



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.

Complete, fold and seal
(see note 2 below)

SURNAME: HOSKINS

FORENAME(S): TAYLOR

1	Student Number	
2	Title of Examination Paper	8 ELECTRONICS II
3	Module Code	SGEE 5000
4	Date and Time of Examination	10/05/22 9:30
5	Examination Venue	GYM
6	Seat Number	3
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
A	31
B1	20
B2	29
Total	80%

80%

A1i Voltage gain = $\text{antilog}(90/20)$
 $= 31.6$ ✓

No units

1 1/2

(ii) Power gain = $\text{antilog}(35/10)$
 $= 3.16$ ✓

1 1/2

A2

(i) output voltage = $V_{in} \times \text{antilog}(48/20)$
 $= (5 \times 10^{-3}) \times \text{antilog}(36/20)$
 $= 315.5 \text{ mV}$ ✓

2

(ii) Load power = V^2 / R
 $= (315.5 \times 10^{-3})^2 / 250$
 $= 0.4 \text{ mW}$ ✓

2.

A3

$A_{vf} = \frac{A_v}{1 + A_v(mv)}$
 $= \frac{500}{1 + (500)(0.015)}$
 $= 58.8$ ✓

3

A4

Consistency of frequency

Consistency of gain. ✗

0

A5

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

Rearrange: $C_T = \frac{1}{L(2\pi f)^2}$
 $= \frac{1}{(4 \times 10^{-4}) \times (2 \times \pi \times 20 \times 10^6)^2}$
 $= 15.83 \text{ pF}$ ✓

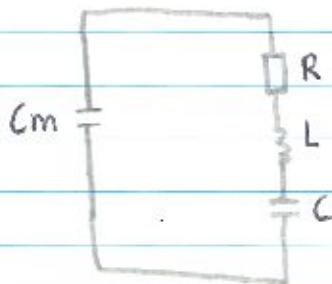
3

$$= 15.83 \text{ pF}$$

- A6 Colpitts oscillator consists of two ~~cap~~ capacitors, C_1 and C_2 and an inductor L . The capacitors are tapped. Capacitor C_1 produces voltage gain, ~~and~~ and C_2 allows for feedback. Frequency can be determined $f = \frac{1}{2\pi\sqrt{LC}}$. The feedback produced is positive. The transistor allows for a 180° phase shift, and C_1 and C_2 potential difference allows for another 180° phase shift. The positive phase allows for oscillation.

6

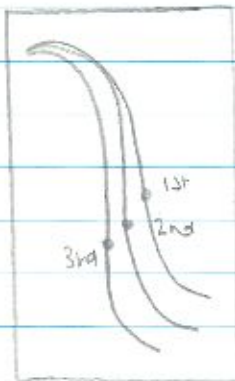
- A7 A quartz crystal is equivalent to the circuit below. When not vibrating, the circuit is equivalent to C_m (mounting capacitor) due to the metal plates. When vibrating the QC is equivalent to the RLC circuit.



✓

4

A8



x

0

A9 $BW = \frac{f_0}{Q}$
 $= \frac{(2.1 \times 10^6)}{105}$

$BW = 20K$ ✓

Cut off freq

Lower freq = $f - \frac{1}{2} BW$
 $= 2.1M - 10K = 2.09M$ ✓

Upper freq = $f + \frac{1}{2} BW$
 $= 2.1M + 10K = 2.11M$ ✓

4

A10 1

- (i) inputs of the gate are A, B, C, and D ✓
 Output of the gate is Y. ✓



4

- (iii) The device is a 4 input AND Gate ✓

PART B

B1

a) - Consistency of frequency $\times$ - Consistency of gain $\checkmark$

1

$$\begin{aligned}
 b \quad I_{R1} &= I_{R2} = V_{CC} / (R_1 + R_2) \\
 &= 16 / (1000 + 22k) \\
 &= 131 \mu A \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 V_{B1} &= I_{R2} \times R_2 \\
 &= (131 \times 10^{-6}) \times 22,000 \\
 &= 2.88 V \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 V_{E1} &= 2.88 - 0.7 \\
 &= 2.18 V \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 I_{R4} &= V_{E1} / R_4 \\
 &= 2.18 / 4700 \\
 &= 0.46 \text{ mA or } 463.8 \mu A \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 \text{Assuming } I_{R4} &= I_{C1}, \quad V_{C1} = V_{CC} - (I_{C1} \times R_3) \\
 &= 16 - (463.8 \times 10^{-6}) \times 22,000 \\
 V_{C1} &= 5.8 V \quad \checkmark
 \end{aligned}$$

$$V_{C1} = V_{B1} = 5.8 V$$

$$\begin{aligned}
 V_{E1} &= 5.8 - 0.7 \\
 &= 5.1 V \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 I_{R6} &= V_{E1} / R_6 \\
 &= 5.1 / 10,000 = 510 \mu A
 \end{aligned}$$

Assuming $I_{R6} = I_{C2}$, $V_{C2} = V_{CC} - (I_{C2} \times R_5)$
 $= 16 - ((510 \times 10^{-6}) \times 10,000)$
 $V_{C2} = 10.9 \text{ V}$ ✓

9

c. $A_{vf} = \frac{A_v}{1 + A_v(mv)}$

Rearrange = $mv = \frac{A_v - A_{vf}}{A_v \times A_{vf}}$
 $= \frac{220 - 20}{220 \times 20}$
 $mv = 0.045$ ✓

4

d - Small losses. ✓

- positive feedback ✗

- Consistent phase shift. ✗

Allow for amplification of very low frequencies.

1

e $Z_{out} \stackrel{v_{out}}{=} Z_{primary}$

$Z_{out} = 2\pi f L_p$
 $4000 = 2 \times \pi \times 1000 \times L_p$
 $L_p = \frac{4000}{2 \times \pi \times 1000}$
 $= 636.6 \text{ mH}$ ✓

$Z_{in} = Z_{secondary}$

$Z_{in} = 2\pi f L_s$
 $1500 = 2 \times \pi \times 1000 \times L_s$
 $L_s = \frac{1500}{2 \times \pi \times 1000}$
 $= 238.7 \text{ mH}$ ✓

5

stage 3

$$R = \frac{(0.6216 \times 1.6 \times 10^{-9}) \pm \sqrt{(0.6216 \times 1.6 \times 10^{-9})^2 - 4(0.3245)(470 \times 10^{-12})}}{4 \times \pi \times 75000 \times (470 \times 10^{-12})(1.6 \times 10^{-9})}$$

$$R_4 = 1242 \Omega$$

$$R_5 = 1564 \Omega$$

4

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

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

$$= 2$$

$$2 \times 2$$

$$L_T = \frac{1}{(2.2 \times 10^{-12}) \times (2 \times \pi \times 5 \times 10^4)^2}$$

$$L_T = 460.6 \mu H$$

4

$$mV = \frac{L_2}{L_1}$$

$$0.2 = \frac{L_2}{L_1}$$

$$L_1 = 5L_2$$

$$\text{Line } mV \text{ } L_T = L_1 + L_2$$

$$\text{sub in } L_1 = 5L_2$$

$$L_T = 5L_2 + L_2$$

$$L_T = 6L_2$$

$$L_T = 460.6 \mu H$$

$$\frac{460.6 \times 10^{-6}}{6} = L_2$$

$$b$$

$$L_2 = 76.7 \mu H$$

$$L_1 = \frac{L_2}{mV}$$

$$L_1 = \frac{76.7 \times 10^{-6}}{0.2} = 2.3 mH$$

2

$$C. f_0 = 1$$

$$2\pi CR\sqrt{6}$$

$$R = \frac{1}{2\pi C f_0 \sqrt{6}}$$

$$R = \frac{1}{2 \times \pi \times (68 \times 10^{-12}) \times 500,000 \times \sqrt{6}}$$

$$R = 1911 \Omega \text{ or } 1.9 k\Omega \checkmark$$

3

3