

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

SURNAME:

FORENAME(S):

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.
3. The answers must be legibly written. The Examiners can either charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the
6. No part of this book is to be torn out; it must be handed in co
7. If more books than one are used, fasten them together using

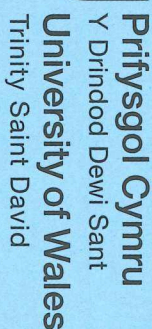
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this 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	2224442 2444222 2111222
2	Title of Examination Paper	Electronics II
3	Module Code	SG-EE5000
4	Date and Time of Examination	7/5/2024 9.30am
5	Examination Venue	Coleg Sir Gar Graig
6	Seat Number	2

7	Number of Answer Books handed in	1002
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(Gweler yr ochr arall am y fersiwn Cymraeg)

[illegible]

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 llawysgrifen ddarlennadwy. Gall yr Arholwyr naill ai anwybyddu sgrïpt annarlennadwy, neu drefnu iddi gael ei theipio a chael yr ymgesydd i dalu.
4. Ysgrifennwch eich atebion mewn inc.
5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnwch llinell ddrwydlynt.
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 gwy/liwr/gwy/liwyr.
8. Rhaid dychwelyd pob llyfr. Ni chaniateir rhynd 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: UTTING

ENW(AU) CYNTAF: WILC1A1

1	Rhif Myfyriwr	
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 Lyfrau Atebion a gyflwynwyd	

[illegible]

(See the other side for English version)

1)

a) V gain of 220
 $20 \log(220) = 46.85 \text{ dB}$ ✓ 2

b) P gain of 2500

$$10 \log(2500) = 33.98 \text{ dB}$$
 ✓ 2

2)

$$10 \log(45) = 16.5 \text{ dB}$$
 power gain ✗

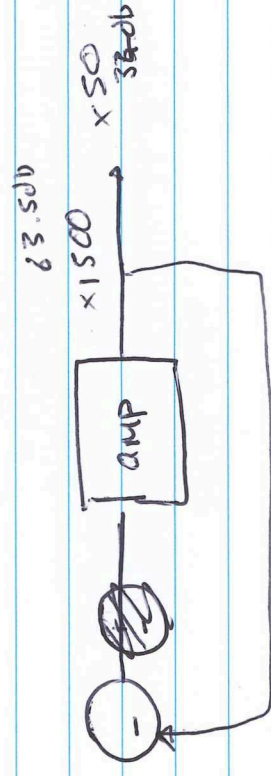
power gain

$$x \times 16.5 = 55$$

$$3.33 = x$$

input power of 3.33 W? ✗

3)



$$x - 1500 = 1500$$

$$1500 - x = 50$$

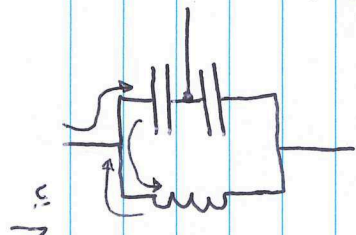
$$x = 1450$$

dB in

✗

$$100 \times \frac{1450}{1500} = 96.6\%$$

4)



A Colpitts oscillator consists of an inductor in parallel with 2 capacitors which are centre tapped. When voltage

This is called a tank circuit.

When voltage is input into the tank the capacitors charge then discharge through the inductor. The inductor then produces a magnetic field which collapses then charges the capacitors. This forms the oscillations of the tank. To sustain the oscillations, the centre tapped capacitors feed back to the tank.

Low gain = 360 (180 across and 180 across tank circuit)

5)

+

0

$$= \frac{1}{3.159 \times 10^{10}} = 3.166 \times 10^{-11} \text{ F}$$

$$= 31.66 \text{ pF} \checkmark$$

4

7)

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

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

$$Q = \frac{10 \times 10^6}{75 \times 10^3} = 133.33 \checkmark$$

3

8)

$$F_c = 120 \times 10^3 \times 10^{-9} \quad C_1 = 1 \mu F$$

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

$$R_1 = \frac{a_1}{2\pi b_1 C_1} = \frac{1.3617}{2\pi (120 \times 10^3) (1 \times 10^{-9})}$$

$$R_1 = 1806 \Omega$$

$C_2 > \frac{C_1 \times 4b}{a^2}$
↓
Not needed for High Pass.

$$\frac{1 \times 10^{-9} \times 4(0.6180)}{(1.3617)^2}$$

$$= 1.33 \times 10^{-9}$$

$$C_2 > 1.33 \times 10^{-9}$$

$$C_2 = 2 \times 10^{-9}$$

$$R = \frac{a_1 C_2 \pm \sqrt{a^2 C_2^2 - 4b C_1 C_2}}{4\pi b C_1 C_2}$$

$$= \frac{1.3617 (2 \times 10^{-9}) \pm \sqrt{1.3617^2 (2 \times 10^{-9})^2 - 4(0.6180)(1 \times 10^{-9})(2 \times 10^{-9})}}{4\pi (120 \times 10^3) (1 \times 10^{-9}) (2 \times 10^{-9})}$$

Stage 2

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

↓

$$\frac{470 \times 10^{-12} \times 4(0.4128)}{1.1402^2}$$

$$= 5.97 \times 10^{-10}$$

$$= 597. \times 10^{-12}$$

$$C_2 > 597 \times 10^{-12} \quad \checkmark$$

$$C_2 = 650 \times 10^{-12} \quad \checkmark$$

$$R = \frac{1.1402(650 \times 10^{-12}) \pm \sqrt{1.1402^2(650 \times 10^{-12})^2 - 4(0.4128)(470 \times 10^{-12})}}{(650 \times 10^{-12})}$$

$$4 \pi (75 \times 10^3)(470 \times 10^{-12})$$

$$(650 \times 10^{-12})$$

$$= \frac{7.4113 \times 10^{-10} \pm 2.1174 \times 10^{-10}}{2.8793 \times 10^{-13}}$$

$$R_1 = 3309.38 \Omega \quad \checkmark \quad \text{using } 650 \text{ pf}$$

$$R_2 = 1838.61 \Omega \quad \checkmark \quad \text{as } C_2.$$

Stage 3

$$C_2 > \frac{470 \times 10^{-12} \times 4(6.3245)}{0.6216^2}$$

↓

$$= 1.579 \times 10^{-9}$$

$$C_2 > 1.579 \times 10^{-9} \quad \checkmark$$

$$C_2 = 2 \times 10^{-9} \quad \checkmark$$

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

$$4 \pi (75 \times 10^3)(2 \times 10^{-9})$$

$$(2 \times 10^{-9})$$

$$R = \frac{1.2432 \times 10^{-9} \pm 2.7798 \times 10^{-10}}{5.7046 \times 10^{-10}}$$

$$8.8593 \times 10^{-13}$$

$$R_1 = 2047.18 \Omega \quad \checkmark$$

$$R_2 = 759.36 \Omega \quad \checkmark$$

using 2mf

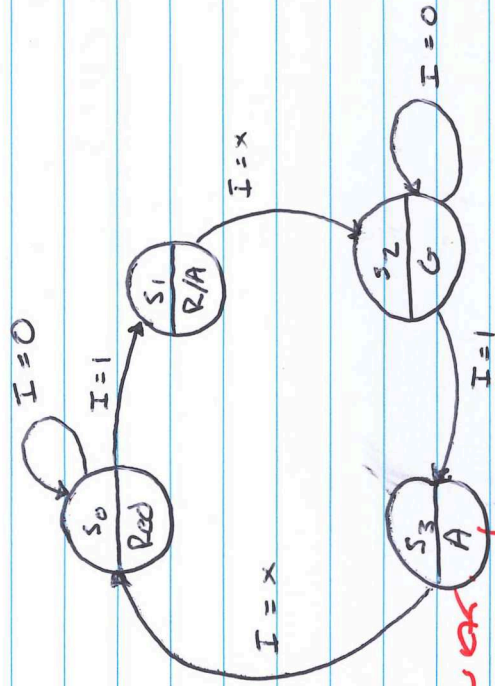
as C2

20.

Question No.	Examiner Only	Question No.	Examiner Only
b)	$\phi = \frac{1}{2\pi\sqrt{LC}}$ $3 \times 10^6 = \frac{1}{2\pi\sqrt{(L)(2 \times 10^{-12})}}$ $3 \times 10^6 \times 2\pi\sqrt{(L)(2 \times 10^{-12})} = 1$ $(3 \times 10^6)^2 \times (2\pi)^2 (L)(2 \times 10^{-12}) = 1^2$ $L = \frac{1}{(3 \times 10^6 \times 2\pi)^2 (2 \times 10^{-12})}$ $L = 1.407 \times 10^{-3} \text{ H}$	c)	$\phi_0 = \frac{1}{2\pi CR\sqrt{6}}$ $100\text{kHz} = \frac{1}{2\pi \cdot 22\text{pF} \cdot R \sqrt{6}}$ $100 \times 10^3 = \frac{1}{2\pi (22 \times 10^{-12}) R \sqrt{6}}$ $R = \frac{1}{2\pi (22 \times 10^{-12}) (\sqrt{6}) (100 \times 10^3)}$ $= 29534 \Omega$
	$M_v = \frac{L_2}{L_1}$ $0.25 = \frac{L_2}{L_1}$ $L_1 + L_2 = 1.407 \times 10^{-3}$ $\frac{1.407 \times 10^{-3}}{5} = 2.814 \times 10^{-4}$ $L_1 = 4(2.814 \times 10^{-4})$ $= 1.1256 \times 10^{-3}$ $0.25 = \frac{2.814 \times 10^{-4}}{1.1256 \times 10^{-3}}$ $L_2 = 2.814 \times 10^{-4} \text{ H}$ $L_1 = 1.1256 \times 10^{-3} \text{ H}$		
Arholwr yn unig	Arholwr yn unig	Arholwr yn unig	Arholwr yn unig
7	7	3	3

Finite state machines

Q3(a)



2

$T=0, T=1$

current	next	Q_A	Q_B	I	Q_{A+}	Q_{B+}	I	R	A	G
s_0	s_1	0	0	1	0	1	1	1	0	0
s_1	s_2	0	1	x	1	0	x	1	1	0
s_2	s_3	1	0	1	1	1	1	0	0	1
s_3	s_0	1	1	x	0	0	x	0	1	0

Q_A, Q_B	I	Q_{A+}	Q_{B+}
00	01110	00	01110
01	00000	0	0
10	00000	0	0
11	00000	0	0

$$Q_{A+} = I Q_B + \bar{Q}_A Q_B$$

Q_B, Q_A	I	Q_{B+}	Q_{A+}
00	01110	0	0
01	00000	0	0
10	00000	1	0
11	00000	1	0

$$Q_{B+} = I \bar{Q}_B$$

2

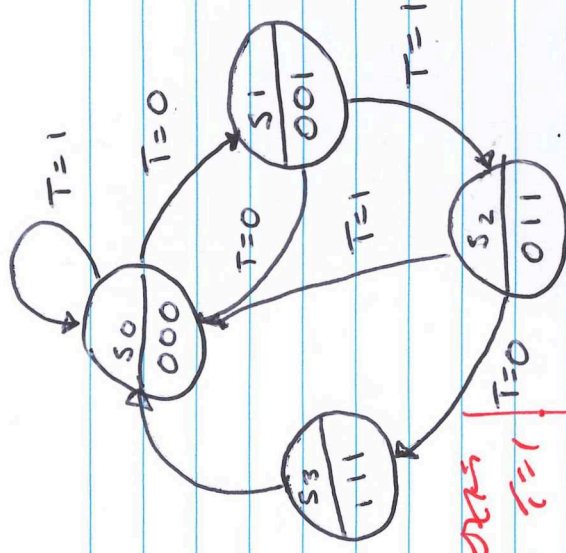
$$R = \bar{Q}_A$$

$$A = Q_B$$

$$G = Q_A Q_B$$

4

Q3)b)



2

present
T=0 T=1

current	next	Q _A	Q _B	Q _A +	Q _B +	T	X	Y	Z
S ₀	S ₁	0	0	0	1	0	0	0	0
S ₁	S ₂	0	1	1	0	1	0	0	1
S ₂	S ₃	1	0	1	1	0	0	1	1
S ₃	S ₀	1	1	0	0	x	1	1	1

2

		Q _A Q _B		Q _A +		Q _B +		Q _A Q _B		Q _A +		Q _B +			
T		00	01	11	10	T		00	01	11	10	T		00	01
0	0	0	0	1	1	0	1	0	1	0	1	0	1	0	1
1	1	0	1	0	0	1	0	0	0	1	0	1	0	0	0

$$Q_{A+} = T\bar{Q}_A Q_B + \bar{T} Q_A Q_B$$

$$Q_{B+} = \bar{T} \bar{Q}_B$$

$$X = Q_A Q_B$$

$$Y = Q_A$$

$$Z = Q_A + Q_B$$

3