



Complete, fold and seal
(see note 2 below)

SURNAME: Thomas

FORENAME(S): Elias Huw

Examination Answer Books

12 Pages

Instructions to Candidates

- Please give the information requested in the boxes below.
- Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
- 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.
- Write your answers in ink.
- Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
- No part of this book is to be torn out; it must be handed in complete.
- If more books than one are used, fasten them together using the tags available from the invigilator(s).
- 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	Signals and digital comms
3	Module Code	SEEE5005
4	Date and Time of Examination	23/05/24
5	Examination Venue	Graig
6	Seat Number	
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
A	37
B1	22
B2	18
Total	77

(Gweler yr ochr arall am y fersiwn Cymraeg)

Llyfr Atebion Arholiadau

12 Tudalen

Cyfarwyddiadau i Ymgeiswyr

- Rhowch yr holl wybodaeth yn gofynnir amdani yn y blychau isod.
- Rhowch eich enw yn y lle a ddarparwyd ar y dde, plygwch ef at i selio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.
- Rhaid i'r atebion fod mewn llawysgrifen ddarllenadwy. Gall yr Arholiwr naill ai anwybyddu sgrïpt annarllenadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.
- Ysgrifennwch eich atebion mewn inc.
- Dechnewch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnw linell drwyddynt.
- Ni ddylid rhwgo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.
- Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyllwr/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	Rhif Myfyrwr	
2	Teitl 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	

Rhestrwch rifau'r cwestiynau a ymgeisiwyd gennych	At Ddbention y Swyddfa
Cyfanswm	

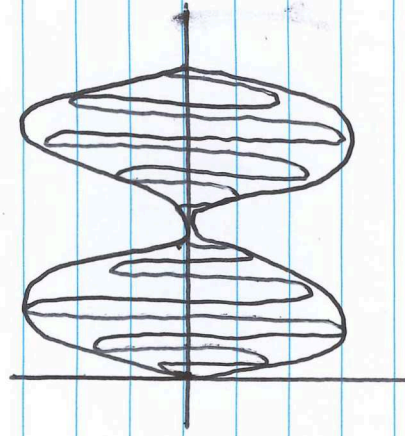
Llenwch, plygwch a seliwch
(gweler nodyn 2 isod)

CYFENW: _____

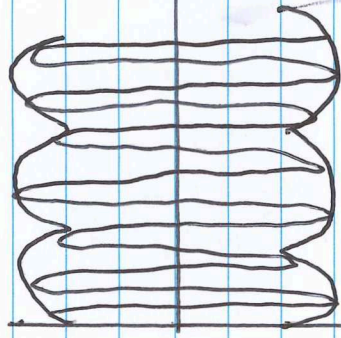
ENW(AU) CYNTAF: _____

A) 2

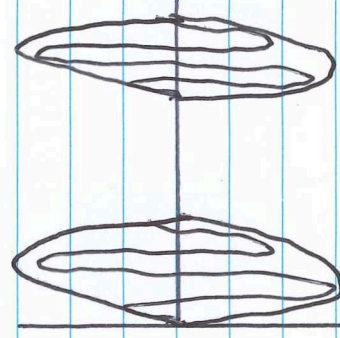
$m = 1$



$m = 0.5$



$m = 1.5$



Question No.	Examiner Only	Question No.	Examiner Only	Answer yn unig	Philly Cwestiwn
2)	$m = \frac{V_{max} - V_{min}}{V_{max} + V_{min}} = \frac{17.5 - 4.5}{17.5 + 4.5} = 0.599$	2			
3)	$250 \times 10^6 = f_c = 250 \times 10^6 \times 2\pi = 6.28 \times 10^9 \text{ rad/s}$ $10,000 = f_s = 62831.9 \times 10^3 = 10,000 \times 2\pi = 62831.9$ $4 \text{ V} = E_c$ $60 \times 10^3 = DF$ $m_f = \frac{DF}{f_s} = \frac{60,000}{10,000} = 6$ $e = E_c \cos(\omega_c t + m_f \sin(\omega_s t))$ $e = 4 \cos(1.57 \times 10^4 t + 6 \sin(62831.9 t))$	4.			
4)	$V_I = 10 \text{ V}$ $V_R = 4 \text{ V}$ $V_{SWR} = \frac{V_I + V_R}{V_I - V_R} = \frac{10 + 4}{10 - 4} = 2.3 \text{ V}$ $P_i = \frac{V_R}{V_I} = \frac{4}{10} = 0.4$	4.			
5)					
	The signal comes in through the antenna and is amplified by the RF amp which selects the signal. The mixer uses the oscillator and RF amp signals and reduces to the IF amp can use it. After the IF amp, the detector cleans the carrier wave and leaves the message, this message is then amplified by the AF amp to a speech frequency for sound.	7			

Question No.	Examiner Only	Question No.	Examiner Only	Answer yn unig	Philly Cwestiwn
7)	- Flash ADC are not limited by the amount of comparators required. - For $n = 8$ bit, 256 comparators are needed. - A analogue inputs applied to comparators in parallel. Set voltages drops are derived by using set resistors. The voltages produced then creates a binary code and latched until the next sample. This creates a digital signal.	7)			
8)	$d = 0.4$ $K = 2.15$ $Z_0 = 75 \Omega$ $Z_0 = \frac{138}{\sqrt{K}} \log \frac{D}{d}$ $75 = \frac{138}{\sqrt{2.15}} \log \frac{D}{0.4}$ $75 = 94.16 \log \frac{D}{0.4}$ $\text{antilog } \frac{75}{94.16} = \frac{D}{0.4}$ $6.26 = \frac{D}{0.4}$ $6.26 \times 0.4 = D = 2.504 \text{ mm}$	8)			

8

Answer yn unig	Philly Cwestiwn	Answer yn unig	Philly Cwestiwn
17		8	

7) Flash ADC are fast but limited by the amount of comparators required.

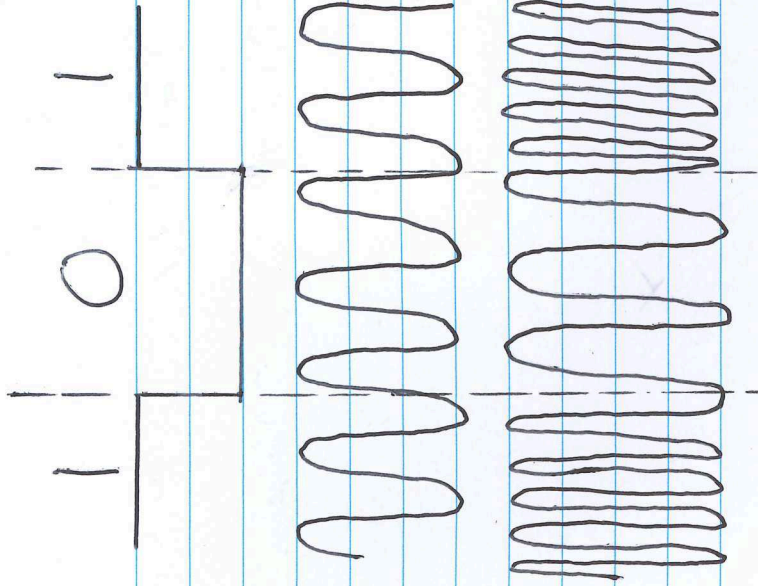
For $n=8$ bit, 256 comparators are needed.

A analogue inputs applied to comparators in parallel. Set voltages drops are derived by using set resistors. The voltages produced then creates a binary code and latches until the next sample. This creates a digital signal.

8) $d = 0.4$
 $K = 2.15$
 $Z_0 = 75 \Omega$
 $Z_0 = \frac{138}{\sqrt{K}} \log \frac{D}{d}$
 $75 = \frac{138}{\sqrt{2.15}} \log \frac{D}{0.4}$
 $75 = 94.16 \log \frac{D}{0.4}$
 $\text{antilog } \frac{75}{94.16} = \frac{D}{0.4}$
 $6.26 = \frac{D}{0.4}$
 $6.26 \times 0.4 = D = 2.504 \text{ mm}$

4.

q1)



Frequency Shift Keying works by increasing the frequency from the carrier which would represent the Boolean expression of 1. Then when the message is the carrier frequency, it represents the Boolean expression of 0.

$$10) P_i = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{120 + j60 - 50}{120 + j60 + 50} = \frac{70 + j60}{170 + j60}$$

$$\text{mag} = \frac{92.2 \angle 40.6^\circ}{180.3 \angle 19.44^\circ} = 0.51 \angle 21.16^\circ \checkmark$$

F_c m ω_s ω_c

$$B) B) \quad V = 14 (1 + 0.65 \cos 25120t) \sin 5.027 \times 10^6 t$$

$$F_c = \frac{5.027 \times 10^6}{2\pi} = 800072 \text{ Hz}$$

$$F_s = \frac{25120}{2\pi} = 3998 \text{ Hz}$$

$$m = 0.65$$

$$F_c = 14$$

$$i) \quad V_{min} = \frac{F_c - mF_s}{2} = \frac{14 - (0.65 \times 14)}{2} = 4.9 \text{ V}$$

$$V_{max} = \frac{F_c + mF_s}{2} = \frac{14 + (0.65 \times 14)}{2} = 23.1 \text{ V}$$

$$ii) \quad F_c - F_s = 800072 - 3998 = 796074 \text{ Hz}$$

$$F_c + F_s = 800072 + 3998 = 804070 \text{ Hz}$$

$$iii) \quad V = \frac{mF_s}{2} = \frac{0.65 \times 14}{2} = 4.55 \text{ V} \checkmark$$

$$R = 10\Omega$$

$$e = 18 \cos(5 \times 10^8 t) + 6 \sin(3000 t)$$

$$F_c = \frac{5 \times 10^8}{2\pi} = 79.58 \times 10^6 \text{ Hz}$$

$$F_s = \frac{3000}{2\pi} = 477.46 \text{ Hz}$$

$$m = 6 \quad k_c = 18$$

$$\Delta F = m \times F_s = 6 \times 3000 = 18000 \text{ Hz}$$

$$P = \frac{k_c^2}{2R} = \frac{18^2}{2 \times 10} = 32.4 \text{ W}$$

d)

$$F_c = 200 \times 10^3 \text{ Hz}$$

$$30 \text{ V} = 30 \times 10^3$$

$$F_s = 20 \text{ KHz}$$

$$\Delta F_c = F_{\max} - F_c = 230 \times 10^3 - 200 \times 10^3 = 30 \text{ KHz}$$

$$\beta = \frac{\Delta F_c}{F_s} = \frac{30 \times 10^3}{20 \times 10^3} = 1.5$$

1.5 is used to find the amplitude.

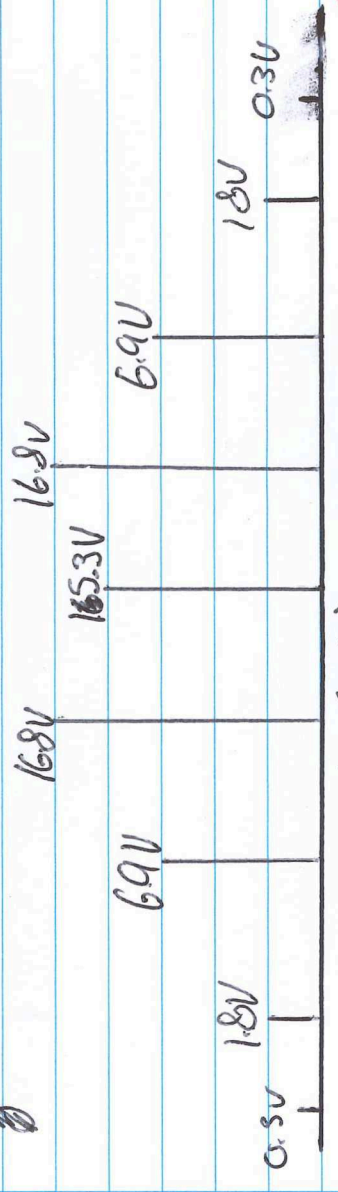
$$j_0 = 30 \times 0.51 = 15.3 \text{ V}$$

$$j_1 = 30 \times 0.56 = 16.8 \text{ V}$$

$$j_2 = 30 \times 0.23 = 6.9 \text{ V}$$

$$j_3 = 30 \times 0.06 = 1.8 \text{ V}$$

$$j_4 = 30 \times 0.01 = 0.3 \text{ V}$$



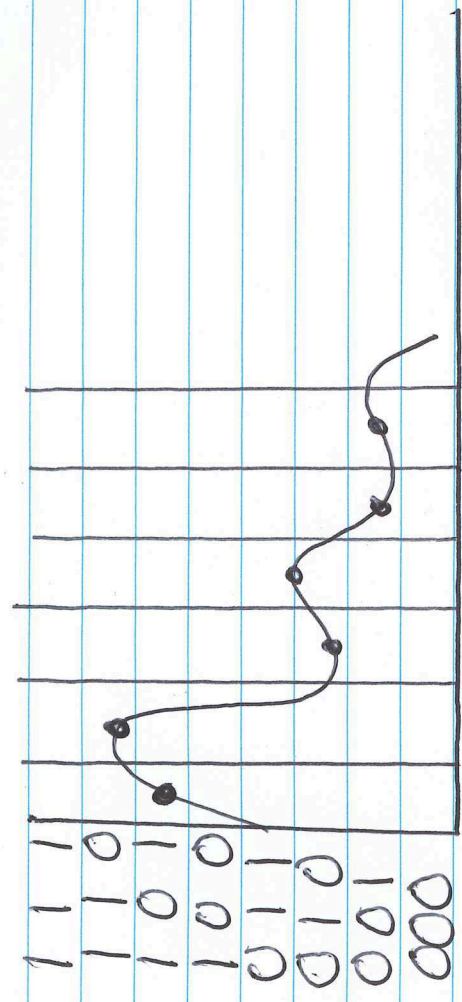
Frequency of message = 20 KHz

Bandwidth = 160 KHz

Amplitude = Voltage peak value

421

e)



Quantisation is set by how many bit ADC is being used, how quick the sample rate is. If these aren't up to specification there could be quantisation error as some signals might change so fast and be missed. Fast sample rate creates a lot of error.

4

4

Rhif y Cwestiwn 4