



Complete, fold and seal
(see note 2 below)

FORENAME(S): Joshua

Jordan

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.**

1	Student Number	1451789
2	Title of Examination Paper	~~88~~ SIGNAL & Comms
3	Module Code	SQEE 5005
4	Date and Time of Examination	12/5/22 9:30
5	Examination Venue	
6	Seat Number	
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
A	28
B1	$21\frac{1}{2}$
B2	7
Total	57%

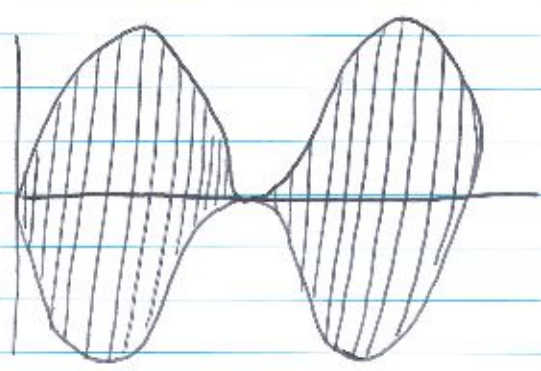
(Gweler yr ochr arall am y fersiwn Cymraeg)

Mark confirmed as 57

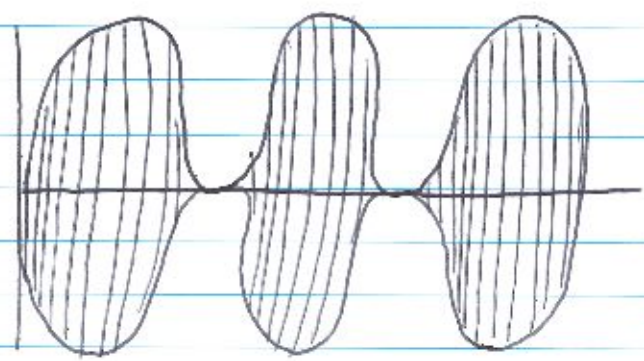
PART A

Al.

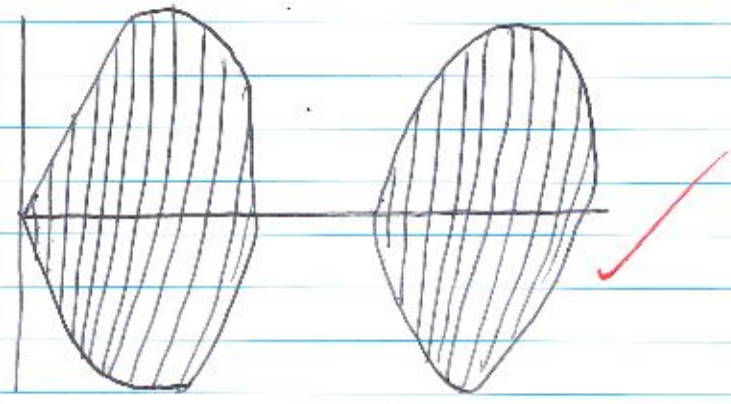
$M = 1$



$M = 0.5$



$M = 1.5$



3

3

$$A2) \quad \frac{35}{2} = 17.5 \quad \frac{9}{2} = 4.5$$

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

$$m = \frac{17.5 - 4.5}{17.5 + 4.5} = 0.59 \checkmark$$

A3) Efficiency of transmission is very high
 & operating range is very large.
 & Noiseless reception. $\checkmark$

A4)

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

$$e = 4 \cos(250 \times \sin 10 t) \checkmark$$

A5) VSWR

$$V_i = 10V \quad V_R = 4V$$

$$\frac{V_i + V_R}{V_i - V_R} = \frac{10 + 4}{10 - 4} = 2.33 \quad \checkmark$$

2

Reflection Co-efficient.

$$P_v = \frac{V_R}{V_i} = \frac{4}{10} = 0.4 \quad \checkmark$$

2

A6)



1

A7) Flash ADC.

It works by applying analogue voltage signals to the parallel comparators.

The output comparators are either 'high' (logic 1) or 'low' (logic 0). This uses an n bit encoder.

The n bit = 8 bits is 256

The n bit = 16 bits is 65536.

1

$$A8) Z_0 = \frac{138}{\sqrt{K}} \log \frac{D}{d} \quad \checkmark$$

$$Z_0 = \frac{138}{\sqrt{2.15}} \log \frac{D}{0.4}$$

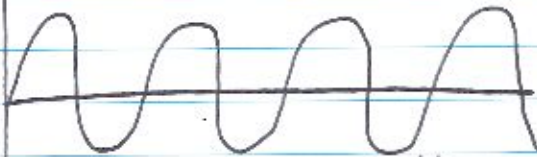
$$75 = 94 \log \frac{D}{0.4} \quad \checkmark$$

$$\text{antilog} \cdot \frac{75}{94} = \frac{D}{0.4} = 4.06 \quad \times$$

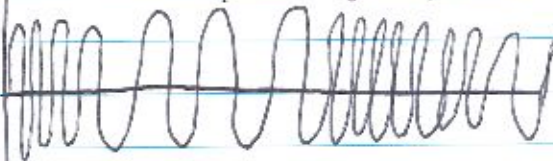
 $3\frac{1}{2}$

A9) FSK

IS the data bit Stream changing the frequency for the amplitude signal.



(~~Amplitude~~ Signal)



(~~Amplitude~~ Signal)

 $2\frac{1}{2}$

$$A10) PV = \frac{Z_L - Z_0}{Z_L + Z_0}$$

$$PV = \frac{120 + j60 - 50}{120 + j60 + 50}$$

$$PV = \frac{70 + j60}{170 + j60}$$

$$= \sqrt{70^2 + 60^2} = 92.2 / 40.6^\circ$$

$$= \tan^{-1} \left(\frac{60}{70} \right)$$

$$= \sqrt{170^2 + 60^2} = 180.3 / 19.44^\circ$$

$$= \tan^{-1} \left(\frac{60}{170} \right)$$

$$\frac{92.2 / 40.6^\circ}{180.3 / 19.44^\circ} = 0.51 / 21.16^\circ$$

6

Question B1

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

$$i) \text{ minimum} = \frac{5.027 \times 10^6}{2\pi} = 800 \text{ KHz.}$$

$$\text{maximum} = \frac{25120}{2\pi} = 4(\text{KHz}).$$

$$800 + 4 = 804 \text{ KHz.} \checkmark$$

$$800 - 4 = 796 \text{ KHz.} \checkmark$$

$$796 \times 4 = 318400$$

$$V = \frac{m_{EC}}{2} = \frac{0.65 \times 14}{2} = 4.55 \text{ V} \checkmark$$

4

4

c)

$$\omega_c = \frac{3000}{2\pi} = 477 \text{ Hz.}$$

$$\omega_s = \frac{5 \times 10^8}{2\pi} = 79.6 \text{ MHz.}$$

$$\text{Modulation index} = 6.$$

$$\text{Maximum deviation} = 6 \times 477 = 2862$$

Power dissipated =

$$\sum \frac{E^2}{2R} = \frac{18^2}{2 \times 10} = \frac{18^2}{20} = 16.2 \text{ W}$$

7

$$d) \quad P_V = \frac{Z_L - Z_0}{Z_L + Z_0}$$

$$P_V = \frac{90 + j40 - 50}{90 + j40 + 50}$$

$$= \frac{40 + j40}{140 + j40}$$

$$= \sqrt{40^2 + 40^2} = 56.6 / 45^\circ$$

$$\tan^{-1}\left(\frac{40}{40}\right)$$

$$= \sqrt{140^2 + 40^2} = 145.6 / 15.95^\circ$$

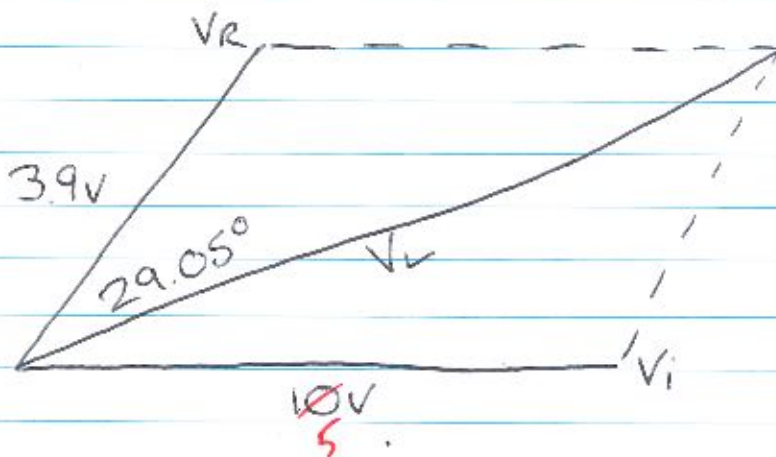
$$\tan^{-1}\left(\frac{40}{140}\right)$$

$$\frac{56.6 / 45^\circ}{145.6 / 15.95^\circ} = 0.39 / 29.05^\circ$$

4

$$ii) \quad 10V$$

$$0.39 \times 10 = 3.9V$$



3 1/2

7 1/2

iii) Load voltage. $V_L = V_1 + V_R$.

10/0° and 3.4/29.05°
~~5~~

$$\begin{aligned} 10/0^\circ &= 10 \cos 0 \\ &\quad + j10 \sin 0 \\ &= 10 + j0. \end{aligned}$$

$$\begin{aligned} 3.4/29.05^\circ &= 3.4 \cos 29.05 \\ &\quad + j 3.4 \sin 29.05. \\ &= 2.97 + j1.65. \end{aligned}$$

$$10 + j0 + 2.97 + j1.65.$$

$$12.97 + j1.65. \quad \checkmark \text{ Carried over.}$$

3

Question B2

$$2^{10} = 1024.$$

$$i) DR = 20 \log(1024)$$

$$DR = 60.21 \text{ dB.} \checkmark$$

$$q = \text{Voltage Range} / N.$$

$$q = 32 / 1024.$$

$$q = 0.03. \checkmark$$

$$V_{QN} = q / \sqrt{12}$$

$$= 8.66 \text{ mV.} \checkmark$$

$$SQNR = \frac{R_{ms}}{V_{QN}} = \frac{4.7}{8.66} = \frac{543}{8.66} \checkmark$$

$$DR = 20 \log \left(\frac{543}{8.66} \right) = 54.7 \text{ dB} \checkmark$$

b) Approximation.

This works by repeatedly comparing the analogue signals with the output of the DAC. The DAC output is one half of its full scale.



e) Quantisation

IS when the continuous range of values are changed into a binary number.

ERROR

IS when the analogue input voltages and the binary output representation is compared through an ADC and all depends on the ~~representation~~ quality of ADC.

1