higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

COMMUNICATION-ELECTRONICS N6

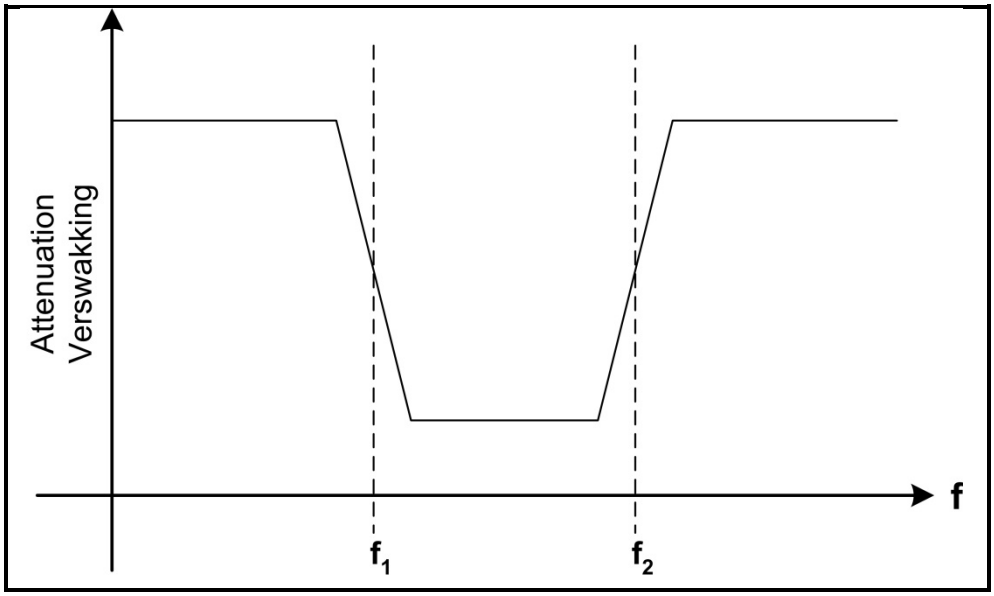
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This marking guideline consists of 12 pages.

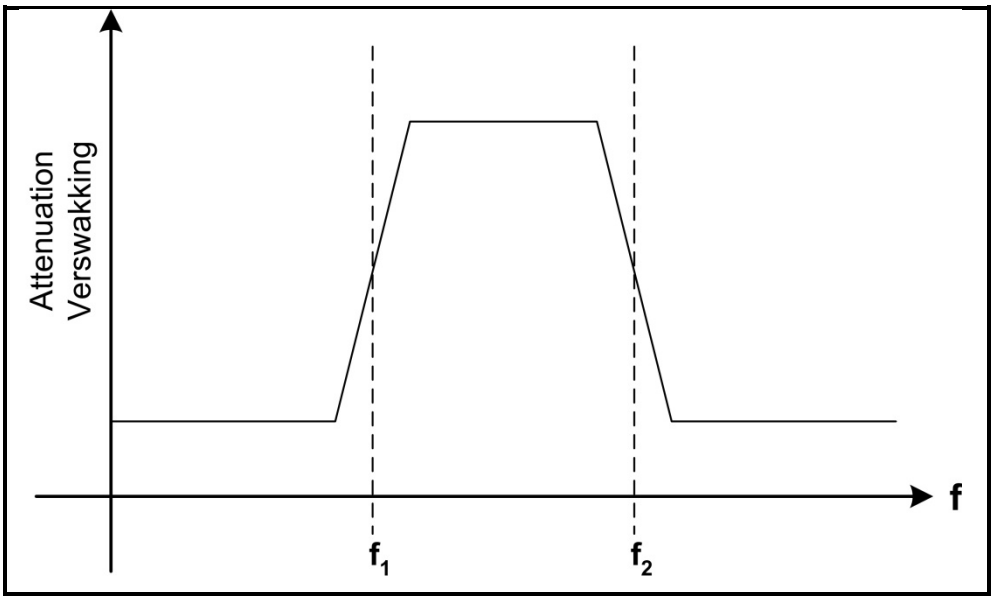
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QUESTION 1

1.1 1.1.1



1.1.2



(2 × 2) (4)

1.2 $L = \frac{Z_o}{4.\pi.f_c}$ $C = \frac{1}{4.\pi.Z_o.f_c}$

$= \frac{600}{4 \times 3,142 \times 5 \times 10^3}$ $= \frac{1}{4 \times 3,142 \times 600 \times 5 \times 10^3}$

= 9,548 mH **= 26,522 nF** (2)

$m = \sqrt{1 - \frac{f_\infty{}^2}{f_c{}^2}}$ Series $C = \frac{C}{m}$

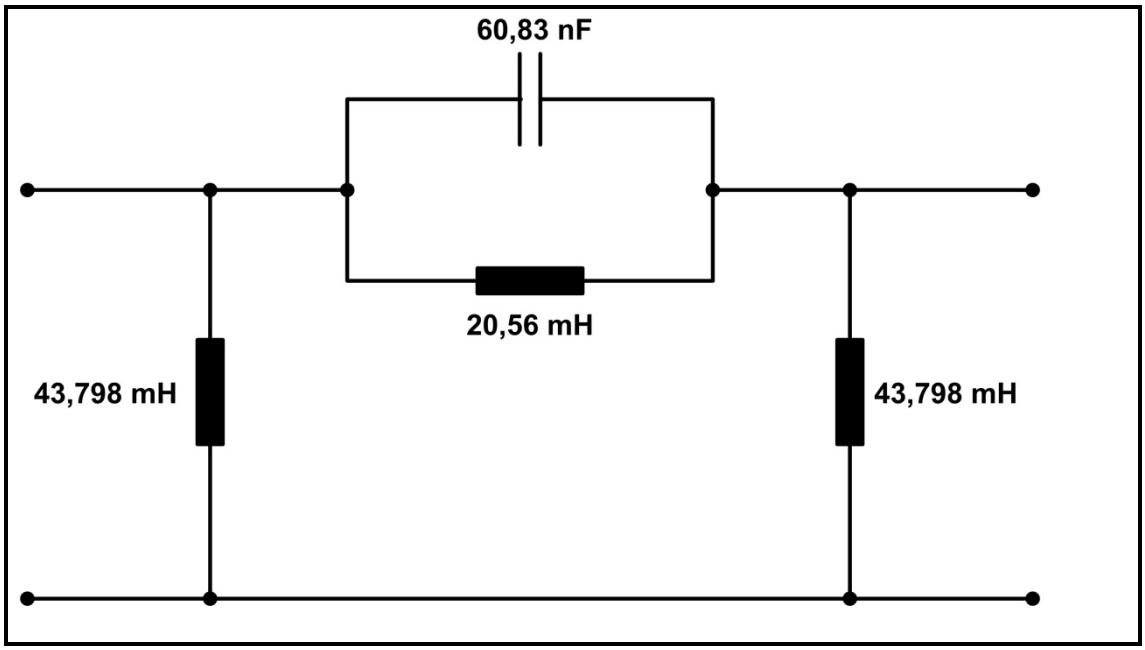
$= \sqrt{1 - \frac{\left(4,5 \times 10^3\right)^2}{\left(5 \times 10^3\right)^2}}$ $= \frac{26,522 \times 10^{-9}}{0,436}$

= 0,436 **= 60,83 nF** (2)

Series $L = \frac{4m}{1-m^2} \cdot L$ Shunt $L = \frac{2.L}{m}$

$= \frac{4 \times 0,436}{1 - 0,436^2} \times 9,548 \times 10^{-3}$ $= \frac{2 \times 9,548 \times 10^{-3}}{0,436}$

= 20,56 mH **= 43,798 mH** (2)



(1)

1.3 1.3.1 Input
1.3.2 Low-pass filter

(2 × 1) (2)

1.4 Shunt C = m.C m = 0,6

$$\therefore C = \frac{\text{Shunt C}}{m}$$

$$= \frac{30 \times 10^{-9}}{0,6}$$

= 50 nF (2)

$$C = \frac{1}{\pi . Z_O . f_C}$$

$$\therefore f_C = \frac{1}{\pi . Z_O . C}$$

$$= \frac{1}{3,142 \times 600 \times 50 \times 10^{-9}}$$

= 10,609 kHz (2)
[17]

QUESTION 2

2.1 No, the attenuator frequency is not sensitive because an attenuator only consists of resistive components which are not frequency sensitive. (3)

2.2 dB = 20 log N

$$\therefore N = \text{antilog } \frac{dB}{20}$$

$$= \text{antilog } \frac{12}{20}$$

= 3,981 (2)

$$Z_1 = R_1\left[\frac{N^2+1}{N^2-1}\right] - 2\sqrt{R_1.R_2}\left[\frac{N}{N^2-1}\right]$$

$$= 480\left[\frac{3,981^2+1}{3,981^2-1}\right] - 2\sqrt{480 \times 420}\left[\frac{3,981}{3,981^2-1}\right]$$

= 303,891 Ω (1)

$$Z_2 = 2\sqrt{R_1.R_2}\left[\frac{N}{N^2-1}\right]$$

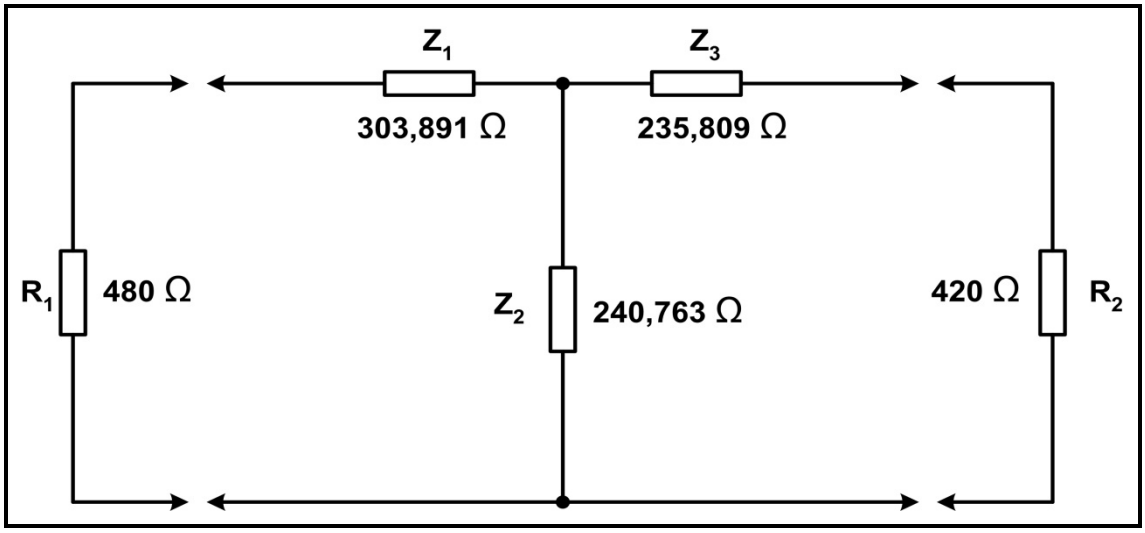
$$= 2\sqrt{480\times420}\left[\frac{3,981}{3,981^2-1}\right]$$

$$= \mathbf{240,763\ \Omega} \quad (1)$$

$$Z_3 = R_2\left[\frac{N^2+1}{N^2-1}\right] - 2\sqrt{R_1.R_2}\left[\frac{N}{N^2-1}\right]$$

$$= 420\left[\frac{3,981^2+1}{3,981^2-1}\right] - 2\sqrt{480\times420}\left[\frac{3,981}{3,981^2-1}\right]$$

$$= \mathbf{235,809\ \Omega} \quad (1)$$



(2)

2.3

$$Z_B = \frac{\sqrt{R_1.R_2}}{2}\ .\ \left[\frac{N^2-1}{N}\right]$$

$$2\,Z_B = \sqrt{R_1.R_2}\ .\ \left[\frac{N^2-1}{N}\right]$$

$$8\times10^3 = \sqrt{300\ .\ R_1}\ .\ \left[\frac{10^2-1}{10}\right]$$

$$8\times10^3 = \sqrt{300\ .\ R_1}\ \times\ [9,9]$$

$$\sqrt{300\ .\ R_1} = 808,081$$

$$300R_1 = 652,995\times10^3$$

$$\therefore\ \mathbf{R_1 = 2,177\ k\Omega} \quad (4)$$

2.4 **For 200 ohm**

$Z_B = Z_o(N-1)$

$\therefore N = \frac{Z_B}{Z_o} + 1$

$= \frac{200}{600} + 1$

= 1,333

dB = 20 log N

= 20 log 1,333

= 2,5 (2)

For 400 ohm

$Z_B = Z_o(N-1)$

$\therefore N = \frac{Z_B}{Z_o} + 1$

$= \frac{400}{600} + 1$

= 1,667

dB = 20 log N

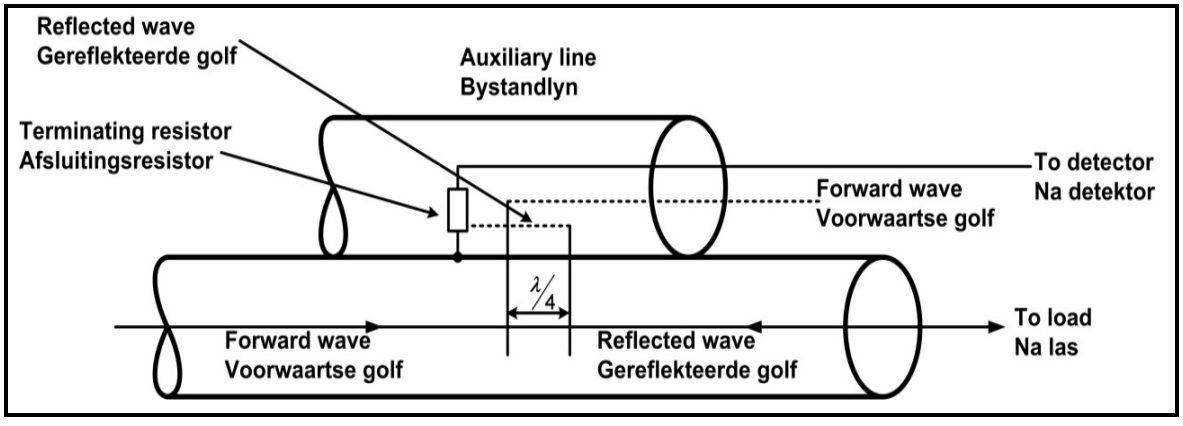
= 20 log 1,667

= 4,44 (2)

[18]

QUESTION 3

3.1



(8)

3.2 3.2.1 It tunes out reactive components.

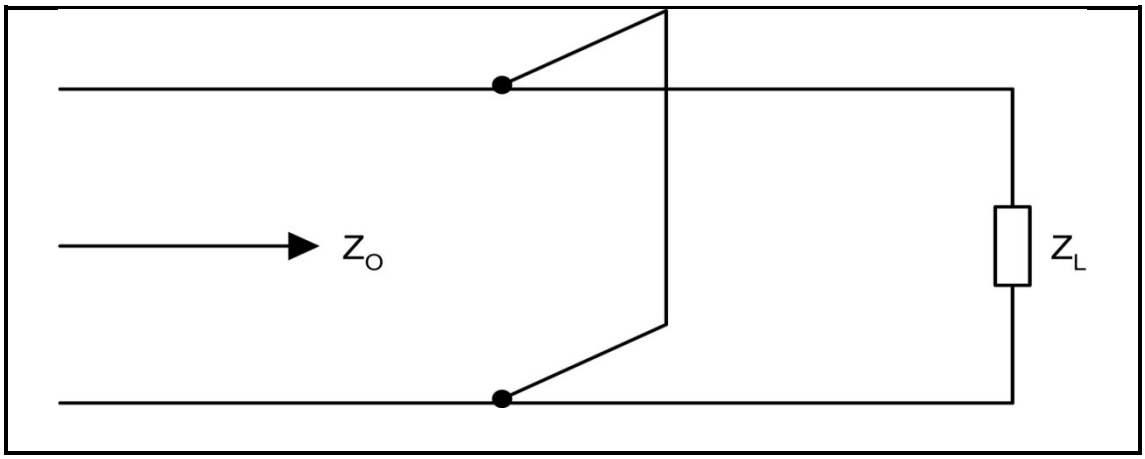
3.2.2 It measures power along a transmission line.

3.2.3 It matches an unbalanced device to a balanced device.

3.2.4 It determines the position and size of the first voltage maximum from the load.

(4 × 1) (4)

3.3



The stub is a short piece of wire which is short-circuited across the transmission line. (4)

3.4 3.4.1 $\text{SWR/SVG} = \frac{Z_L}{Z_o}$

$= \frac{750}{600}$

$= \mathbf{1,25}$

3.4.2 $\text{SWR/SVG} = \frac{Z_L}{Z_o}$

$= \frac{900}{600}$

$= \mathbf{1,5}$

(2 × 1) (2)
[18]

QUESTION 4

4.1 4.1.1 dB = 10 log S/N

$\therefore$ S/N = $\text{antilog}\frac{dB}{10}$

= $\text{antilog}\frac{15}{10}$

= **31,623**

$\therefore$ C = $\Delta f.\log_2[1 + S/N]$

= $10 \times 10^3 \log_2[1 + 31{,}623]$

= $10 \times 10^3 \log_2[32{,}623]$

= $10 \times 10^3 \left[\frac{\log 32{,}623}{\log 2}\right]$

= **50 278,18 bits/sec**

4.1.2 dB = 10 log S/N

$\therefore$ S/N = $\text{antilog}\frac{dB}{10}$

= $\text{antilog}\frac{7{,}5}{10}$

= **5,623**

$\therefore$ C = $\Delta f.\log_2[1 + S/N]$

= $20 \times 10^3 \log_2[1 + 5{,}623]$

= $20 \times 10^3 \log_2[6{,}623]$

= $20 \times 10^3 \left[\frac{\log 6{,}623}{\log 2}\right]$

= **54 549,7 bits/sec**

(2 × 2) (4)

4.2 $En = \sqrt{4.K.T.\Delta F.R}$

$$\therefore R = \frac{En^2}{4.K.T.\Delta F}$$

$$= \frac{\left(18 \times 10^{-6}\right)^2}{4 \times 1{,}38 \times 10^{-23} \times 298 \times 30 \times 10^3}$$

= 656,551 kΩ (3)

4.3 4.3.1
- Lightning
- Static electricity (Any 1 × 1) (1)

4.3.2
- Ignition systems
- Electric motors (Any 1 × 1) (1)

4.3.3
- Fluorescent lights
- The random motion of atoms and molecules in all types of material (2)

4.4 4.4.1 **dB** = 10 log F

$$\therefore \mathbf{F} = \text{antilog } \frac{dB}{10}$$

$$= \text{antilog } \frac{2{,}755}{10}$$

$$= \mathbf{1{,}886}$$

$$\mathbf{F} = 1 + \frac{R'_{eq}}{R_a}$$

$$\therefore R'_{eq} = R_a(F - 1)$$

$$= 85(1{,}886 - 1)$$

$$= \mathbf{75\ ohm}$$ (4)

4.4.2 $\mathbf{T_{eq}} = T_O(F - 1)$

$$= 297(1{,}886 - 1)$$

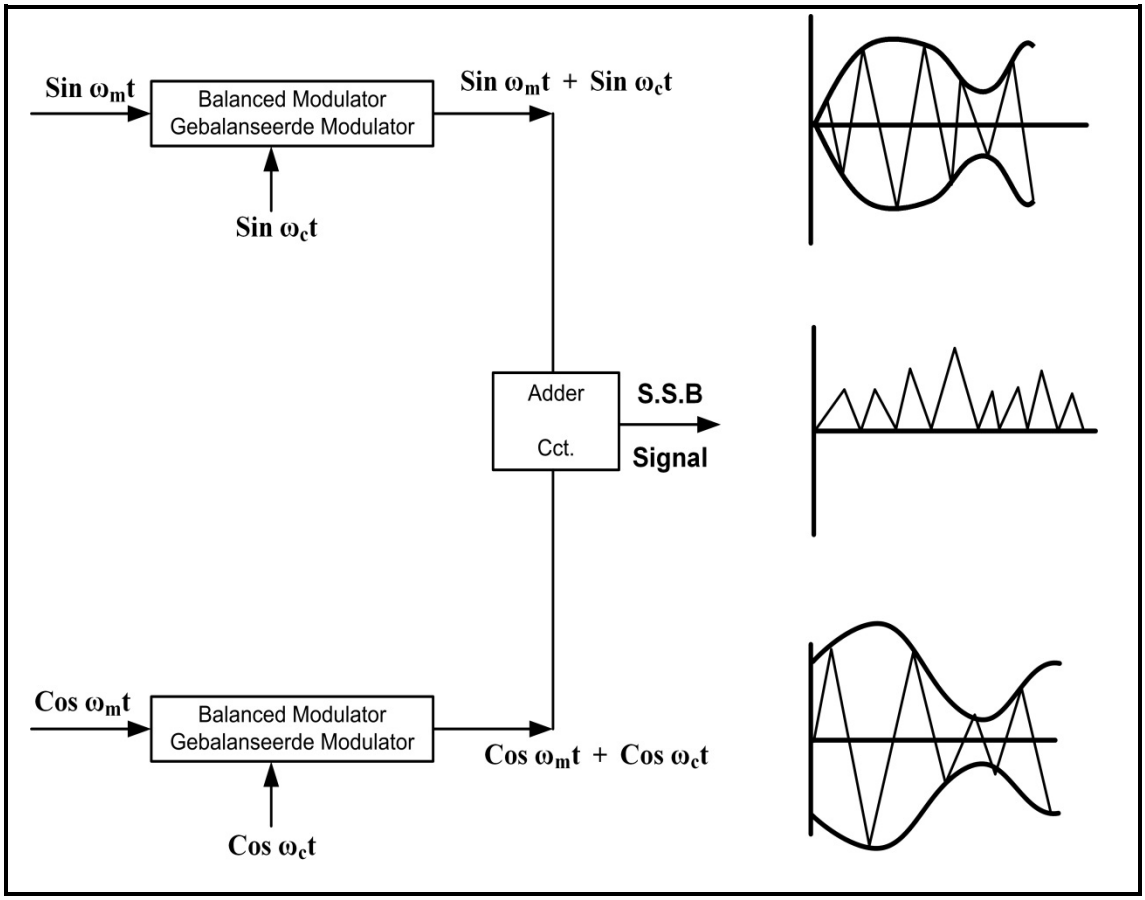
$$= \mathbf{263\ K}$$

$$\therefore \mathbf{t} = \mathbf{-10\ ^0C}$$ (1)

[16]

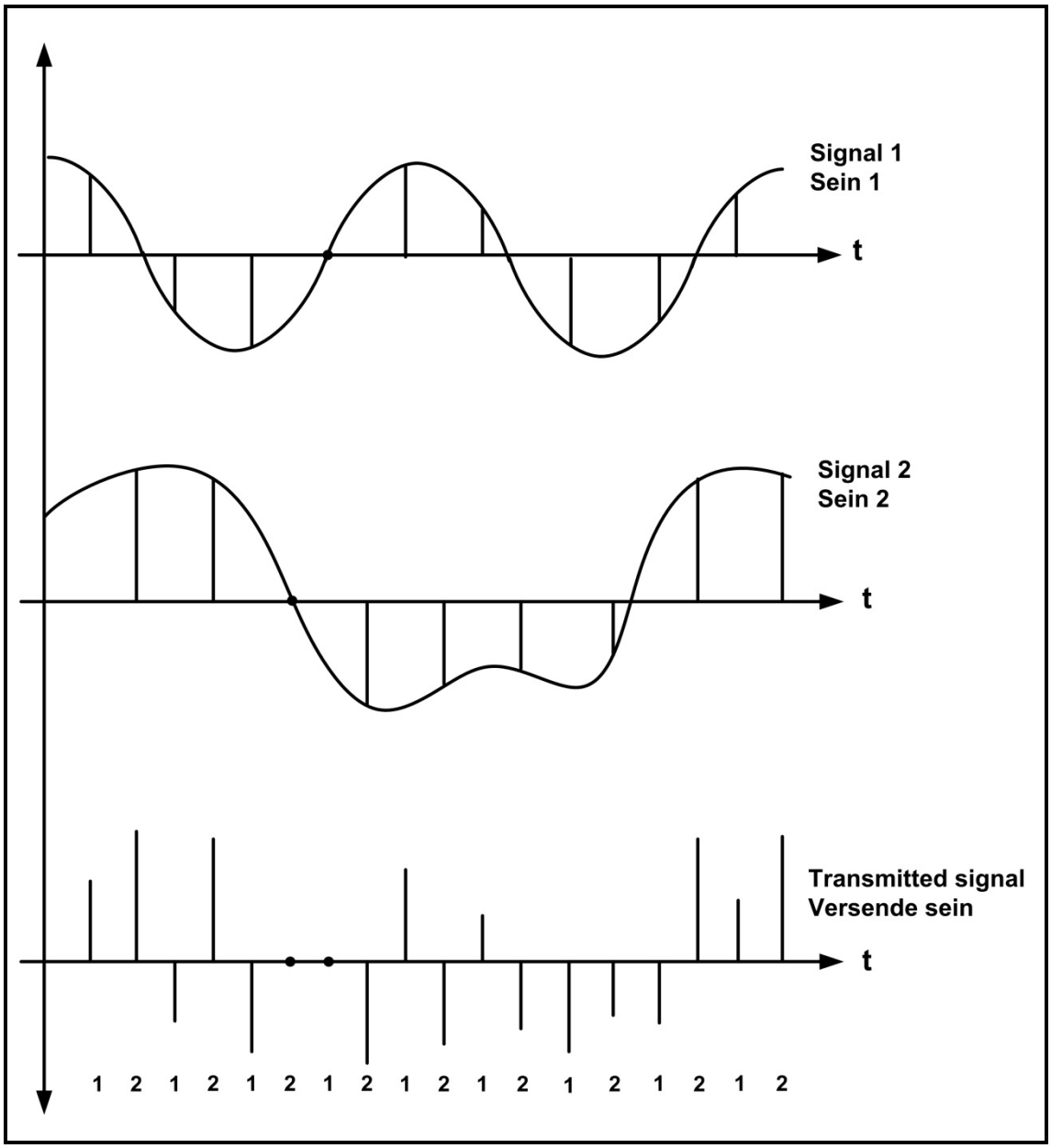
QUESTION 5

5.1



(12)

5.2 Sampling is a process whereby parts of a signal are taken at a tempo of t = ½ of seconds and only the sample is transmitted.



(6)
[18]

QUESTION 6

6.1 6.1.1 P_R = Pd.A

$= 1,2\times10^{-12}\times12$

$= 14,4\times10^{-12}$ watts (1)

6.1.2 $A = \frac{G.\lambda^2}{4.\pi}$

$\lambda = \frac{c}{f}$

$\frac{A.4.\pi}{\lambda^2}\lambda = \frac{3\times10^8}{120\times10^6}$

$= \frac{12\times4\times3,142}{2,5^2}$

= 2,5 m

= **24,131** (3)

$\therefore$ dB = 10 log G

= 10 log 24,131

= 13,826 dB (1)

6.2 6.2.1 It is a device that will convert an electro-magnetic quantity into a corresponding electrical current.

6.2.2 It is a device that will convert electrical current into a corresponding electric-magnetic quantity.

6.2.3 It is the ratio of power density radiated in a specific direction to the power density by an isotropic antenna.

(3 × 2) (6)

6.3 Angle modulation is defined as a modulation whereby the instantaneous angle of the carrier wave is varied which leads to two forms of modulation known as frequency modulation and phase modulation. (2)

[13]

TOTAL: 100

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