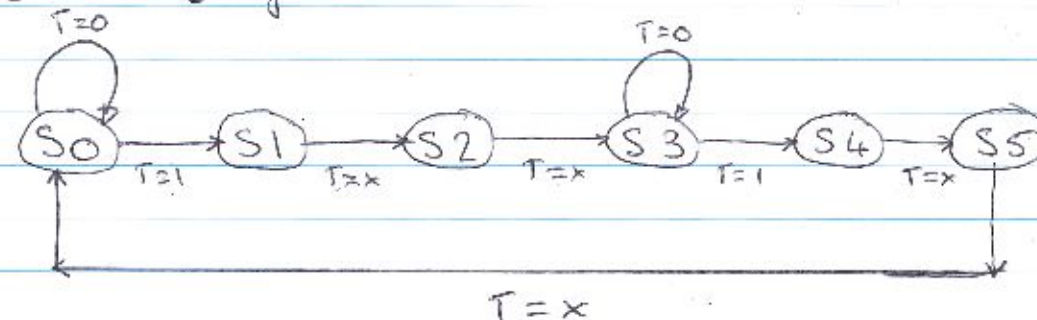
$$= \frac{1}{2\pi \sqrt{47 \times 0.33 \mu}}$$

$$= \underline{1.28 \text{ kHz}} \quad \checkmark$$

B3

$$S_0 = \text{Red}, S_1 = R/A, S_2 = R/A, S_3 = G, S_4 = A, S_5 = A \quad \checkmark$$

State diagram



Truth table.

Current	Next		Next						Outputs		
	T=0	T=1	T=0			T=1			R	A	G
S0	S0	S1	0	0	0	0	0	1	1	0	0
S1	S2	S2	0	1	0	0	1	0	1	1	0
S2	S4 ³	S3	0	1	1	0	1	1	1	1	0
S3	S4 ³	S4	0	1	1	1	0	0	0	0	1
S4	S5	S5	1	0	1	1	0	1	0	1	0
S5	S0	S0	0	0	0	0	0	0	0	1	0

Karnaugh maps

QA⁺

	B̄C̄	B̄C	BC	BC̄
TĀ	00	01	11	10
TĀ	00	0	0	0
TĀ	01	1	0	x
TĀ	11	0	x	x
TĀ	10	0	0	1

$$QA^+ = A\bar{C} + B\bar{C} \quad \checkmark$$

QB^+

	$\bar{B}\bar{C}$ 00	$\bar{B}C$ 01	BC 11	$B\bar{C}$ 10
$\bar{A}$ 0	0	1	1	1
A 1	0	0	x	x

$$QB^+ = \bar{B}\bar{C} + \bar{B}C + B\bar{C}$$

$$= \bar{B}\bar{C} + B\bar{C}$$

1 1/2

 QC^+

	$\bar{B}\bar{C}$ 00	$\bar{B}C$ 01	BC 11	$B\bar{C}$ 10
$\bar{A}$ 0	0	0	1	1
A 1	1	0	x	x

$$QC^+ = \bar{B}\bar{C} + \bar{A}B + A\bar{C}$$

1 1/2

Red

	$\bar{B}\bar{C}$ 00	$\bar{B}C$ 01	BC 11	$B\bar{C}$ 10
$\bar{A}$ 0	1	1	0	1
A 1	0	0	x	x

$$\text{Red} = \bar{B}\bar{C} + B\bar{C}$$

1

Amber

	$\bar{B}\bar{C}$ 00	$\bar{B}C$ 01	BC 11	$B\bar{C}$ 10
$\bar{A}$ 0	0	1	0	1
A 1	1	1	0	0

$$\text{Amber} = \bar{B}\bar{C} + \bar{A}B$$

0

Green

	$\bar{B}\bar{C}$ 00	$\bar{B}C$ 01	BC 11	$B\bar{C}$ 10
$\bar{A}$ 0	0	0	1	0
A 1	0	0	x	x

$$\text{Green} = BC$$

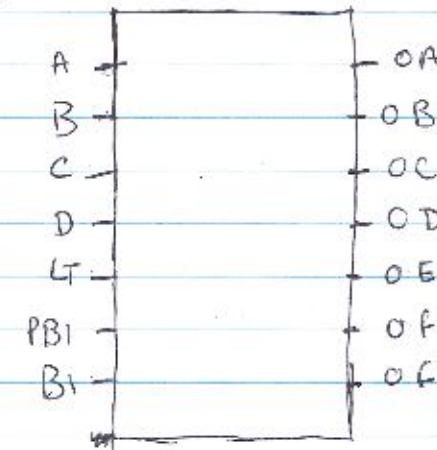
1

B3b

Inputs = A, B, C, D, LT, RBI, BI

Outputs = OA, OB, OC, OD, OE, OF, OF

Entity gate

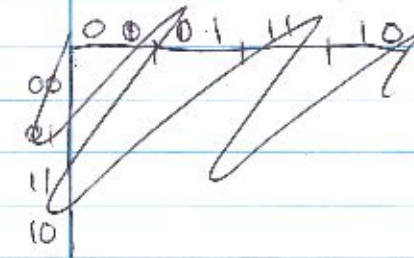


This device has 7 input and 7 outputs AND gate.

7 segment display
LT = lamp test.

5

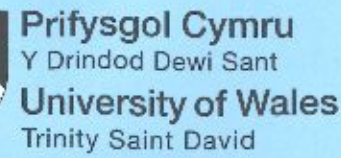
5



$$A5. f = \frac{1}{2\pi\sqrt{LC}}$$

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

$$= 1.59$$



SURNAME: MORGAN

FORENAME(S): JONATHAN

12 Pages

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1	Student Number	1708172
2	Title of Examination Paper	ELECTRONICS II
3	Module Code	SGEES000
4	Date and Time of Examination	9:30 → 12:00 TUES 14 th MAY
5	Examination Venue	C27
6	Seat Number	
7	Number of Answer Books handed in	

(Gweler yr ochr arall am y fersiwn Cymraeg)

[illegible] $38\frac{1}{2} \text{ g}$ 

Prifysgol Cymru
University of Wales
Trinity Saint David

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 a'i selio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.
3. Rhaid i'r atebion fod mewn llawysgriften ddarlledadwy. Gall yr Arhoga ei theipio a chael yr ymgaisydd i dalu.

www.audiochips.com

nydd i dalu.

4. Ysgyffwrdd eiddoedd aledion mewn inc.

5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw tras 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, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyllywtr/gwyllywr.

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 Mlytyrwr	
2	Teti 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	

(See the other side for English version)

[illegible]

Llenwch, plygwrch a seliwrch
(gweler nodyn 2 isod)

CYFENN:

ENW(AU) CYNTAF:

- A1. 1st Stage Voltage gain = 150
 2nd Stage Voltage gain = 200
 3rd Stage Voltage gain = 125

$$\begin{array}{ll} 1^{\text{st}} & 20 \log 150 = 43.5 \text{ dB} \\ 2^{\text{nd}} & 20 \log 200 = 46 \text{ dB} \\ 3^{\text{rd}} & 20 \log 125 = 42 \text{ dB} \end{array}$$

$$\text{Total voltage gain} = 43.5 + 46 + 42 = 131.5 \text{ dB} \checkmark$$

(4)

- A4. Consistency of Gain - negative feedback improves consistency

Improves frequency Response -

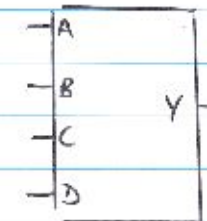
(3)

Improves thermal Stability -

- A8. Gate 1 Inputs = A
 B
 C
 D

$$\text{Gate 1 outputs} = Y \checkmark$$

Entity for gate 1 =



$$Y <= A \text{ and } B \text{ and } C \text{ and } D \checkmark$$

(4)

Bi

a. Resistive load 2k
Voltage gain 75dB.
Input Signal 1.2mV

~~Load~~ V Output voltage = $V_{out} = V_{in} \times \text{antilog}(75/20)$

$$V_{out} = 1.2 \text{ mV} \times 5623.4 = 6.75 \text{ V}$$

$$\text{Load Power} = \frac{V^2}{R} = \frac{67.5^2}{2000} = 2.28 \text{ W}$$

d. Voltage gain without feedback = 2400
Feedback fraction $m_v = 0.02$.

$$A_{vf} = \frac{A_v}{1 + A_v m_v}$$

$$A_{rf} = \frac{2400}{1 + (2400 \times 0.02)} = 48.98 \text{ V}$$

83.

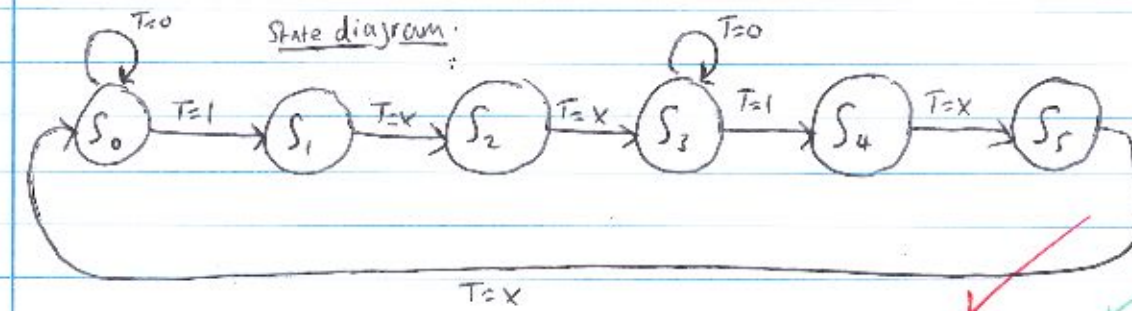
a Input = Trigger
Outputs = Red
Amber
Green

Sequence:

Red.
Red/Amber
Green
Amber
Red.

States :

- $S_0 = \text{Red}$
- $S_1 = \text{Red/Amber}$
- $S_2 = \text{Red/Amber}$
- $S_3 = \text{Green}$
- $S_4 = \text{Amber}$
- $S_5 = \text{Amber}$ ✓



State Table:

[illegible]

Karnaugh Maps.

QA^+

BC \ A	00	01	11	10
00	0	0	0	0
01	1	0	X	X
11	1	0	X	X
10	0	0	1	0

$\begin{array}{r} TABC \\ 0100 \\ 1100 \\ \hline A\bar{B}\bar{C} \end{array} \quad \begin{array}{r} TABC \\ 1111 \\ 1011 \\ \hline TBC \end{array}$

$QA^+ = A\bar{B}\bar{C} + TBC$

QB^+

BC \ A	00	01	11	10
00	0	1	1	1
01	0	0	X	X
11	0	0	X	X
10	0	1	0	1

$\begin{array}{r} TABC \\ 0001 \\ 1001 \\ \hline \bar{A}\bar{B}C \end{array} \quad \begin{array}{r} TABC \\ 0011 \\ 0010 \\ \hline \bar{A}\bar{B} \end{array} \quad \begin{array}{r} TABC \\ 0010 \\ 1010 \\ \hline \bar{A}BC \end{array}$

$QB^+ = \bar{A}\bar{B}C + \bar{A}\bar{B} + \bar{A}BC$

~~QC^+~~

BC \ A	00	01	11	10
00	0	0	1	1
01	1	0	X	X
11	0	1	X	X
10	1	0	0	1

~~$\begin{array}{r} TABC \\ 0011 \\ 0010 \\ \hline \bar{A}\bar{B}C \end{array} \quad \begin{array}{r} TABC \\ 1001 \\ 1010 \\ \hline T\bar{A}\bar{B} \end{array} \quad \begin{array}{r} TABC \\ 1101 \\ 1111 \\ \hline T\bar{A}C \end{array} \quad \begin{array}{r} TABC \\ 0101 \\ 0110 \\ \hline T\bar{A}C \end{array}$~~

QC^+

BC \ A	00	01	11	10
00	0	0	1	1
01	1	0	X	X
11	1	0	X	X
10	1	0	0	1

$\begin{array}{r} TABC \\ 0011 \\ 0010 \\ \hline \bar{A}\bar{B}C \end{array} \quad \begin{array}{r} TABC \\ 1100 \\ 1100 \\ \hline A\bar{B}\bar{C} \end{array} \quad \begin{array}{r} TABC \\ 1010 \\ 1000 \\ \hline T\bar{A}\bar{C} \end{array}$

$QC^+ = \bar{A}\bar{B}C + A\bar{B}\bar{C} + T\bar{A}\bar{C}$

RED

BC \ A	00	01	11	10
0	1	1	0	1
1	0	0	X	X

$\begin{array}{r} ABC \\ 001 \\ 001 \\ \hline \bar{A}\bar{B} \end{array} \quad \begin{array}{r} ABC \\ 010 \\ 110 \\ \hline \bar{B}C \end{array}$

Red = $\bar{A}\bar{B} + \bar{B}C$

Amber

BC \ A	00	01	11	10
0	0	1	0	1
1	1	1	X	X

$\begin{array}{r} ABC \\ 001 \\ 001 \\ \hline \bar{B}C \end{array} \quad \begin{array}{r} ABC \\ 010 \\ 110 \\ \hline \bar{B}C \end{array} \quad \begin{array}{r} ABC \\ 101 \\ 101 \\ 110 \\ 110 \\ \hline A \end{array}$

Amber = $A + \bar{B}C + \bar{B}C$

Green

BC \ A	00	01	11	10
0	0	0	1	0
1	0	0	X	X

$\begin{array}{r} ABC \\ 011 \\ 011 \\ \hline \bar{B}C \end{array}$

Green = $\bar{B}C$

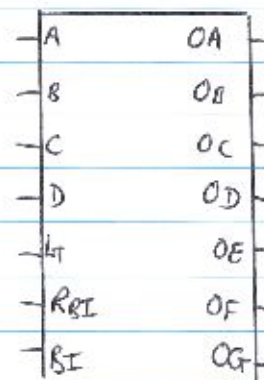
b. i Inputs for Gate 1 = A

Outputs for Gate 1 = OA

B
 C
 D
 LT
 RBI
 BI

OB
 OC
 OD
 OE
 OF
 OG

ii



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	1708182
2	Title of Examination Paper	SGEE 5000 ELECTRONICS
3	Module Code	
4	Date and Time of Examination	14/05/19 9:30 AM
5	Examination Venue	
6	Seat Number	
7	Number of Answer Books handed in	

(Gweler yr ochr arall am y fersiwn Cymraeg)

Complete, fold and seal
(see note 2 below)

SURNAME: THORNHILL

FORENAME(S): CALLUM

ANTHONY

List the numbers of the questions you have attempted	Office Use
QB3 a	
QB3 b i	
QB3 b ii	
QB2 b	
QB2 c	
QA5	
QA6	
QA7	
QA8 i	
QA8 ii	
QA8 iii	
B3	26
B2	7
A	11
Total	144

44%



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Trinity Saint David

Llyfr Atebion Arholiadau

Cyfarwyddiadau i Ymgeiswyr

12 Tüdalen

CYFENW:

ENW(AU) CYN TAF:

Llenwch, plygwh a seliwh
(gweler nodyn 2 isod)

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

www.oup.com

3. Rhaid i'r atebion fod mewn llawysgnten dda, gael ei theipio a chael yr ymgeisydd i dalu.

4. Ysgriennwch eich atebion mewn inc.

5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnwch llinell drwyddyn.

6. Ni ddylid rhwgo unrhyw ran o'r llwyfr 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 gwyllw/gwylwyr.

8. Rhaid dychwelyd pob llyfr. Ni chaniau arholi o dan unrhyw amgylchiadau.

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	

(See the other side for English version)

[illegible]

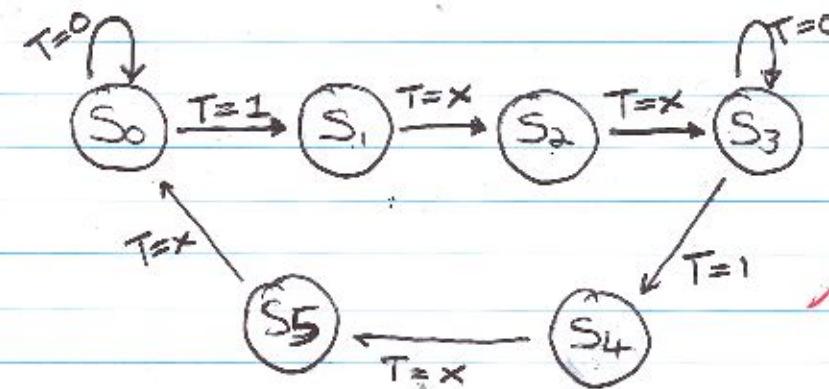
PART B

QB3

a)

 $S_0 = \text{Red}$ $S_1 = \text{Red/amber}$ $S_2 = \text{Red/amber}$ $S_3 = \text{Green}$ $S_4 = \text{Amber}$ $S_5 = \text{Amber}$

States assigned to outputs above.
State diagram below.



State table below.

Current	Next		NEXT						OUTPUT		
			T=0			T=1					
	T=0	T=1	Q_A^+	Q_B^+	Q_C^+	Q_A^+	Q_B^+	Q_C^+	R	A	G
S_0	S_0	S_1	0	0	0	0	0	1	1	0	0
S_1	S_2	S_2	0	1	0	0	1	0	1	1	0
S_2	S_3	S_3	0	1	1	0	1	1	1	1	0
S_3	S_3	S_4	0	1	1	1	0	0	0	0	1
S_4	S_5	S_5	1	0	1	1	0	1	0	1	0
S_5	S_0	S_0	0	0	0	0	0	0	0	1	0

Karnaugh Maps on next page.

$Q_A^+ = BC$

TA	00	01	11	10
00	0	0	0	0
01	1	0	x	x
11	1	0	x	x
10	0	0	1	0

Red BC

A	00	01	11	10
0	0	1	1	0
1	0	0	x	x

$$R = \bar{A}\bar{C} + \bar{A}\bar{B}$$

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

$Q_B^+ = BC$

TA	00	01	11	10
00	0	1	1	1
01	0	0	x	x
11	0	0	x	x
10	0	1	0	1

Amber BC

A	00	01	11	10
0	0	1	0	1
1	1	1	x	x

$$A = A + \bar{B}C + B\bar{C}$$

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

$Q_C^+ = BC$

TA	00	01	11	10
00	0	0	1	1
01	1	0	x	x
11	1	0	x	x
10	1	0	0	1

Green BC

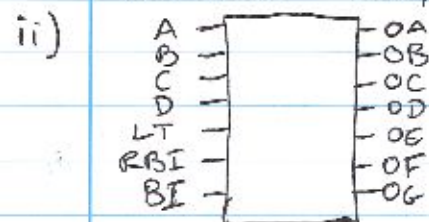
A	00	01	11	10
0	0	0	1	0
1	0	0	x	x

$$G = BC$$

$$Q_C^+ = T\bar{C} + A\bar{C} + \bar{T}B$$

b) i) Inputs = A, B, C, D, LT, RBI, BI

Outputs = OA, OB, OC, OD, OE, OF, OG



QB2
b)

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

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

$$C = \frac{1}{(2 \times \pi \times 30 \times 10^6)^2 \times 20 \times 10^{-6}}$$

$$C = 1.41 \times 10^{-12} \text{ F}$$

$$M_V = 0.25$$

$$M_V = \frac{C_1}{C_2} \therefore C_2 = 4C_1$$

$$C_T = \frac{C_1 C_2}{C_1 + C_2}$$

$\div$ top and bot by C_1

$$C_T = \frac{\frac{C_1 C_2}{C_1}}{\frac{C_1 + C_2}{C_1}} = \frac{C_2}{\frac{C_1 + C_2}{C_1}}$$

22

4

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

$$f = \frac{1}{2\pi\sqrt{47 \times 10^{-6} \times 300 \times 10^{-12}}}$$

$$f = 1.34 \text{ MHz}$$



3

PART A

A5)

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

rearranging for C

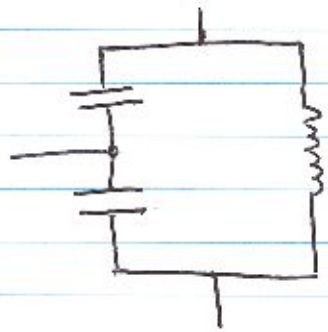
$$C = \frac{1}{(2\pi f)^2 L}$$

$$C = \frac{1}{(2\pi \times 20 \times 10^6)^2 \times 5 \times 10^{-6}}$$

$$C = 12.67 \times 10^{-12} \text{ F}$$

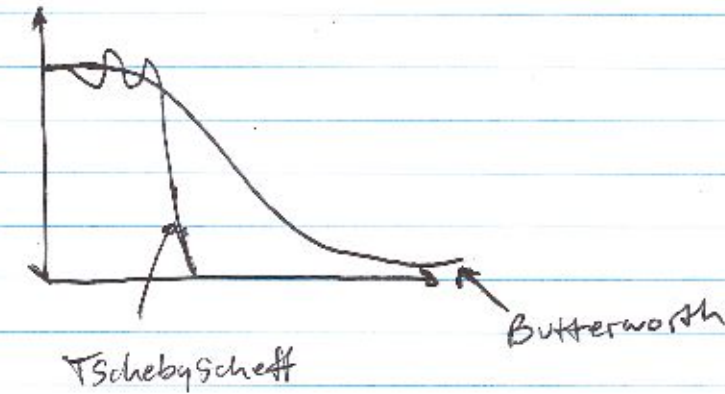
A6)

Consists of two capacitors in parallel with one inductor. Values of capacitors and inductor set the oscillation behaviour of the circuit. Oscillator is tapped between both capacitors. When powered, capacitors charge ready to begin oscillation. CCT looks like this



A7)

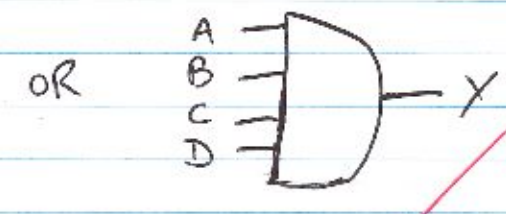
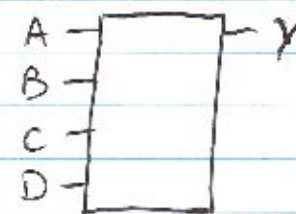
Butterworth filters have a roll off between the Bessel and Tschebyscheff filters. ~~As~~ The Butterworth has a wider passband at the start and end of its band and tapers off smoothly. Butterworth looks like this.



A8)

i) inputs: A, B, C, D
Outputs: Y

ii)



iii)

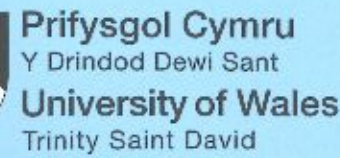
A	B	C	D	Y
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0

A	B	C	D	Y
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

Output only energises when all inputs are present.

1

4



SURNAME: Ocas

FORENAME(S): Nathan

12 Pages

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.
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1	Student Number	1602828
2	Title of Examination Paper	ELECTRONIC 2
3	Module Code	SGEE5000
4	Date and Time of Examination	14 th May 9:30-12:00
5	Examination Venue	Coleg Sir Gar C27
6	Seat Number	
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
A1 <i>A</i>	<i>36</i>
A2 <i>B1</i>	<i>26</i>
A3 <i>B3</i>	<i>14</i>
A4	
A5	
A6	
A7	
A8	
B1	
B2	
Total	<i>769</i>

(Gweler yr ochr arall am y fersiwn Cymraeg)



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Llyfr Atebion Arholiadau

12 Tüdalen

Cyfarwyddiadau i Ymgeiswyr

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

guidio, ch. 9w.

3. Rhaid i'r atebion fod mewn llawysgriften ddatlennadwy. Gall yr Arholwyr naill ai anwybyddu sgript annarllennadwy, neu drefnu iddi gael ei threplio a chael yr ymgeisydd i dalu.
4. Ysgriftennwy 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 rhwygo 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 gwyllwr/gwyliwyr.
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 amgylchriadau.

(See the other side for English version)

1	Rhif Myfyriwr	
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	

[illegible]

Llenwch, plygwh a seliwh
(gweler nodyn 2 isod)

CYFENW:

ENW(AU) CYNTAF:

A1.)

First stage

$$\begin{aligned}\text{Voltage gain of 150} \\ &= 20 \log(150) \\ &= 43.52 \text{ dBs}\end{aligned}$$

Second stage

$$\begin{aligned}\text{Voltage gain of 200} \\ &= 20 \log(200) \\ &= 46.02 \text{ dBs}\end{aligned}$$

Third stage

$$\begin{aligned}\text{Voltage gain of 125} \\ &= 20 \log(125) \\ &= 41.94 \text{ dBs}\end{aligned}$$

$$\text{Total voltage gain} = 43.52 + 46.02 + 41.94 = \underline{131.48 \text{ dBs}}$$

(4)

A2.)

$$\text{Input power (P}_{in}\text{)} = P_{out} / \text{antilog}\left(\frac{45}{10}\right) = 150 / 31622.78 = \underline{4.74 \text{ mW}}$$

$$A_v = \text{Antilog}\left(\frac{30}{20}\right) = 31.62$$

$$V_{out} = \sqrt{P \times R} = \sqrt{150 \times 8} = 34.64 \text{ V}$$

$$V_{in} (\text{input voltage}) = \frac{V_{out}}{A_v} = \frac{34.64}{31.62} = \underline{1.096 \text{ V}}$$

(5)

A3.)

For impedance matching, Z_{out} of transistor = $Z_{primary}$ Therefore $Z_{out} = 2\pi f L_p$

$$20,000 = 2\pi \times 600 \times L_p$$

$$L_p = 20,000 / (2\pi \times 600)$$

$$L_p = \underline{5.31 \text{ H}}$$

For impedance matching, Z_{in} of next stage = $Z_{secondary}$ Therefore, $Z_{in} = 2\pi f L_s$

$$1500 = 2\pi \times 600 \times L_s$$

$$L_s = 1500 / (2\pi \times 600)$$

$$L_s = \underline{0.398 \text{ H}}$$

(5)

A4.)

Advantages of negative feedback

- 1.) consistency of gain
- 2.) improves frequency response.
- 3.) increases thermal stability.

(3)

A1.)

First stage

$$\begin{aligned}\text{Voltage gain of 150} \\ &= 20 \log(150) \\ &= 43.52 \text{ dBs}\end{aligned}$$

Second stage

$$\begin{aligned}\text{Voltage gain of 200} \\ &= 20 \log(200) \\ &= 46.02 \text{ dBs}\end{aligned}$$

Third stage

$$\begin{aligned}\text{Voltage gain of 125} \\ &= 20 \log(125) \\ &= 41.94 \text{ dBs}\end{aligned}$$

$$\text{Total voltage gain} = 43.52 + 46.02 + 41.94 = 131.48 \text{ dBs}$$

(4)

A2.)

$$\text{Input power (P}_{\text{in}}) = P_{\text{out}} / \text{antilog}\left(\frac{45}{10}\right) = 150 / 31622.78 = 4.74 \text{ mW}$$

$$A_v = \text{Antilog}\left(\frac{30}{20}\right) = 31.62$$

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$$V_{\text{in}} (\text{input voltage}) = \frac{V_{\text{out}}}{A_v} = \frac{34.64}{31.62} = 1.096 \text{ V}$$

(5)

A3.)

For impedance matching, Z_{out} of transistor = $2 \times \text{primary}$

$$\text{Therefore } Z_{\text{out}} = 2\pi f L_p$$

$$20,000 = 2\pi \times 600 \times L_p$$

$$L_p = 20,000 / (2\pi \times 600)$$

$$L_p = 5.31 \text{ H}$$

For impedance matching, Z_{in} of next stage = $2 \times \text{secondary}$

$$\text{Therefore, } Z_{\text{in}} = 2\pi f L_s$$

$$1500 = 2\pi \times 600 \times L_s$$

$$L_s = 1500 / (2\pi \times 600)$$

$$L_s = 0.398 \text{ H}$$

(5)

A4.)

Advantages of negative feedback

- 1.) consistency of gain
- 2.) improves frequency response.
- 3.) increases thermal stability.

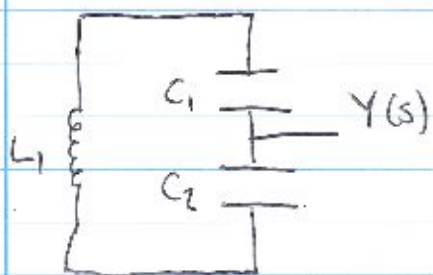
(3)

A5.) $f = \frac{1}{2\pi\sqrt{LC}}$

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

$$C = \frac{1}{5\mu \times (2\pi \times 20M)^2} = 12.67pF$$

A6.) Colpits Oscillator



Here is a diagram of an colpits oscillator circuit. It is made up of two capacitors and one inductor. The frequency of oscillations can be found using the equation:

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

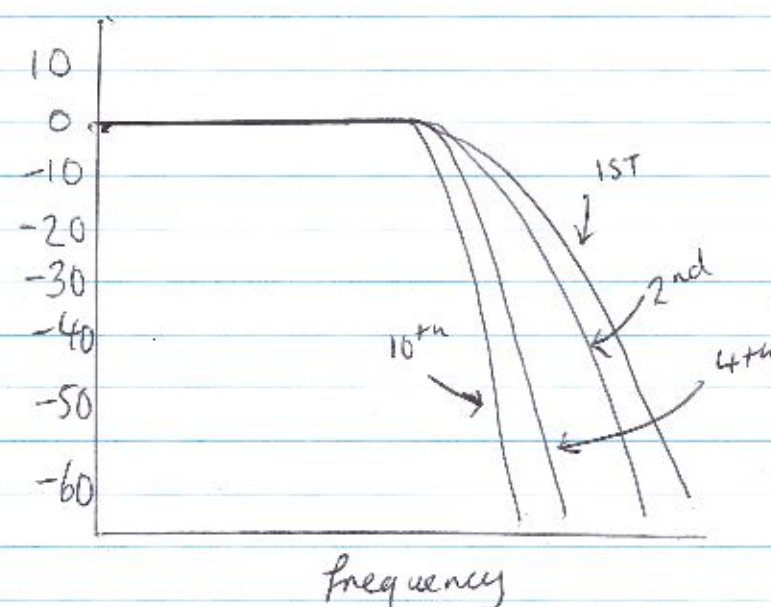
When the circuit energises:

- 1.) The capacitors fully charge.
- 2.) The capacitors discharge through L_1 , setting up oscillations.
- 3.) The output voltage appears across C_1 and the feedback appears across C_2 .
- 4.) The feedback is 180° out of phase to the output voltage across C_1 .
- 5.) The transistor of the amplifier produces a 180° phase shift and a further 180° phase shift from the C_1 - C_2 voltage divider.
- 6.) This ensures they are properly phased to produce continuous undamped oscillations.

(4)

(6)

A7.) Butterworth



The butterworth filter has maximum passband flatness.

The roll-off for a butterworth filter = 20dBs/decade

A8.) inputs = A, B, C, D

OUTPUTS = Y.



(5)

(3)

Part BQ. B1

a) Output Voltage = $V_{out} = V_{in} \times \text{Antilog}\left(\frac{75}{20}\right) = 10.2\text{m} \times 56.23.4$
 $= 6.75\text{V}$
 Load power = $P_{Load} = V^2/R = 6.75^2/2000$
 $= 22.78\text{mW}$ ✓

b) First Stage

$$I_{R1} = I_{R2} = V_{CC} / (R_1 + R_2) = 15 / (100\text{K} + 22\text{K}) = 122.95\mu\text{A}$$

$$V_{B1} = V_{R2} = I_{R2} \times R_2 = 122.95\mu\text{A} \times 22\text{K} = 2.7\text{V}$$

$$V_{E1} = V_{B1} - 0.7 = 2.7 - 0.7 = 2\text{V}$$

$$I_{R4} = \frac{V_{E1}}{R_4} = \frac{2}{4700} = 425.5\mu\text{A}$$

Assuming $I_{C1} = I_{R4}$ then $V_{C1} = V_{CC} - I_{C1}R_3$
 $= 15 - (425.5\mu \times 22\text{K})$
 $= 5.65\text{V}$ ✓

Second Stage

$$V_{B2} = V_{C1} = 5.65\text{V}$$

$$V_{E2} = V_{B2} - 0.7 = 5.65 - 0.7 = 4.95\text{V}$$

$$I_{R6} = \frac{V_{E2}}{R_6} = \frac{4.95}{10,000} = 495\mu\text{A}$$

Assuming $I_{C2} = I_{R6}$ then $V_{C2} = V_{CC} - I_{C2}R_5$
 $= 15 - (495\mu \times 10000)$
 $= 10.06\text{V}$ ✓

c)

$$\text{Bandwidth} = \frac{\text{frequency (f)}}{Q \text{ factor (q)}}$$

$$= \frac{2\text{M}}{100} = 20\text{KHz}$$

$$\text{lower frequency} = f - \frac{1}{2} \text{ bandwidth}$$

$$= 2\text{M} - 10\text{K} = 1.99\text{MHz}$$

$$\text{upper frequency} = f + \frac{1}{2} \text{ bandwidth}$$

$$= 2\text{M} + 10\text{K} = 2.01\text{MHz}$$

d)

$$A_{rf} = \frac{A_v}{1 + A_v M_v}$$

$$= \frac{2400}{1 + (2400 \times 0.02)} = 48.98$$

e)

Advantages of tuned amplifiers:

1. Small power loss
2. high selectivity
- 3.

f.) resonant frequency (f_0) ~~on~~ $\frac{1}{2\pi\sqrt{LC}}$ $= \frac{1}{2\pi\sqrt{LC}}$
 ~~$\frac{1}{2\pi\sqrt{LC}}$~~
 ~~$= \frac{1}{2\pi\sqrt{10.33\mu \times 47m}}$~~
 ~~$= \frac{1}{2\pi\sqrt{10.33\mu \times 47m}}$~~
 ~~$= 1227.95 \text{ Hz}$~~
 $= 1227.95 \text{ Hz}$ ✓ (3)

Question B2

a.) $R_1 = \frac{a_1}{2\pi f_c C_1} = \frac{5.6334}{2 \times \pi \times 100k \times 220p} = 138.23 \mu\Omega$ ✓ (2)

First stage

Second stage:

$C_2 \geq \frac{C_1 \times 4b}{a^2} = \frac{5n \times 4 \times 2.653}{0.76^2} = 53.06 \text{ nF}$ ✓ (3)

Take C_2 as 53 nF ✓

b.) $m_v = 0.25$

$m_v = \frac{C_1}{C_2}$

$0.25 = \frac{C_1}{C_2}$ then $C_2 = 4C_1$

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

$C = \frac{1}{L(2\pi f)^2} = \frac{1}{20\mu H \times (\pi \times 30M)^2} = 710 \text{ nF}$ ✓

$C_T = \frac{C_1 C_2}{C_1 + C_2}$

÷ top and bottom by C_1 :

$C_T = \frac{C_2}{1 + \frac{C_2}{C_1}}$

if $0.25 = \frac{C_1}{C_2}$ then $\frac{C_2}{C_1} = 4$ ✓

Therefore, $710n = \frac{C_2}{1+4} = \frac{C_2}{5}$ ✓

$C_2 = 710n \times 5 = 3.55 \mu F$ ✓

and $C_1 = \frac{C_2}{4} = \frac{3.55}{4} = 887.5 \text{ nF}$ ✓ (6)

(c)

frequency of oscillator = $\frac{1}{2\pi\sqrt{LC}}$

$$= \frac{1}{2\pi \times \sqrt{47\mu \times 300p}}$$

$$= \underline{1.34MHz}$$



(3)