



Requirements for this paper:

Multi choice cards: ☐

Programmable calculator: ☐

Graphic paper: ☐

Laptop: ☐

Open book examination ☐

EKSAMEN/
EXAMINATION:

Semestertoets 1
Semester test 1

KWALIFIKASIEPROGRAM/
/QUALIFICATION PROGRAM:

MODULEKODE/
MODULE CODE:

EERI 423

DUUR/
DURATION:

1 uur / 1 hour

MODULE BESKRYWING/
MODULE DESCRIPTION:

**Telekommunikasie /
Telecommunication**

MAKS / MAX:

47

EKSAMINATOR(E)/
EXAMINER(S):

Prof J.E.W. Holm

DATUM /
DATE:

2014-08-11

TYD / TIME:

12:00

MODERATOR:

Mr C. vd Merwe

TOTAAL / TOTAL: 47

VRAAG 1 / QUESTION 1 - [12]

1.1) Noem die basiese elemente van enige versender. / *List the basic elements of any transmitter.* [4]

- Carrier generator (carrier source)
- Modulation
- Amplification
- Matching to antenna for transmission

1.2) Definieer (i) basisband en (ii) breëband kommunikasie. / *Define (i) baseband and (ii) broadband communication.* [2]

- Baseband – unmodulated information signal directly onto transmission medium
- Broadband – modulated carrier signal onto transmission medium

1.3) Noem en verduidelik die drie soorte multipleksering wat oor die algemeen gebruik word. / *List and explain the three types of multiplexing that are commonly used.* [6]

- FDMA – Intelligence signals modulate sub-carriers which are added and transmitted across a number of frequency channels
- TDMA – Intelligence signals are sequentially sampled and transmitted over 1 frequency
- CDMA – Intelligence is converted to digital and uniquely coded onto 1 frequency

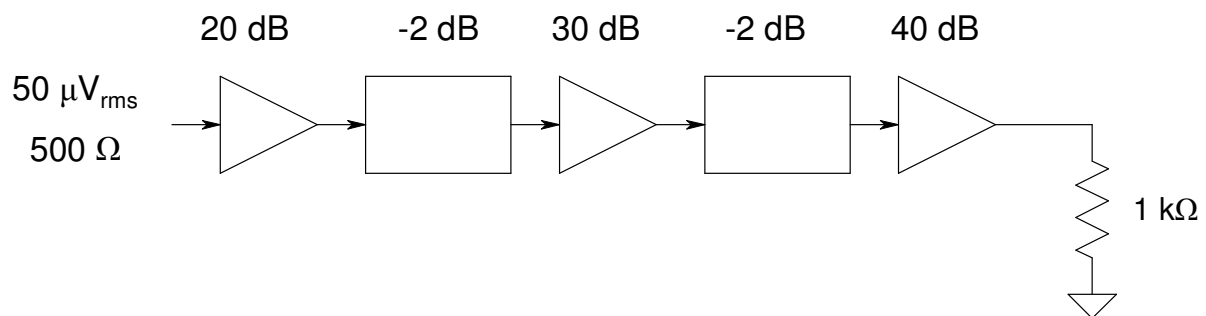
VRAAG 2 / QUESTION 2 - [16]

2.1) 'n Versterker versterk 4 mW rms om 'n uitset te gee van 20 V_p in 'n las van 50 Ω. Wat is die wins in dB? / An amplifier amplifies 4 mW rms to give an output of 20 V_p into a load of 50 Ω. What is the gain in dB? [4]

$$P_{out} = \frac{1}{2} V^2 / R = 400 / (2 \cdot 50) = 4W \quad [2]$$

$$\text{Gain} = 10 \log(4/0.004) = 30 \text{ dB} \quad [2]$$

2.2) Die IF trap van 'n ontvanger het die volgende drywingswinselemente / The IF stage of a receiver has the following power gain elements:



- 1) Gee die totale wins van die ontvanger in dB / Give the total gain of the receiver in dB; [2]
- 2) Bereken die uitsetdrywing in dBm / Compute the output power in dBm; [2]
- 3) Wat sal die uitsetspanning (rms) wees oor 'n 1 kΩ las / What will the output voltage (rms) be across a 1 kΩ load? [2]

- 1) Total gain = Σ gains = 86 dB [2]
- 2) Input power = $V_{in}^2 / 500 \Omega = 5 \text{ pW} = -83 \text{ dBm}$
Output power = $-83 \text{ dBm} + 86 \text{ dB} = 3 \text{ dBm}$ [2]
- 3) Output power (in W) = $10^{0.3} = 2 \text{ mW}$
Output voltage = 1.4 V [2]

2.3) Beskryf kortliks die volgende terme verwant aan A/D omskakeling: / Briefly explain the following terms related to A/D conversion:

- 1) Resolusie / Resolution; [2]
 - 2) Kwantiseringsruis / Quantizing noise; [2]
 - 3) Dinamiese bereik / Dynamic range. [2]
- 1) Resolution of an A/D converter: The smallest value recognised by the A/D converter given by $V_{ref} / 2^N$. [2]
 - 2) Quantizing noise: The noise voltage that can be added to the input signal as a result of an error produced by the A/D conversion. [2]
 - 3) Dynamic range: A measure of the range of input voltages that can be converted by an A/D, determined by the ratio of the maximum input voltage to the minimum recognizable voltage converted to deibels. [2]

VRAAG 3 / QUESTION 3 - [19]

3.1) Toon aan dat 'n μ -Wet omsetter ("componder") werk deur twee insetspannings (0.3V en 3V) deur 'n omsetter te stuur en die winste dan te vergelyk. Aanvaar $\mu = 255$ en die maksimum spanning is 5V. / Show that a μ -Law compander actually works by sending two input voltages (0.3V and 3V) through the compander and comparing the gain values. Assume $\mu = 255$ and the maximum voltage is 5V. [5]

μ	255
Vin1	0.3 V
Vin2	3 V
Vm	5 V

Vout1	2.51675 V	1
Gain1	8.38917 High gain	1

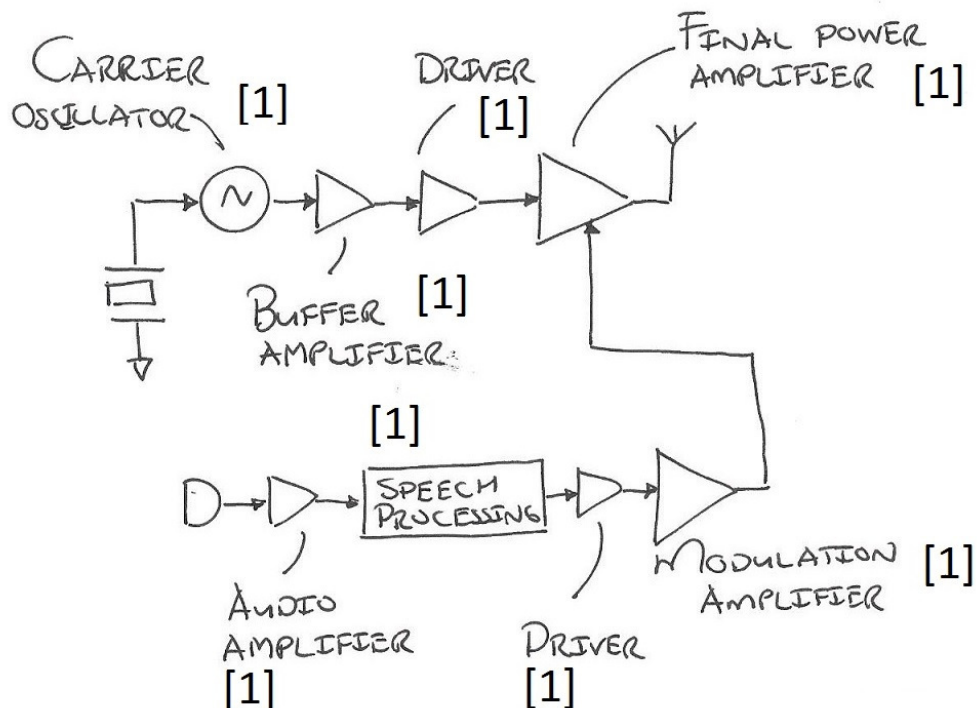
Vout2	4.54174 V	1
	Low	
Gain2	1.51391 gain	1

Gain at 3V input is less than gain at 0.3V input (8.4 vs 1.5) 1

5

3.2) Teken die basiese elemente van 'n tipiese hoë-vlak AM versender en verduidelik benoem elke element. Jy hoef nie die antenne te noem of te beskryf nie.

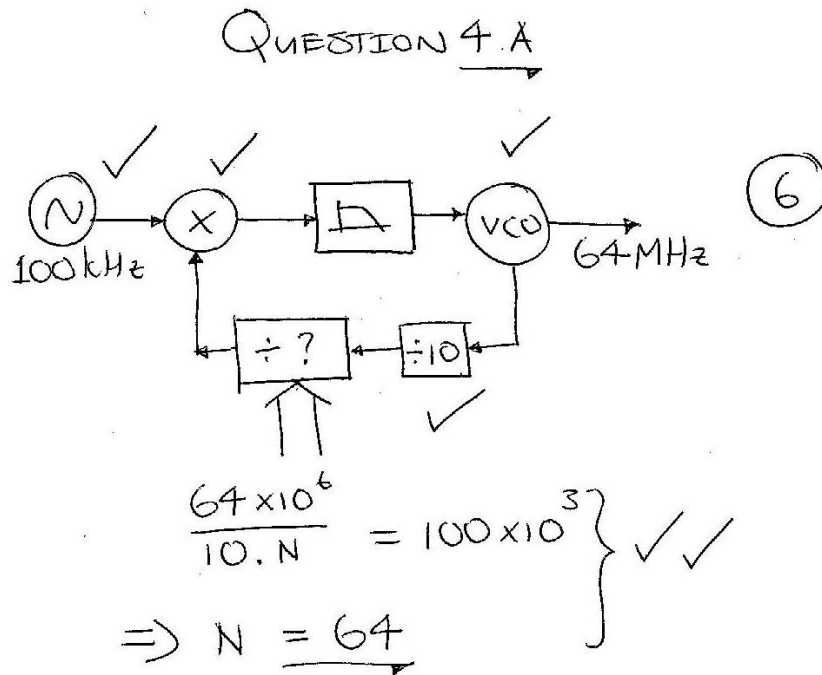
Draw the basic elements of a typical high-level AM transmitter and name each element. You don't have to name and describe the antenna. [8]



3.3) 'n Frekwensie-sintetiseerder word benodig met volgende spesifikasies: / A frequency synthesizer is required with the following specifications: [6]

Uitsetfrekwensie / Output frequency: 64 MHz
 Verwysingsfrekwensie / Reference frequency: 100 kHz
 Voorverdeler / Prescaler: 10

Teken 'n blokdiagram van die sintetiseerder en dui die programmeerbare verdeler se waarde aan sodat die verlangde uitsetfrekwensie behaal kan word. / Draw a block diagram of the synthesizer and indicate the programmable divider's value so that the desired output frequency can be achieved.



EERI423 FORMULEBLAD
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Datakommunikasie / Data communication

$$V_{out} = \frac{V_m \ln\left(1 + \frac{\mu V_{in}}{V_m}\right)}{\ln(1 + \mu)}$$

$$C = 2B \log_2(N)$$

$$V_{out} = \frac{1 + \ln\left(\frac{AV_{in}}{V_m}\right)}{1 + \ln(A)}$$

$$C = B \log_2\left(1 + \frac{S}{N}\right)$$