



Complete, fold and seal
(see note 2 below)

SURNAME: Davies

FORENAME(S): Jonathan
Daffydd Lee

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	
2	Title of Examination Paper	S4E 5000 Electronics II
3	Module Code	S4E 5000
4	Date and Time of Examination	Tues 10/5/2022
5	Examination Venue	Gym
6	Seat Number	6

7	Number of Answer Books handed in	
---	----------------------------------	--

[illegible]

18

36%

A1
i $\frac{90}{20} = 4.5 = 10^{4.5} = 31.6 \text{ K}$ ✓

NO UNITS.

ii $\frac{35}{16} = 3.5 = 10^{3.5} = 3.16 \text{ KW}$ ✓

3

A2 $R_L = 250 \Omega$ $V_g = 36 \text{ dB}$ $V_{in} = 5 \text{ mV}$

i $\frac{36}{20} = 1.8$ $\text{antilog}(1.8) = 10^{1.8} = 63 \text{ V} \times 5 \text{ mV}$

ii $\frac{V^2}{R} = \frac{63^2}{250} = 15.876 \text{ W}$ ✓ *correct answer*

3.

A3 $M_V = 0.015$ $A_{vf} = 500$

$A_{vf} = \frac{A_v}{1 + A_v M_V} = \frac{500}{1 + 500 \times 0.015} = 99.8 \text{ mV}$ ✓

2.

A4 ~~Feedback~~ Feedback allows the circuit to be more responsive to temp change and provides stability through the capacitors. ✓

0

A5 $L = 4 \mu\text{H}$ $f = 20 \text{ MHz}$

$f = \frac{1}{2\pi\sqrt{LC}}$ ✓ $\frac{1}{L \times (2\pi f)^2}$

Rearrange to find $C = \frac{1}{2\pi(Lf)^2} = \frac{1}{2\pi(4 \times 10^{-6} \times 20 \times 10^6)^2}$

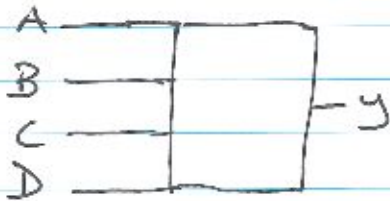
$C = 24.87 \mu\text{F}$

1

A9 $BW = \frac{f_c}{Q} = \frac{2.1 \times 10^6}{105} = 20K \text{ dB}$ ^{Hz}

i) A10 inputs are A, B, C, D
output is Y

ii) Entity is



iii) it is a 4 input AND gate.

A#8 Tchebysheff filter allows a sharper curve with a higher roll off.

B2

$$\begin{aligned} A_1 &= 0.6656 \\ A_2 &= 1.1402 & B_2 &= 0.4128 \\ A_3 &= 0.6216 & B_3 &= 0.3245 \end{aligned}$$

$$C_1 = 470 \text{ pF} \quad f_c = 75 \text{ kHz}$$

$$\text{i) } R_1 = \frac{1}{2\pi f_c a_1 c_1} = \frac{1}{2\pi \times 75 \times 10^3 \times 0.6656 \times 470 \times 10^{-12}}$$

$$= 6.78 \text{ k}\Omega$$

$$\text{ii) } C_2 > \frac{C_1 \times 4b}{a^2} = \frac{470 \times 10^{-12} \times 4 \times 0.4128}{1.1402^2} = 597 \text{ pF}$$

3

Let C_2 be 600 pF as $C_2 >$

Stage 3

$$C_2 > \frac{C_1 \times 4b}{a^2} = \frac{470 \times 10^{-12} \times 4 \times 0.3245}{0.6216^2} = 1.58 \text{ nF}$$

1

Let C_2 be 1.6 nF as $C_2 >$

1

iii Stage 2 - $C_2 = 600 \text{ pF}$

$$R_2 = \frac{1.1402 \times 600 - \sqrt{1.1402^2 \times 600^2 - 4 \times 0.4128 \times 470 \times 600}}{4\pi \times 75 \text{ K} \times 470 \text{ p} \times 600}$$

3

$$R_2 = 2.39 \text{ k}\Omega$$

$$R_3 = \frac{1.1402 \times 600 + \sqrt{1.1402^2 \times 600^2 - 4 \times 0.4128 \times 470 \times 600}}{4\pi \times 75 \text{ K} \times 470 \text{ p} \times 600}$$

3

$$R_3 = 2.76 \text{ k}\Omega$$

Stage 3 $C_2 = 1.6 \text{ nF}$ ✓

$$R_4 = \frac{0.6216 \times 1.6 \text{ n} - \sqrt{0.6216^2 \times 1.6 \text{ n}^2 - 4 \times 0.3245 \times 470 \text{ p} \times 1.6 \text{ n}}}{4 \pi \times 75 \text{ K} \times 470 \text{ p} \times 1.6 \text{ n}}$$

$$R_4 = 1.24 \text{ K } \Omega$$
 ✓

$$R_5 = \frac{0.6216 \times 1.6 \text{ n} + \sqrt{0.6216^2 \times 1.6 \text{ n}^2 - 4 \times 0.3245 \times 470 \text{ p} \times 1.6 \text{ n}}}{4 \pi \times 75 \text{ K} \times 470 \text{ p} \times 1.6 \text{ n}}$$

$$R_5 = 1.56 \text{ K } \Omega$$
 ✓

c) $f_0 = \frac{1}{2\pi CR \sqrt{6}}$ ✓

Rearrange to find R

$$R = \frac{1}{2\pi \frac{C}{f} \sqrt{6}} = \frac{1}{2\pi \times \frac{68 \text{ p}}{500 \text{ K}} \times \sqrt{6}}$$

$$R = 477.8 \times 10^{12} \Omega$$
 CARRY OVER

31 $V_{CC} = 16V$ $R_1 = 100k\Omega$ $R_2 = 22k\Omega$ $R_4 = 4.7k\Omega$
 $R_3 = 22k\Omega$

$$I_{B1} = V_{B1} = \frac{16}{100k} = 160\mu A \quad \times$$

$$V_{B2} = I_{B2} = 160\mu A \times 22k\Omega = 3.52V \quad \times$$

$$V_{B4} = \frac{V_{B2}}{4.7k} = \frac{3.52}{4.7k} = 0.7V$$

$$3.52 - 0.7 = 2.82V \quad \checkmark$$

$$I_{B4} = \frac{2.82}{4.7k} = 600\mu A$$

Assuming $C_4 = I_{B4}$

$$I_{B3} = \frac{V_{B3}}{22k} = \frac{2.82}{22k} = 128\mu A$$

$$2.82 - 0.7 = 2.12V$$

$$I_{B6} = \frac{2.12}{10k} = 212\mu A$$

Assuming $C_6 = I_{B4}$

$$I_{B5} = \frac{V_{B5}}{10k\Omega} = 212\mu A \times 10k\Omega$$

a) Continuous supply due to the generated feedback in C_1 feeding C_2 .

Better stability