higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

APRIL EXAMINATION

INDUSTRIAL ELECTRONICS N5

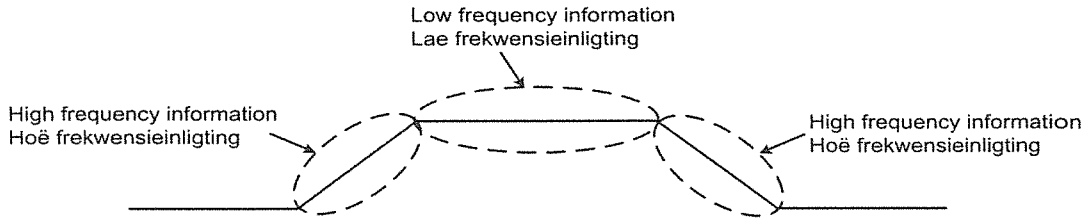
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This marking guideline consists of 12 pages.

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QUESTION 1

1.1



Low and High frequency shortcomings

(3)

1.2 1.2.1

$$X_L = 2\pi fL$$

$$= 2\times\pi\times100\times10^{3}\times0,001\times10^{-3}$$

$$= 6,283\ \Omega$$

$$= 6,283\ \angle 90^0\ \Omega \longrightarrow$$

$$Z_T = \frac{R \times jX_L}{R + jX_L}$$

$$= \frac{20\ \angle 0^0 \times 6,283\ \angle 90^0}{20 + j\,6,283}$$

$$= \frac{125,664\ \angle 90^0}{20,964\ \angle 17,4^0}$$

$$= 5,994\ \angle 72,6^0\ \Omega \longrightarrow$$

OR

$$\frac{1}{Z_T} = \frac{1}{R} - j\frac{1}{X_L}$$

$$= \frac{1}{20} - j\frac{1}{6,2854}$$

$$= 0,05 - j0,159$$

$$\frac{1}{Z_T} = 0,167\ \angle -72,5^\circ$$

$$Z_T = \frac{1}{0,167\ \angle -72,5^\circ}$$

$$= 5,99\ \angle 72,5^\circ\ \Omega$$

(4)

1.2.2

$$I_T = \frac{V_T}{Z_T}$$

$$= \frac{20\ \angle 0^0}{5,994\ \angle 72,6^0}$$

$$= 3,34\ \angle -72,6^0\ \text{A} \longrightarrow$$

(2)

1.2.3

$$I_L = \frac{V_T}{jX_L}$$

$$= \frac{20\ \angle 0^0}{6,283\ \angle 90^0}$$

$$= 3,183\ \angle -90^0\ \text{A} \longrightarrow$$

(2)

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1.2.3 $= \frac{V_T}{R}$

$= \frac{20 \angle 0^0}{20 \angle 0^0}$

$= 1 \angle 0^0$ **A** ⟶

(2)
[13]

QUESTION 2

2.1 POWER SUPPLIES

$$V'_{r(rms)} = \frac{X_c}{\sqrt{R^2 + X_c^2}} \times V_{r(rms)}$$

$$V'^2_{r(rms)} \cdot \left(R^2 + X_c^2\right) = X_c^2 \times V^2_{r(rms)}$$

$$V'^2_{r(rms)} \cdot R^2 + V'^2_{r(rms)} \cdot X_c^2 = X_c^2 \cdot V^2_{r(rms)}$$

$$V'^2_{r(rms)} \cdot R^2 = X_c^2 \cdot V^2_{r(rms)} - V'^2_{r(rms)} \cdot X_c^2$$

$$V'^2_{r(rms)} \cdot R^2 = X_c^2 \left[V^2_{r(rms)} - V'^2_{r(rms)} \right]$$

$$X_c^2 = \frac{V'^2_{r(rms)} \times R^2}{V^2_{r(rms)} - V'^2_{r(rms)}}$$

$$X_c = \sqrt{\frac{V'^2_{r(rms)} \times R^2}{V^2_{r(rms)} - V'^2_{r(rms)}}}$$

$$= \sqrt{\frac{(0,8)^2 \times (1500)^2}{(1,8)^2 - (0,8)^2}}$$

$= 744{,}208\ \Omega$ ⟶

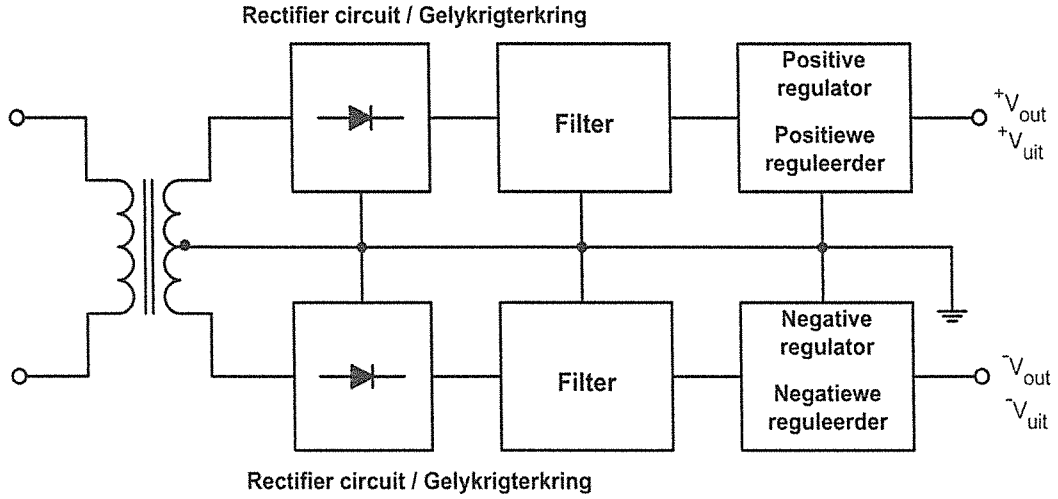
$$C = \frac{1}{4 \times \pi \times f \times X_c}$$

$$= \frac{1}{4 \times \pi \times 50 \times 744{,}208}$$

$= 2{,}139\ \mu f$ ⟶

(6)

2.2



Double powers (7)
[13]

QUESTION 3

3.1 3.1.1 $$R_C = \frac{V_{cc} - V_{ce}}{I_c}$$

$$= \frac{12 - 6}{0{,}005}$$

$$= 1{,}2\ k\Omega \quad (2)$$ (2)

3.1.2 $$I_b = \frac{I_C}{\beta}$$

$$= \frac{5 \times 10^{-3}}{200}$$

$$= 25\ \mu A$$

$$R_b = \frac{V_{cc} - V_{be}}{I_b}$$

$$= \frac{12 - 0{,}6}{25 \times 10^{-6}}$$

$$= 456\ k\Omega$$ (3)

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3.2 3.2.1

$$Z_1 = h_{ie} - \left[\frac{h_{fe} \cdot h_{re} \cdot Z_L}{1 + h_{oe} \cdot Z_L}\right]$$

$$= 1200 - \left[\frac{60 \times 2 \times 10^{-4} \times 2000}{1 + \left(20 \times 10^{-6} \times 2000\right)}\right]$$

$$= 1200 - 23{,}077$$

$$= 1176{,}923\ \Omega \rightarrow$$

$$Z_i = \frac{R_b \times Z_1}{R_b + Z_1}$$

$$= \frac{220000 \times 1176{,}923}{220000 + 1176{,}923}$$

$$= 1170{,}66\ \Omega \rightarrow$$ (3)

3.2.2

$$A_i = \frac{h_e}{1 + h_{oe} \cdot Z_L}$$

$$= \frac{60}{1 + \left(20 \times 10^{-6} \times 2000\right)}$$

$$= 57{,}692 \rightarrow$$ (2)

3.2.3

$$A_V = \frac{-h_{fe} \cdot Z_L}{h_{ie} + \left(h_{ie} \cdot h_{oe} - h_{fe} \cdot h_{re}\right) Z_L}$$

$$= \frac{-60 \times 2000}{1200 + \left(1200 \times 20 \times 10^{-6} - 60 \times 2 \times 10^{-4}\right) 2000}$$

$$= -98{,}039 \rightarrow$$ (2)

(2)

3.3
- Amplitude distortion
- Non-linear distortion
- Frequency distortion

(3)
[15]

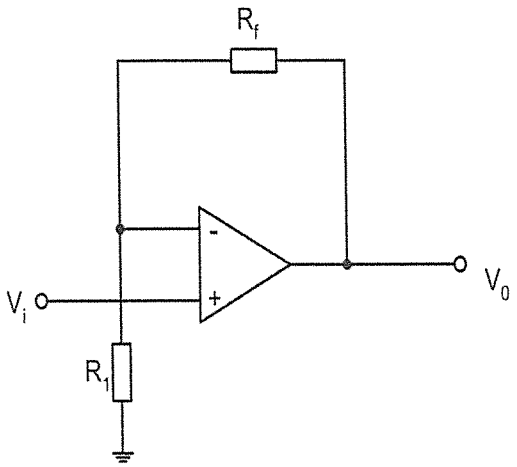
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QUESTION 4

4.1 4.1.1 When the two input signals are opposite in polarity, the amplifier's response at its output will reflect the difference between the two input signals. This is known as the differential mode. (2)

4.1.2 When the two input signals are of the same polarity, the amplifier's response will reflect hardly any difference. This is known as the common mode. (2)

4.2 4.2.1



THE NON-INVERTING OPERATIONAL AMPLIFIER (3)

4.2.2

$$V_0 = \left(1 + \frac{R_f}{R_1}\right) V_i$$

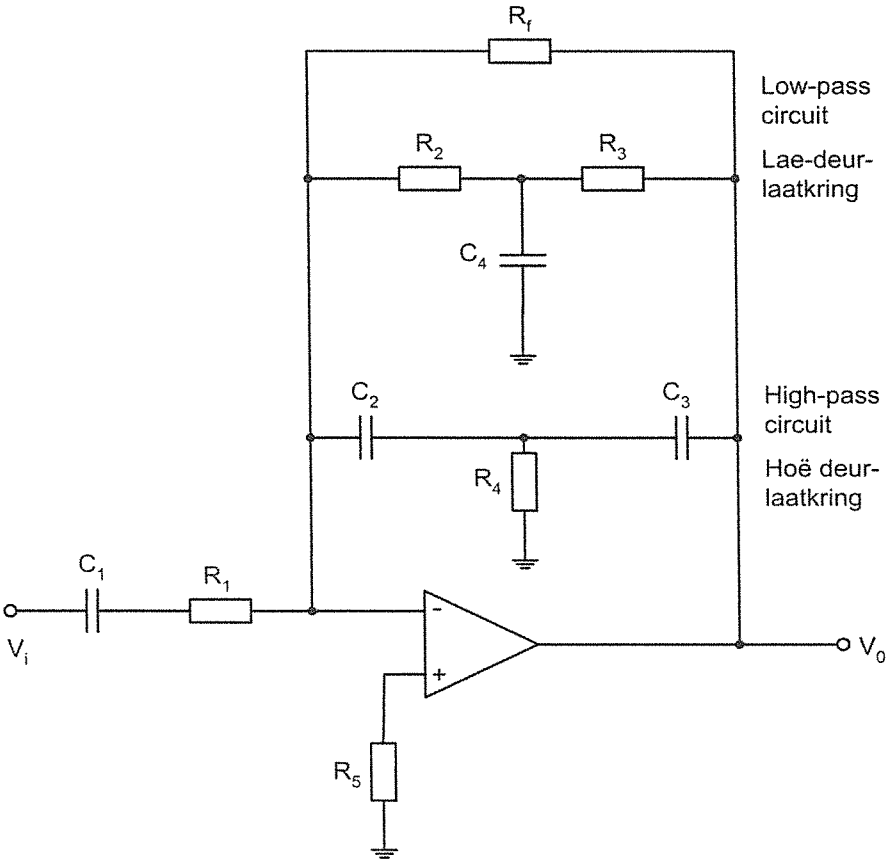
$$\frac{V_o}{V_i} = \left(1 + \frac{R_f}{R_1}\right)$$

$$= 1 + \frac{10000}{1000}$$

$$\frac{V_o}{V_i} = 11 \longrightarrow$$ (3)

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4.3

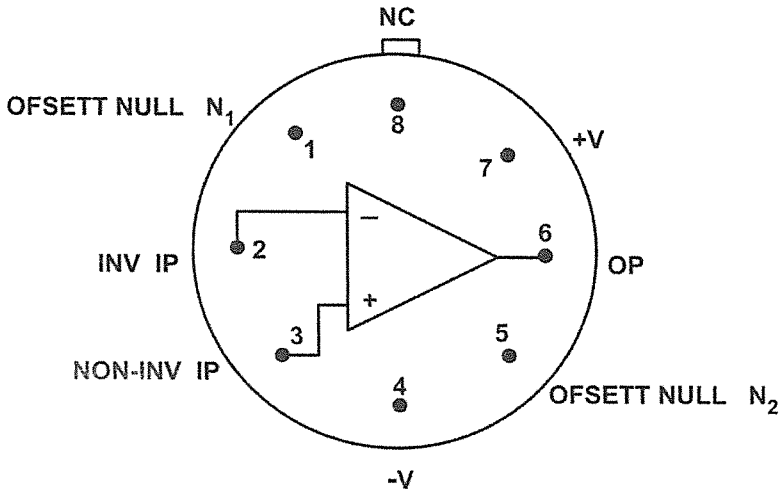


BAND-PASS FILTER (4)
[14]

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QUESTION 5

INTEGRATED CIRCUITS

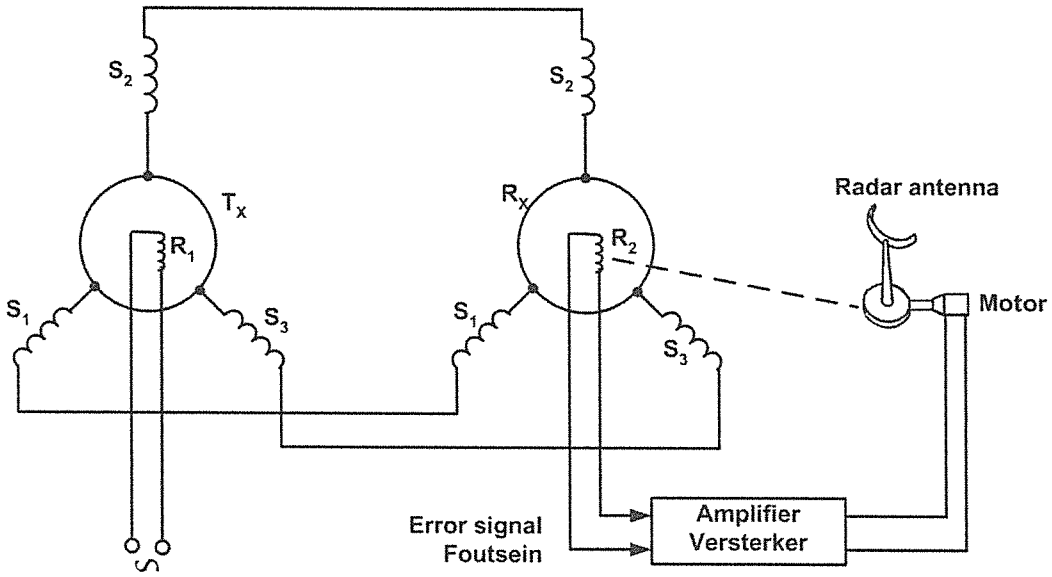


741-INTEGRATED OPERATIONAL AMPLIFIER IN A METAL CAN PACK

(4)
[4]

QUESTION 6

6.1 6.1.1 **TRANSDUCERS**



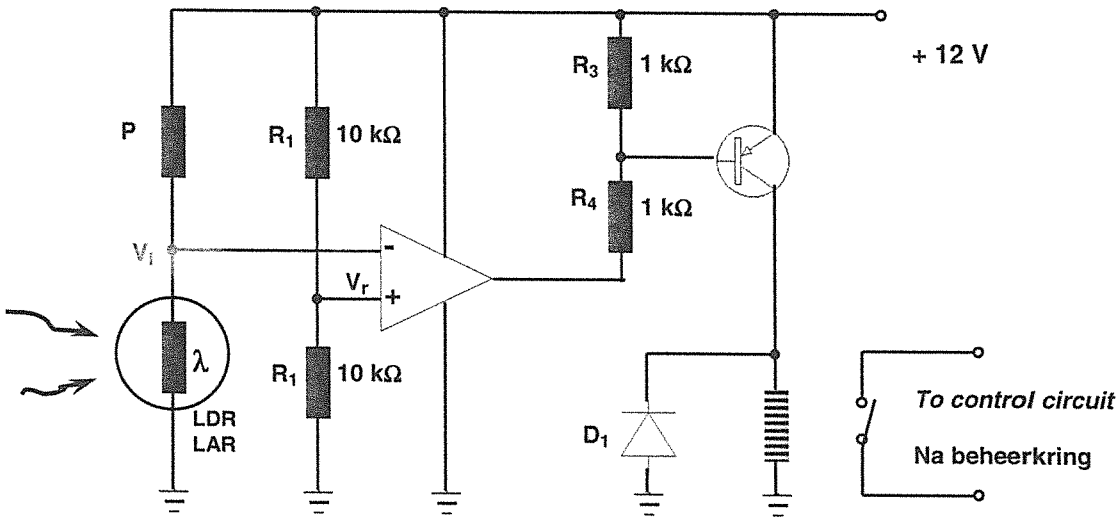
Synchronous motors in a closed loop system (5)

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6.1.2 **TRANSMITTER ROTOR - THROUGH AN ANGLE θ**

The transmitter Tx and receiver Rx are in balance as soon as the rotors stand at the same angle. If the rotor of the transmitter turns at an angle θ, the rotor of the receiver will produce an error signal to turn the motor. The antenna also turns the rotor of the receiver at the same angle θ so that the error signal becomes zero. (4)

6.2



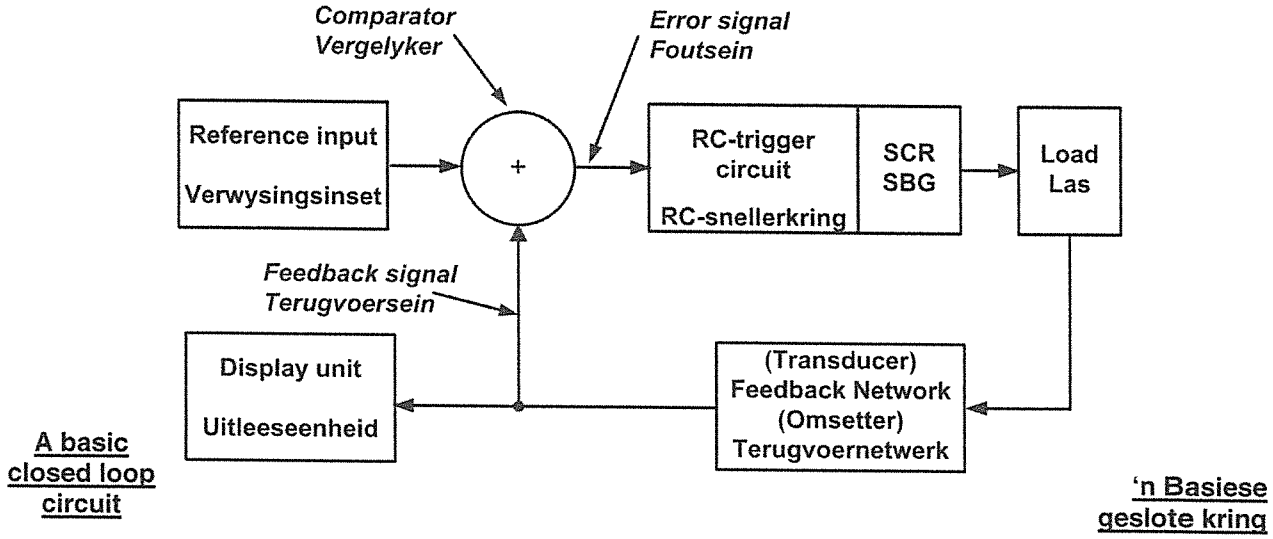
PRECISION LIGHT SWITCH

(5)
[14]

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QUESTION 7

ELECTRONIC PHASE CONTROL



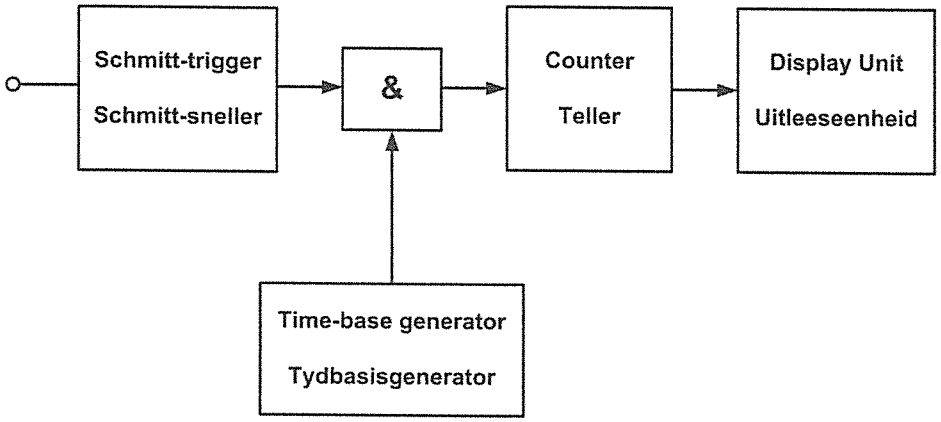
A basic closed loop circuit

'n Basiese geslote kring

The comparator compares the feedback signal from the load with the reference signal. As soon as the load deviates, an error signal appears on the output of the comparator, which is used by the control circuit in order to bring the load condition back to normal. [8]

QUESTION 8

TEST EQUIPMENT



A FREQUENCY COUNTER [5]

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QUESTION 9

9.1 **OSCILLATORS**

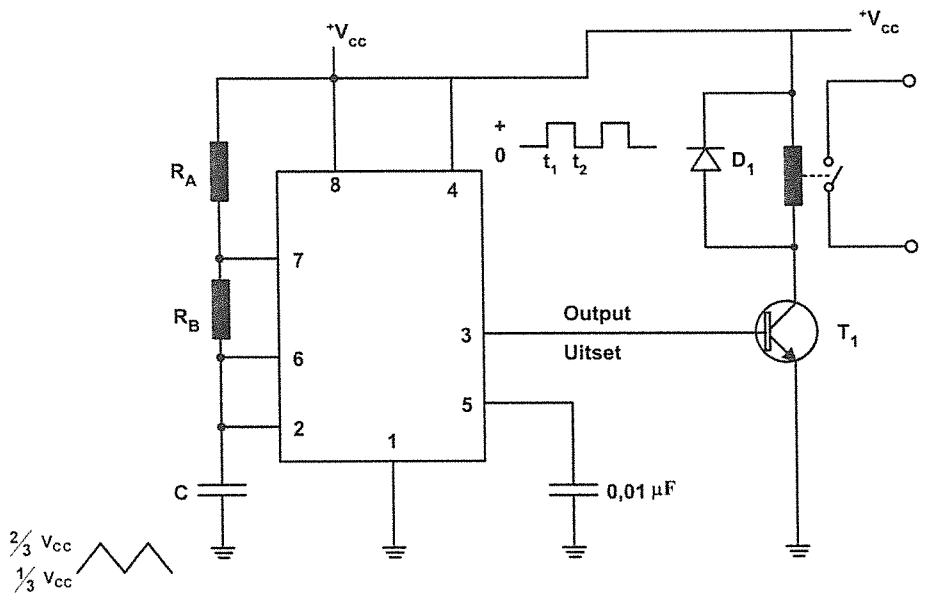
FREQUENCY OF UJT-OSCILLATOR (F):

$$f = \frac{1,5}{R.C}$$

$$= \frac{1,5}{15 \times 10^{3} \times 10 \times 10^{-6}}$$

$$= \underline{\underline{10 \text{ Hz}}}$$ (2)

9.2



$t_{low} = 0,693 (R_B) C$ $t_{high} = 0,693 (R_A + R_B) C$

$15 = 0,693 (R_B) \times 220 \times 10^{-6}$ $30 = 0,693 (98386,4 + R_A) \times 220 \times 10^{-6}$

$R_B = \underline{\underline{98,386 \text{ k}\Omega}}$ $R_A = \underline{\underline{98,386 \text{ k}\Omega}}$ (12)

[14]

TOTAL: 100

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