



Complete, fold and seal
(see note 2 below)

SURNAME: Lupton

FORENAME(S): Oliver

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	<u>signas and digital communications</u>
3	Module Code	<u>SGEE5005</u>
4	Date and Time of Examination	<u>23/5/24</u> <u>09:30 - 12:00</u>
5	Examination Venue	<u>coreg sir</u> <u>qwr.</u>
6	Seat Number	
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
<u>A</u>	<u>B0433.</u>
<u>B1</u>	<u>B7</u>
<u>B2</u>	<u>7</u>
Total	<u>474</u>

(Gweler yr ochr arall am y fersiwn Cymraeg)

Llyfr Atebion Arholiadau

12 Tudalen

Cyfarwyddiadau i Ymgeiswyr

- Rhowch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
- 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.
- Rhaid i'r atebion fod mewn llawysgrifen ddarlennadwy. Gall yr Arholwyr naill ai anwybyddu sgrïpt annarlenadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.
- Ysgrifennwch eich atebion mewn linc.
- Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.
- Ni ddylid rhwngo 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 gwyliwr/gwyliwyr.
- 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 Myfyriwr	
2	Teitl y Papur Arholiad	
3	Cod y Modiwl	
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 Ddlbenion y Swyddia
Cyfanswm	

Llenwch, plygwch a seliwch
(gweler nodyn 2 isod)

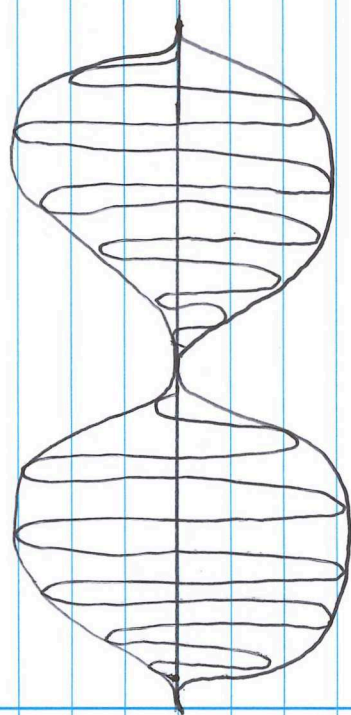
CYFENW: _____

ENW(AU) CYNTAF: _____

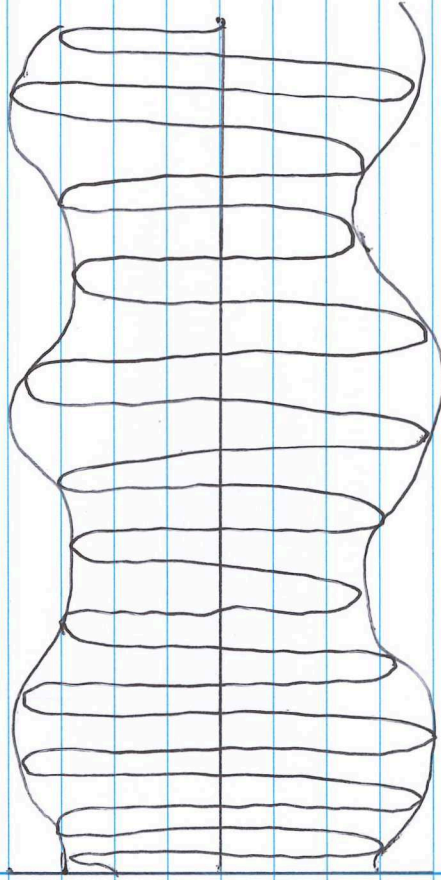
Section A

① modulation envelope

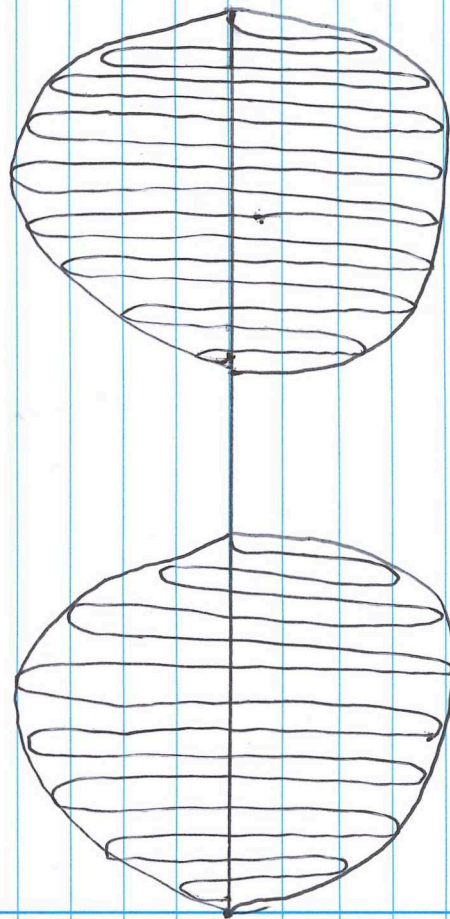
Modulation factor 1.



Modulation factor 0.5



modulation factor 1.5



②

$$\begin{aligned} \text{max p-p} &= 35 \text{ mV} \\ \text{min p-p} &= 9 \text{ mV} \end{aligned}$$

$$m = \frac{V_{\text{max}} - V_{\text{min}}}{V_{\text{max}} + V_{\text{min}}}$$

$$= \frac{35 - 9}{35 + 9} = 0.590$$

③ 3 advantages of fm over Am.

- It has noiseless reception ✓
- Operating range is quite large ✓
- The efficiency of transmission is very high ✓

④

$$e = E_c \cos(\omega_c t + m_f \sin \omega_m t)$$

$$E_c = 4$$

$$\begin{aligned} \omega_c &= 2\pi f_c \\ &= 2\pi \times 250 \times 10^6 \\ &= 1.571 \times 10^9 \text{ rads} \end{aligned}$$

$$\begin{aligned} \omega_s &= 2\pi f_s \\ &= 2\pi \times 10 \times 10^3 \\ &= 62.83 \times 10^3 \text{ rads} \end{aligned}$$

$$m_f = \frac{\Delta f}{f_s} = \frac{60 \times 10^3}{10 \times 10^3} = 6$$

$$e = 4 \cos(1.571 \times 10^9 t + 6 \sin 62.83 \times 10^3 t)$$

⑤

$$V_{\text{SWR}} = \frac{|V_{i1}| + |V_{r1}|}{|V_{i1}| - |V_{r1}|}$$

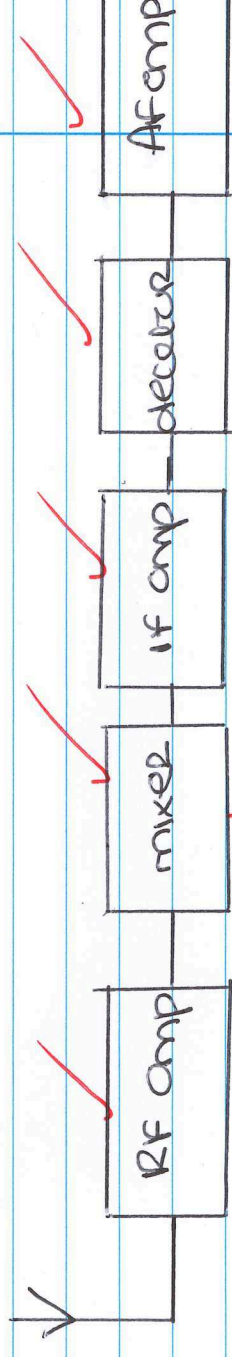
$$= \frac{|10| + |4|}{|10| - |4|}$$

$$= 2.3$$

b).

$$P_r = \frac{|V_{r1}|}{|V_{i1}|} = \frac{|4|}{|10|} = 0.4$$

⑥ Superhetrodyne radio receiver.



RF amp:
selects signal it wants.

mixer
reduces RF to IF.

IF amp.

Amplification takes place.

decoder

removes carrier and leaves you with the message

AF amp.

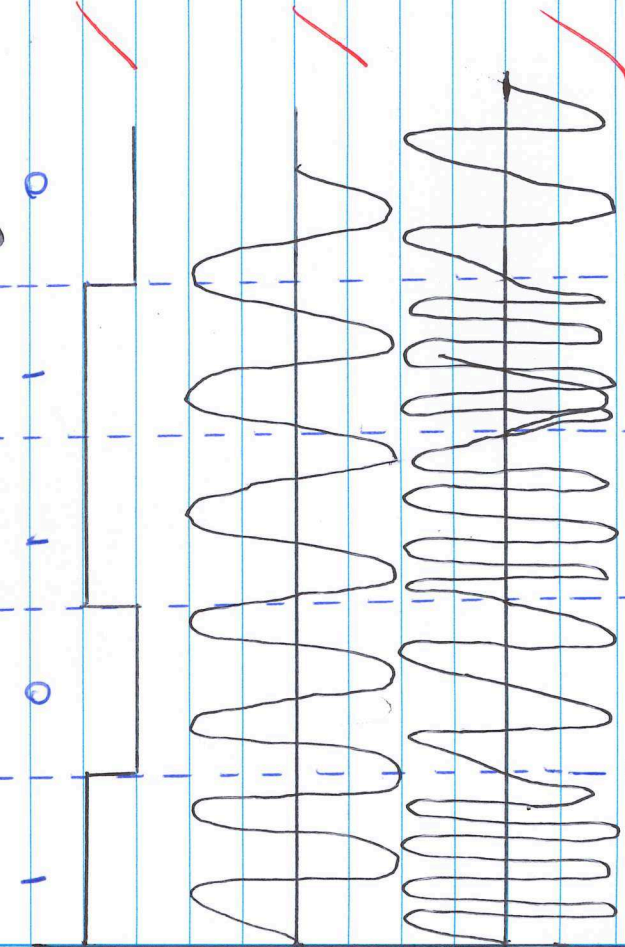
drives your loud speaker

⑦. flash adc works:

An analogue input signal is applied to parallel comparators, and each comparator will have a reference voltage. Comparator outputs (either high or low) are applied to the n level to a bit encoder. Flash converters are fast but are limited to the number of comparators required.

$$\text{⑧. } f = \frac{138}{2.5} \log\left(\frac{0.4}{1}\right) = \frac{138}{2.5} \log(0.4) = 138 \log(0.4) = 138 \times 0.25 = 34.5$$

⑨. FSK - frequency shift keying



The digital data stream changes the frequency of the carrier signal.

Section B.

a).

b). ~~sin wave is represented by the expression~~

~~$$V = 14(1 + 0.65 \cos 25120t) \sin(5.027 \times 10^6 t) \text{ V.}$$~~

~~$$e = EC \cos(\omega_c t + m f \sin \omega_m t).$$~~

~~$$EC = 14$$~~

~~$$\omega_c = 25120 \rightarrow 2\pi f_c$$~~

~~$$= \frac{25120}{2\pi} = 3997.97$$~~

~~$$\omega_m = 5.027 \times 10^6 \rightarrow 2\pi f_m$$~~

~~$$= \frac{5.027 \times 10^6}{2\pi} = 800.072 \times 10^3$$~~

⑩. ⑧. $75 = \frac{138}{2.15} \log\left(\frac{0}{0.4}\right)$

$75 = 94.1109 \left(\frac{0}{0.4}\right)$

$\log\left(\frac{0}{0.4}\right) = \frac{0}{0.4} = D = 0.4 \text{ mm}$

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

$$e = E_c \cos(\omega_c t + m_f \sin \omega_m t)$$

$$E_c = 18$$

$$\omega_c = 5 \times 10^8$$

$$f_c = \frac{\omega_c}{2\pi} = \frac{5 \times 10^8}{2\pi} = 79.577 \times 10^6 \text{ Hz} \quad \checkmark \quad 2$$

$$f_s = \frac{\omega_s}{2\pi} = \frac{3000}{2\pi} = 477.465 \text{ Hz} \quad \checkmark \quad 1$$

$$m_f = 6 \quad \checkmark \quad 1$$

$$A_f = m_f \times f_s = 6 \times 477.465 = 2864.79 \text{ Hz} \quad \checkmark \quad 1$$

$$P = \frac{E_{rms}^2}{R} = \frac{18^2}{10} = 32.4 \text{ W} \quad \checkmark \quad 1$$

Question two

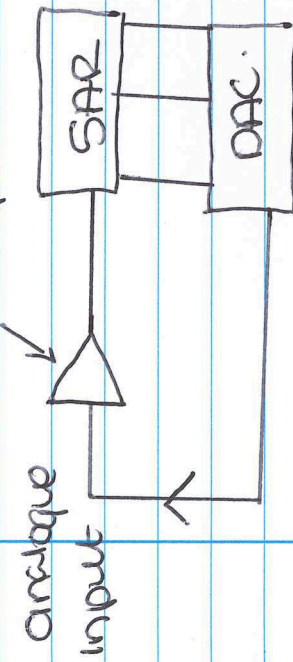
digital modulation

a).

+

0.

b). Successive approximation A/D converter.



The circuit operates by repeatedly comparing the analogue signal voltage with the number of approximate voltages that are created by the DAC. The shift register is cleared and then the DAC output is then zero.

3.

c).

e). Quantisation error

Quantising approximates a continuous range of values and replaces it with a binary number. Error is introduced between the input voltage and the output binary, ~~representing the error~~

2

a). 16 QAM

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

each of the codes are represented by the phase and amplitude combination.

1101	15	phase shifted	45°
1001	15	phase shifted	135°
1100	75	phase shifted	225°
1000	75	phase shifted	315°

2

Section B a).

$$\text{Frequency deviation} = f_{max} - f_c = 230K - 200K = 30 \text{ kHz} \checkmark$$

1

modulation index

$$\frac{f_c}{f_m} = \frac{200K}{20K} = 10K$$

Q31

Sheet

1

$$B1 = 1$$

$$B3 = 2$$