



Complete, fold and seal
(see note 2 below)

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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.

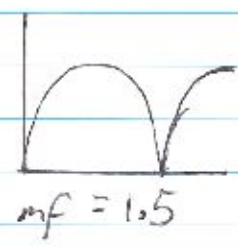
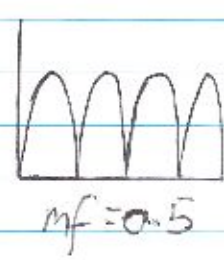
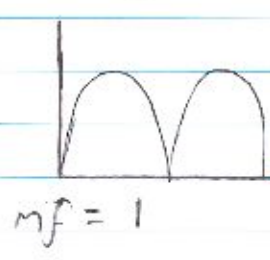
1	Student Number	1910599
2	Title of Examination Paper	Signals and Digital Comms.
3	Module Code	SGEE5005
4	Date and Time of Examination	12/5/22 09:30
5	Examination Venue	
6	Seat Number	
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
A	19
B2	7
B3	8
Total	34%

mark confirmed as 34

A1

3 amplitude modulated waveforms.



X

0

A2

AM Wave

$$V_{max} = 35 \text{ mV}$$

$$V_{min} = 9 \text{ mV}$$

Calculate mf.

$$m = \frac{V_{max} - V_{min}}{V_{max} + V_{min}} = \frac{35 \times 10^{-3} - 9 \times 10^{-3}}{35 \times 10^{-3} + 9 \times 10^{-3}}$$

$$m = \frac{26 \times 10^{-3}}{44 \times 10^{-3}} = 0.591 \quad \checkmark$$

2

A3

Advantages of FM over AM.

- * Can transmit further
- * ~~Audio clarity of transmitted~~
- * Audio quality is better after transmitted.

2

A4

$$250 \text{ MHz } f_c$$

$$10 \text{ kHz } f_s$$

$$V_c = 4 \text{ V}$$

$$\text{max } f_d = 60 \text{ kHz}$$

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

$$e = 4 \cos(250 \times 10^6 t + 10 \times 10^3 t) \quad \checkmark \quad \frac{1}{2} \quad \frac{1}{2}$$

2

A5

Incident wave = 10V reflected wave = 4V
 calculate VSWR & p.v.

$$VSWR = \frac{|\bar{V}_I| + |\bar{V}_R|}{|\bar{V}_I| - |\bar{V}_R|}$$

$$= \frac{10 + 4}{10 - 4} = \frac{14}{6}$$

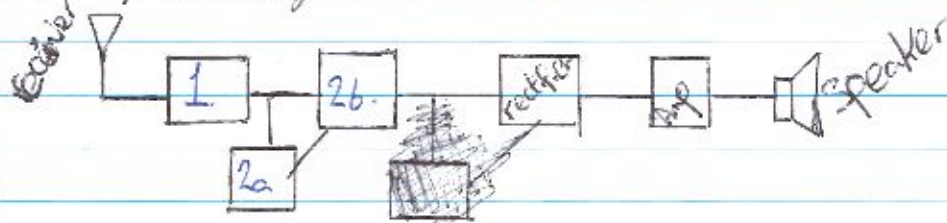
$$VSWR = \frac{14}{6} = 2.3$$

$$P_v = \frac{V_r}{V_i} = \frac{4}{10}$$

$$P_v = 0.4$$

A6

AM Superheterodyn radio receiver.



Receiver - Obtains transmitted waveforms.

1. - filters unwanted frequencies

2a & 2b. - Removes the amplitude modulation & produces a waveform.

Rectifier - Smoothes waveform & removes noise.

Amplifier (Amp) - increases the voltage

Speaker. - Vibrates to produce the received waveform.

A10

50Ω Trans line, $Z_L = 120 + j60 \Omega$

Calc. PV in polar form.

conv to rec.

$$x = m \cos \theta$$

$$y = m \sin \theta$$

conv to polar.

$$m = \sqrt{x^2 + y^2}$$

$$\theta = \tan^{-1}\left(\frac{y}{x}\right)$$

$$P_V = \frac{\bar{Z}_L - Z_0}{\bar{Z}_L + Z_0} = \frac{120 + j60 - 50}{120 + j60 + 50} = \frac{70 + j60}{170 + j60}$$

Conversion to Polar.

$$m = \frac{70 + j60}{\sqrt{70^2 + 60^2}} \quad \phi = \tan^{-1}\left(\frac{60}{70}\right) = 40.601^\circ$$

$$= 92.195^\circ$$

$$n = \frac{170 + j60}{\sqrt{170^2 + 60^2}} \quad \phi = \tan^{-1}\left(\frac{60}{170}\right) = 19.440^\circ$$

$$= 180.278^\circ$$

$$P_V = \frac{70 + j60}{170 + j60} = \frac{92.195 \angle 40.601^\circ}{180.278 \angle 19.44^\circ}$$

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$$P_V = 0.5114 \angle -21.161^\circ$$

~~Question B~~

$$b) \quad \underline{\cancel{v = 14(1 + 0.65 \cos 25120t) \sin(5.027 \times 10^6 t) \text{ Volts.}}}$$

$$\underline{\cancel{\omega_c = 25120 \quad \omega_s = 5.027}}$$

$$c) \quad \underline{\cancel{e = 18 \cos(5 \times 10^8 t + 65 \sin(300 \pi t))}} \\ \underline{\cancel{e = E_c \cos(\omega_c t + m_f \sin(\omega_s t))}}$$

$$\underline{\cancel{E_c = 18 \quad \omega_c = 5 \times 10^8 \quad m_f = 6 \quad \omega_s = 300 \pi}}$$

Question B2.

a)

$$V_s = 4.7 V_{rms} \quad f_{max} = 3.4 \text{ KHz} \quad 10 \text{ bit quant. ser.}$$

$$V_{range} = -16 \text{ V to } +16 \text{ V (32 bits)}$$

i) dynamic range.

$$DR = 20 \log_{10}(N) \quad \text{and } N = 2^n$$

$$n = 10 \quad \therefore N = 1024.$$

$$DR = 20 \log_{10}(1024)$$

$$= 60.206 \text{ dB} \quad \checkmark$$

ii) SQNR.

$$SQNR = \text{rms Signal Voltage} / V_{QN}$$

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

$$q = \frac{V_{range}}{N}$$

$$q = \frac{32}{1024} = \frac{1}{32} = 0.03125 \quad \checkmark$$

$$V_{QN} = \frac{0.03125}{\sqrt{12}} = 9.021 \text{ mV} \quad \checkmark$$

$$SQNR = \frac{4.7}{9.021 \times 10^{-3}}$$

$$= 521.0065 \quad \checkmark$$

for dB

$$20 \log(521.0065) = 54.3369 \text{ dB} \quad \checkmark$$

7

Question B3.

b.) Purpose of each layer of the OSI network model.

1. Application -
2. Presentation - Use of the Program.
- 3.
4. Transport -
- 5.
6. Networking - IP Addressing.
7. Physical - Permissions.

5

c.) $G = 99$.

Message 1 = 567412 check 43

Message 2 = 985314 check 55.

For an error to occur the check digit must not be the same as the remainder after dividing by G . For example;

$$\frac{567412}{99} = 5731.43$$

Whereas MS2 has a different remainder as shown below;

$$\frac{985314}{99} = 9952.6$$

∴ message 2 has the error. ✓

3.