

SURNAME: Thomas

FORENAME(S): Daniel

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		Office Use
2	Title of Examination Paper	Signals and digital communications	A 18
3	Module Code	SGEE5005	B1 22
4	Date and Time of Examination	23/05/2024 09:30	B3 4
5	Examination Venue	Colleg Sir Gar graig	
6	Seat Number		
7	Number of Answer Books handed in		
		Total	9477

(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 â'i selio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.
- Rhaid i'r atebion fod mewn llawysgrifen ddarlennadwy. Gall yr Arholiwr naill ai anwybyddu sgrïpt annarlennadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.
- Ysgrifennwch eich atebion mewn inc.
- Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell 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/gwylywyr.
- 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.

Llenwch, plygwch a seliwch
(gweler nodyn 2 isod)

CYFENW: _____

ENW(AU) CYNTAF: _____

1	Rhif Myfyriwr		Rhestrwch rifau'r cwestiynau a ymgeisiwyd gennych	At Ddbention y Swyddia
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			
			Cyfanswm	

(See the other side for English version)

Section A

2)

~~min~~ ~~V_{max}~~ ~~V_{min}~~

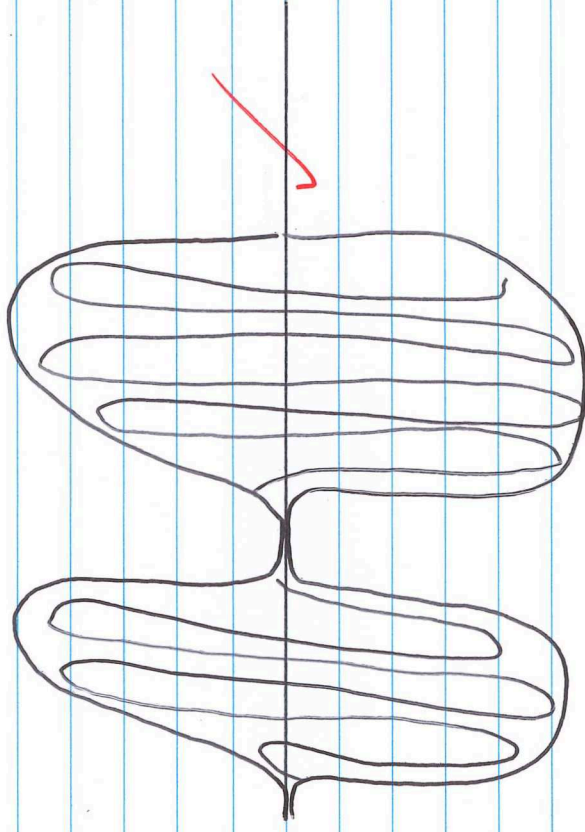
$$m = \frac{V_{max} - V_{min}}{V_{max} + V_{min}} = \frac{17.5 - 4.5}{17.5 + 4.5}$$

$$= 0.59$$

Section A

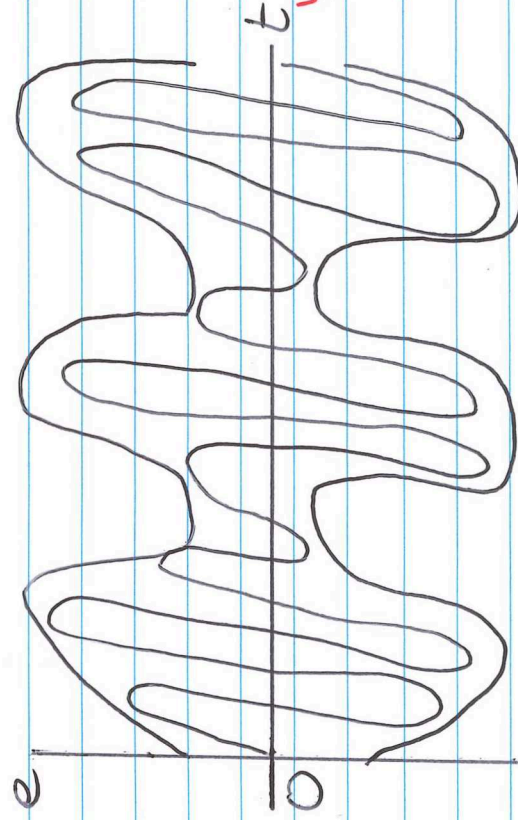
1)

$$m = 1$$



A.m wave

$$m = 0.5$$



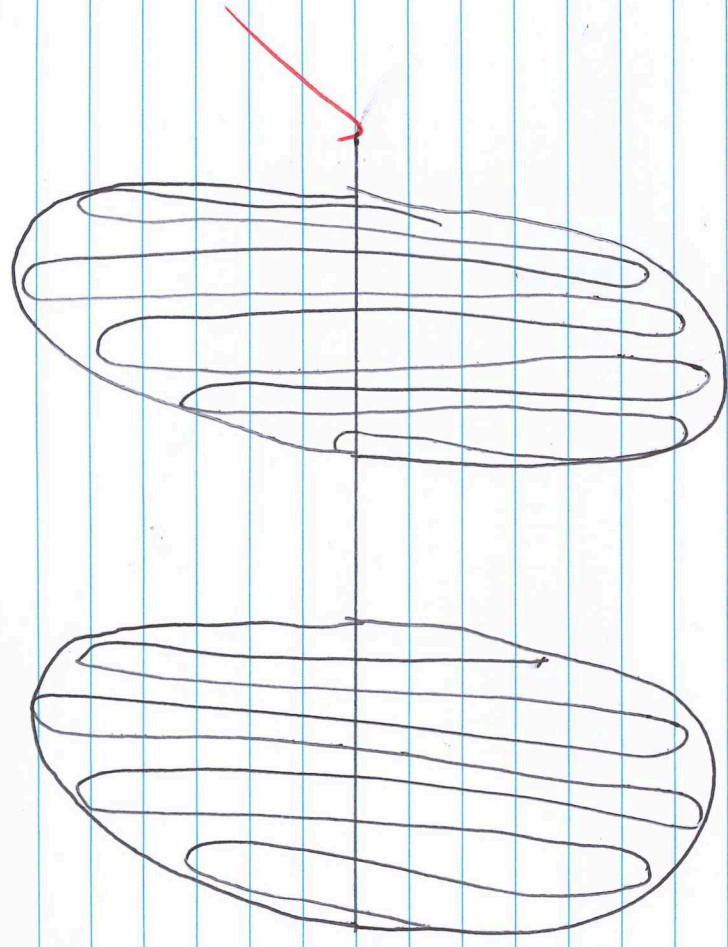
A.m wave

$$m = 1.5$$

Section A

Q1

Continued



A-m wave

Section A

Q3

The operating range is quite large ✓

It gives high fidelity reception ✓

The efficiency of transmission is ✓ very high

$$a) |\overline{VI}| = 10 \quad |\overline{VR}| = 4$$

$$VSWR = \frac{|\overline{VI}| + |\overline{VR}|}{|\overline{VI}| - |\overline{VR}|}$$

$$= \frac{10 + 4}{10 - 4} = 2.33$$

$$b) P_v = \frac{|\overline{VR}|}{|\overline{VI}|} = \frac{4}{10} = 0.4 \checkmark$$

4.

Section A

Q4

$$E_c = 4$$

Question No.	Examiner Only	Question No.	Examiner Only
Section A Q10	$Z_L = 120 + j60$ $Z_0 = 120 + j60$ $120 + j60 - 50 = 70 + j60$ $P_V = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{50 - j120 + j}{50 + j120 + 50}$ in Polar form $70 + j60 = \sqrt{70^2 + 60^2} \angle \tan^{-1} \frac{60}{70} = 92.3 \angle 40.6^\circ$ $170 + j60 = \sqrt{170^2 + 60^2} \angle \tan^{-1} \frac{60}{170} = 180.3 \angle 19.44^\circ$ $P_V = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{92.3 \angle 40.6^\circ}{180.3 \angle 19.44^\circ}$ $= 0.51 \angle 21.16^\circ$	Section B ~~Q10~~ Q11B)	E_c carrier amplitude = 14 modulating frequency $m = 0.65$ Carrier frequency $f_c = 5.027 \times 10^6$ $= 800 \text{ KHz}$ message signal frequency = $\frac{25120}{2\pi}$ $= 4 \text{ KHz}$ $V_{min} = E_c - mE_c = 14 - 0.65 \times 14 = 4.9 \text{ V}$ $V_{max} = E_c + mE_c = 14 + 0.65 \times 14 = 23.1 \text{ V}$ $f_c - f_s = 800 - 4 = 796 \text{ KHz}$ $f_c + f_s = 800 + 4 = 804 \text{ KHz}$ Carrier amplitude = $E_c = 14 \text{ V}$ Sideband amplitude = $\frac{mE_c}{2}$ $= \frac{0.65 \times 14}{2} = 4.55$
Arholwr yn unig	Arholwr yn unig		

Section B
Q1C)

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

$$i) f_c = \frac{\omega_c}{2\pi} = \frac{5 \times 10^8}{2\pi} = 79.55 \times 10^8 \text{ MHz}$$

$$ii) f_s = \frac{\omega_s}{2\pi} = \frac{3000}{2\pi} = 477.46 \text{ Hz}$$

$$iii) m_f = 6$$

$$iv) \Delta m_f = m_f \times f_s = 6 \times 477.46 = 2864.76 \text{ Hz}$$

$$v) \frac{E_{rms}^2}{2R} = \frac{18^2}{2 \times 10} = 1.8 \text{ W}$$

Section B
Q1D)

$$i) \text{ Frequency deviation } (\delta f_c) = f_{\max} - f_c = 230 - 200 = 30 \text{ KHz}$$

$$ii) \text{ Modulation index } (\beta) = \frac{\delta f_c}{f_m} = \frac{30}{20} = 1.5$$

iii) Component amplitudes are calculated from the Bessel table for $(\beta) = 1.5$

$$J_0 = 30 \times 0.51 = 15.3 \text{ V}$$

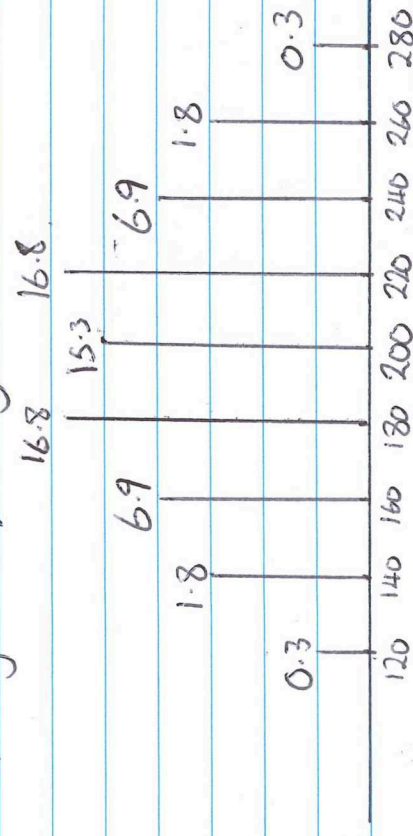
$$J_1 = 30 \times 0.56 = 16.8 \text{ V}$$

$$J_2 = 30 \times 0.23 = 6.9 \text{ V}$$

$$J_3 = 30 \times 0.06 = 1.8 \text{ V}$$

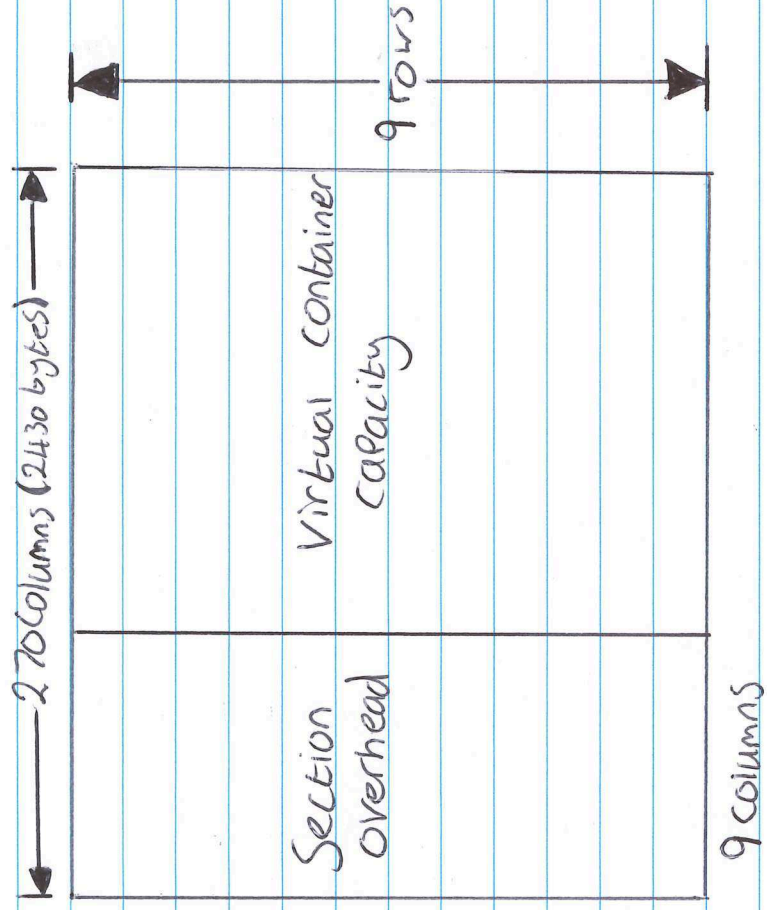
$$J_4 = 30 \times 0.01 = 0.3 \text{ V}$$

Component spacing is calculated as the modulating frequency i.e. 20 KHz



Bandwidth = 160 KHz

Section B
Q3 d)



4

4

4