



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: Rigby

FORENAME(S): Ethan

1	Student Number	
2	Title of Examination Paper	Electronics II
3	Module Code	SGEE 5000
4	Date and Time of Examination	9:30 10.05.22
5	Examination Venue	Sports hall
6	Seat Number	11
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
A	16
82	27
83	26
Total	69%

69%

B2

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

a)

$$\text{Stage 1: } a_1 = 0.6656$$

$$R_1 = \frac{a_1}{2\pi F_c C_1} = \frac{0.6656}{2\pi \times 75 \text{ K} \times 470 \text{ p}}$$

$$R_1 = 3 \text{ K} \Omega$$

4

$$\text{Stage 2: } a_1 = 1.1402 \quad b_1 = 0.4128$$

$$C_2 > \frac{C_1 \times 4b}{a^2} = C_2 > \frac{470 \text{ p} \times 4 \times 0.4128}{1.1402^2}$$

$$C_2 > 596.9 \text{ pF}$$

$\therefore C_2$ used will be 600 pF

4

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

$$R_1 = 2390.4 \Omega$$

$$R_2 = 2757.5 \Omega$$

6

$$\text{Stage 3: } a_1 = 0.6216 \quad b_1 = 0.3245$$

$$C_2 > \frac{C_1 \times 4b}{a^2} = C_2 > \frac{470 \text{ p} \times 4 \times 0.3245}{0.6216^2}$$

$$C_2 > 1.579 \text{ nF}$$

$\therefore C_2$ used will be 1.6 nF

2

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

$$R_1 = \frac{0.6216 \times 1.6n - \sqrt{(0.6216 \times 1.6n)^2 - 4 \times 0.3245 \times 470p \times 1.6n}}{4 \pi \times 75,000 \times 470p \times 1.6n}$$

$$R_1 = 1242.1 \Omega$$

$$R_2 = \frac{0.6216 \times 1.6n + \sqrt{(0.6216 \times 1.6n)^2 - 4 \times 0.3245 \times 470p \times 1.6n}}{4 \pi \times 75,000 \times 470p \times 1.6n}$$

$$R_2 = 1564.5 \Omega$$

b) $f = 5 \text{ MHz}$ $m_v = 0.2$ $C = 2.2 \text{ pF}$

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

$$L_1 = \frac{L_2}{0.2} = L_1 = 5 L_2$$

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

$$L = \frac{1}{2.2p (2 \pi \times 5M)^2}$$

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

$$L = 461 \text{ pH}$$

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

$$L_r = \frac{L_2 L_1}{L_2 + L_1}$$

÷ top and bottom by L_2

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

$$L_r = \frac{L_1}{1 + \frac{L_1}{L_2}}$$

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

$$\frac{L_1}{L_2} = 5$$

$$L = \frac{L_1}{1 + 5}$$

$$461\mu = \frac{L_1}{6}$$

$$461\mu \times 6 = L_1$$

$$L_1 = 2.77\text{mH}$$

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

$$0.2 = \frac{L_2}{2.77\text{m}}$$

$$0.2 \times 2.77\text{m} = L_2$$

$$L_2 = 554\mu\text{H}$$

c) $C = 68\text{pF}$ $f = 500\text{kHz}$

$$f_0 = \frac{1}{2\pi CR\sqrt{5}}$$

$$\neq R = \frac{1}{2\pi \times 500\text{K} \times 68\text{p} \times \sqrt{5}}$$

$$2\pi CR\sqrt{5} = \frac{1}{f}$$

$$R = 1911\Omega$$

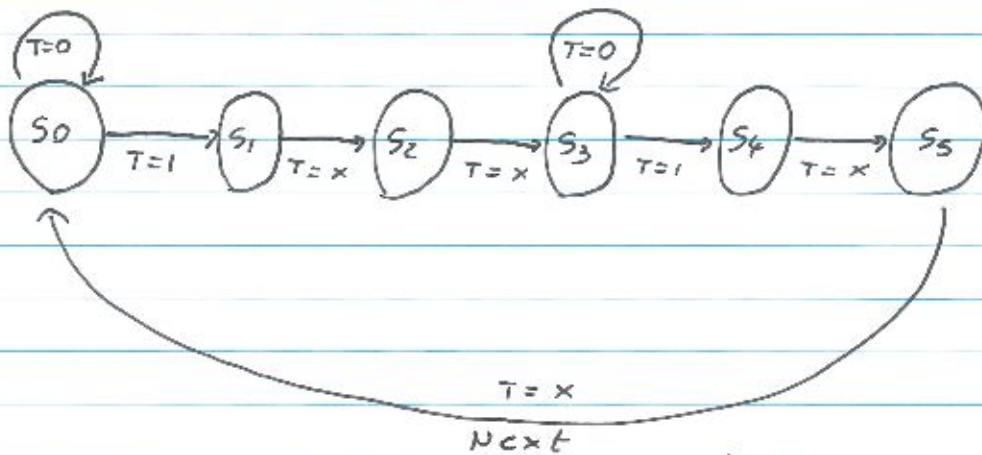
$$2\pi CR = \frac{1}{f\sqrt{5}}$$

$$CR = \frac{1}{2\pi f\sqrt{5}}$$

$$R = \frac{1}{2\pi fC\sqrt{5}} \quad \neq$$

3

B3 $S_0 = \text{Red}$ $S_1 = \text{Red/Amber}$ $S_2 = \text{Red/Amber}$ $S_3 = \text{Green}$
 a) $S_4 = \text{Amber}$ $S_5 = \text{Amber}$



Current	Next		Current T=0			Next		
	T=0	T=1	Q_A^+	Q_B^+	Q_C^+	Q_A^+	Q_B^+	Q_C^+
S_0	S_0	S_1						
S_1	S_2	S_2						
S_2	S_3	S_3						
S_3	S_3	S_4						
S_4	S_5	S_5						
S_5	S_0	S_0						

Current	Next		T=1			T=0			R	A	G
	T=1	T=0	Q_A^+	Q_B^+	Q_C^+	Q_A^+	Q_B^+	Q_C^+			
S_0	S_1	S_0	0	0	1	0	0	0	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_4	S_3	1	0	0	0	1	1	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

$QA^+ BC$

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

 $QB^+ BC$

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

 $QC^+ BC$

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

Red

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

Amber

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

Green

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

Equations

$$QA = A\bar{C} + \bar{T}BC$$

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

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

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

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

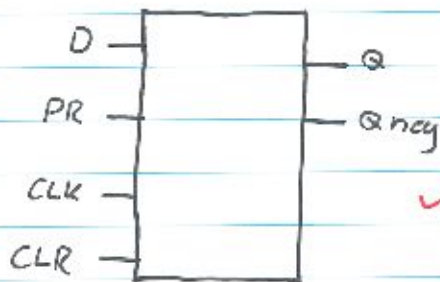
$$Green = BC$$

21/22

21

b) inputs : D, PR, CLK, CLR ✓

out : Q, Qneg ✓



States	D	PR	CLK	CLR	Q	Qneg
1	x	1	x	0	0	1
2	x	0	x	1	1	0
3	1	x	1	x	1	0
4	1	x	1	x	0	1
5	1	x	1	x	0	1
6	x	x	x	x	x	x

A5

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

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

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

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

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

$$C = \frac{1}{4\mu(2\pi \times 20M)^2}$$

$$C = 15.8 \text{ pF}$$

3.

A6 Two capacitors are wired in parallel with an inductor between the two capacitors (C_1, C_2) is a spur in the cable. When power is applied to the spur the discharge of the capacitor cause an oscillation across the inductor. The following equation allows you to find the frequency:

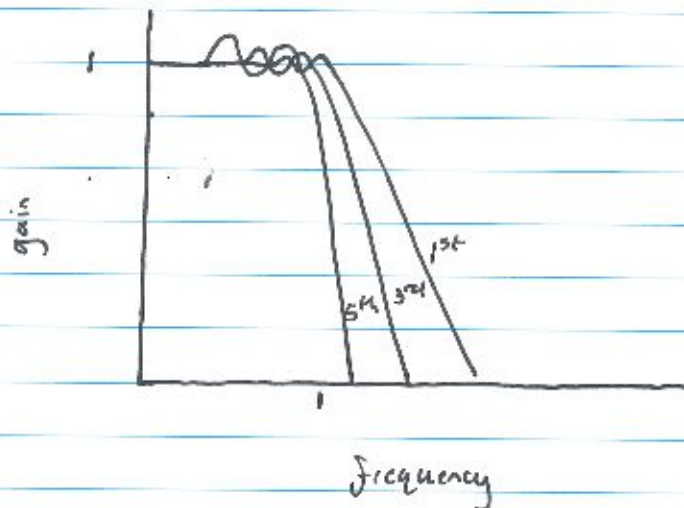
$$f = \frac{1}{2\pi\sqrt{LC}}$$

if measuring across C_1 you will get your signal output, if measuring across C_2 you get the signal feedback. each 180° out of phase with each other.

3

(6)

A8 A Tschhebyscheff filter provides the user with a great ~~passband~~ drop off point. This allows the frequency to be ~~bit~~ filtered closer to the desired level. The negative thing about this kind of filter on the other hand is the gain oscillates at a greater magnitude the larger the order of the filter. This is illustrated below.



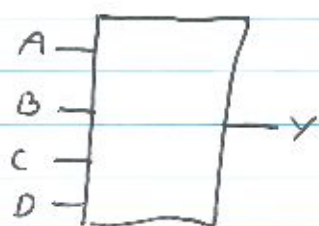
A9 $BW = \frac{f_0}{Q}$

$BW = \frac{2.1M}{105}$

$BW = 20,000 \text{ Hz}$ ✓

A10 inputs : A , B - C , ~~0~~0

outputs : Y



This VHDL code represents an ~~and~~ gate.

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	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

4