

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

SURNAME: Thomas

FORENAME(S): Joshua

Examination Answer Books

12 Pages

Instructions to Candidates

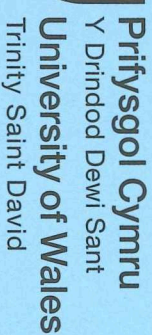
1. Please give the information requested in the boxes below.
 2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
 3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the 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.

[illegible]

1	Student Number	
2	Title of Examination Paper	Signals + digital communications
3	Module Code	SGEE5005
4	Date and Time of Examination	23/5/24 9:30
5	Examination Venue	
6	Seat Number	
7	Number of Answer Books handed in	

(Gweler yr ochr arall am y fersiwn Cymraeg)



Llyfr Atebion Arholiadau

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 at 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 ymgeisydd i dalu.
4. Ysgrifennwch eich atebion mewn inc.
5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.
6. Ni ddylid rhwngwyo 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 gwyllwyr/gwyllwyr.
8. 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	
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 Llyfrau Atebion a gyflwynwyd	

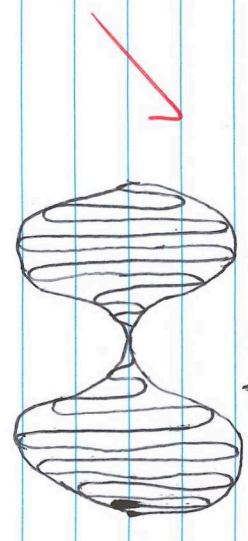
[illegible]

(See the other side for English version)

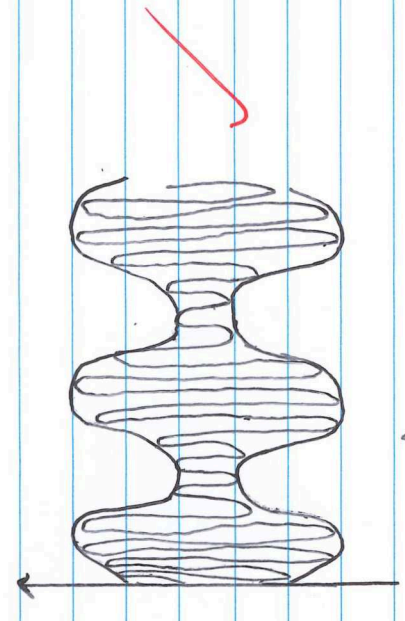
Section A

1)

$m_f = 1$

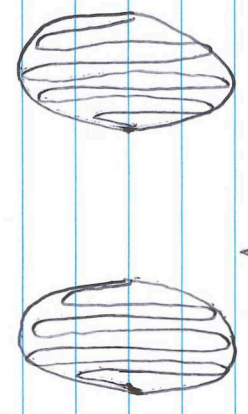


$m_f = 0.5$



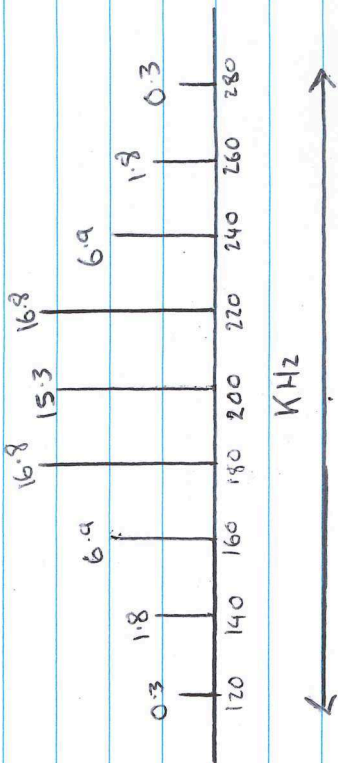
A.M. Wave

$m = 1.5$



[illegible]

Question No.	Examiner Only	Question No.	Examiner Only
10)	$Z_L = 120 + j60 \Omega$ $Z_0 = 50 \Omega$ $P_V = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{120 + j60 - 50}{120 + j60 + 50}$ $= \frac{70 + j60}{170 + j60}$ In Polar : $P_V = \frac{92.7 \angle 40.6^\circ}{180.3 \angle 19.4^\circ}$ $= 0.51 \angle 21.2^\circ$	Section B Q 1. b)	$V = 14 (1 + 0.65 \cos 25120t) \sin (5.027 \times 10^6 t) \text{ Volts}$ $E_c = 14 \text{ V}$ $m_f = 0.65$ $f_c = \frac{5.027 \times 10^6}{2\pi} = 800 \text{ KHz}$ $f_s = \frac{25120}{2\pi} = 4 \text{ KHz}$ i) $V_{min} = E_c - m E_c = 14 - (0.65 \times 14)$ $= 4.9 \text{ V}$ $V_{max} = E_c + m E_c = 14 + (0.65 \times 14)$ $= 23.1 \text{ V}$ ii) $f_c - f_s = 800 \text{ K} - 4 \text{ K} = 796 \text{ KHz}$ $f_c + f_s = 800 \text{ K} + 4 \text{ K} = 804 \text{ KHz}$ iii) $E_c = 14 \text{ V}$ $E_s = \frac{m_f \times E_c}{2} = \frac{0.65 \times 14}{2}$ $= 4.55 \text{ V}$
Answer yn unig	6	Answer yn unig	6

Question No.	Examiner Only	Question No.	Examiner Only
C)	$e = 18 \cos(5 \times 10^8 t + 6 \sin(3000 t))$		
i)	$f_c = \frac{5 \times 10^8}{2\pi} = 79.6 \text{ MHz}$		
ii)	$f_s = \frac{3000}{2\pi}$		5.
iii)	$mf = 6$		
iv)	$\Delta f_c = mf \times f_s = 6 \times 477.5 = 2865 \text{ Hz}$		
v)	$P = \frac{E_{rms}^2}{2R} = \frac{18^2}{16} = 20.25 \text{ W}$		The frequency spacing on the Spectrum diagram is determined by using the sinusoidal frequency which in this case is 20KHz. Bandwidth = 280 - 120 = 160KHz
D)			
i)	$\Delta f_c = f_{max} - f_c = 230K - 200K = 30KHz$		
ii)	$B = \frac{\Delta f_c}{f_s} = \frac{30K}{20K} = 1.5$		
iii)	Using the modulation index calculated above, and the Bessel table and the carrier wave peak amplitude, $J_0 - J_4$ can be calculated		
	$J_0 = 30 \times 0.51 = 15.3 \text{ V}$		
	$J_1 = 30 \times 0.56 = 16.8 \text{ V}$		
	$J_2 = 30 \times 0.23 = 6.9 \text{ V}$		
	$J_3 = 30 \times 0.06 = 1.8 \text{ V}$		
	$J_4 = 30 \times 0.01 = 0.3 \text{ V}$		
			Arholwr yn unig
			Arholwr yn unig
			Arholwr yn unig

Question No.	Examiner Only	Question No.	Examiner Only	Examiner Only
Q.3 b) i)	$P_V = \frac{Z_L - Z_0}{Z_L + Z_0}$ $= \frac{90 + j40 - 50}{90 + j40 + 50} = \frac{40 + j40}{140 + j40}$ In Polar: $P_V = \frac{56.6 \angle 45^\circ}{145.6 \angle 16^\circ}$ $= 0.39 \angle 29^\circ \quad \checkmark$ ii) $V_I = 10 \angle 0^\circ = 10 \angle 0^\circ$ $V_L = 90 + j40$ $V_R = V_L - V_I = 80 + j40$ $V_L = V_I + V_R \quad \times$	5	~~Message 567412 divided by 99~~	
Arholwr yn unig	Rhif y Cwestiwn	Arholwr yn unig	Rhif y Cwestiwn	Rhif y Cwestiwn