higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

APRIL EXAMINATION

INDUSTRIAL ELECTRONICS N5

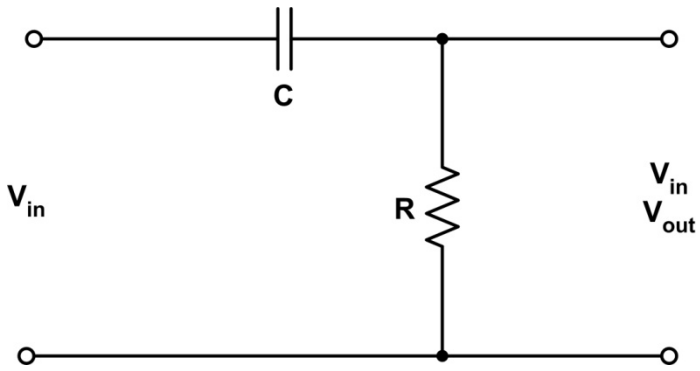
7 APRIL 2016

This marking guideline consists of 13 pages.

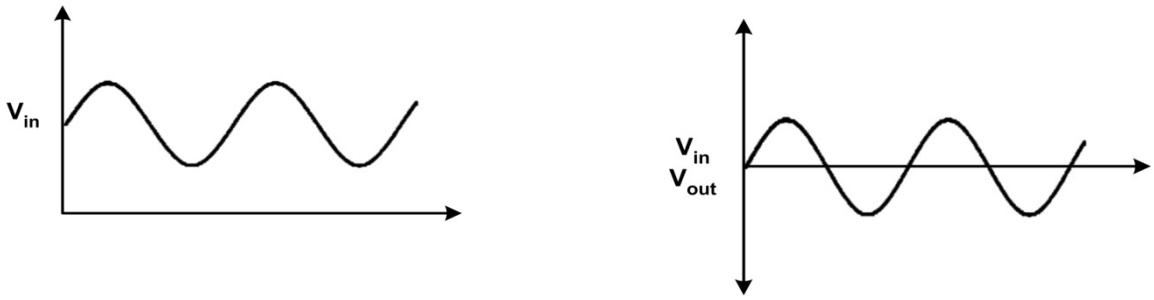
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QUESTION 1

1.1

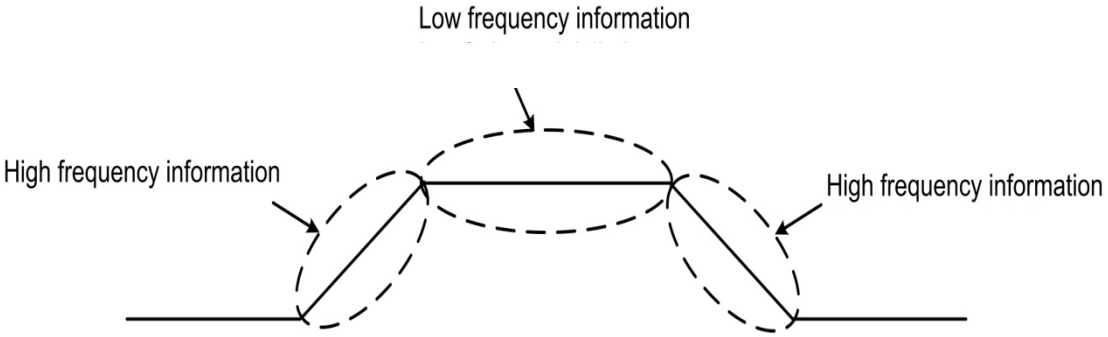


CIRCUIT DIAGRAM OF RC-COUPLING



INPUT- AND OUTPUT WAVEFORMS (4)

1.2



(3)

1.3 1.3.1 $X_L = 2.\pi.f.L$

$= 2 \times \pi \times 100 \times 10^3 \times 0,001 \times 10^{-3}$

$= 6,283\ \Omega$

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

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

$$= \frac{20\angle 0^0 \times 6,283\angle 90^0}{20 + j6,283}$$

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

$= 5,994\angle 72,6^0\ \Omega$ (4) (4)

1.3.2 $I_T = \frac{V_T}{Z_T}$

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

$= 3,34\angle -72,6^0$ A (2)

1.3.3 $I_L = \frac{V_T}{jX_L}$

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

$= 3,183\angle -90^0$ A (2)

1.3.4 $I_R = \frac{V_T}{R}$

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

$= 1\angle 0^0$ A (2)

[17]

QUESTION 2

2.1 2.1.1

$$r = \frac{1}{4\sqrt{3} \cdot f \cdot C \cdot R_L}$$

$$\therefore C = \frac{1}{4\sqrt{3} \times 50 \times 100 \times 0,03}$$

$$= 962,25\ \mu f \qquad (2)$$

2.1.2

$$I_{dc} = \frac{V_{dc}}{R_L}$$

$$= \frac{12}{100}$$

$$= 120\ mA$$

$$V_{dc} = V_m - \frac{I_{dc}}{4\ f\ C}$$

$$\therefore V_m = V_{dc} + \frac{I_{dc}}{4\ f\ C}$$

$$= 12 + \left(\frac{0,12}{4 \times 50 \times 962,2 \times 10^{-6}}\right)$$

$$= 12,624\ V \qquad (4)$$

2.2

$$I_Z = \frac{P_Z}{V_Z}$$

$$= \frac{500 \times 10^{-3}}{10}$$

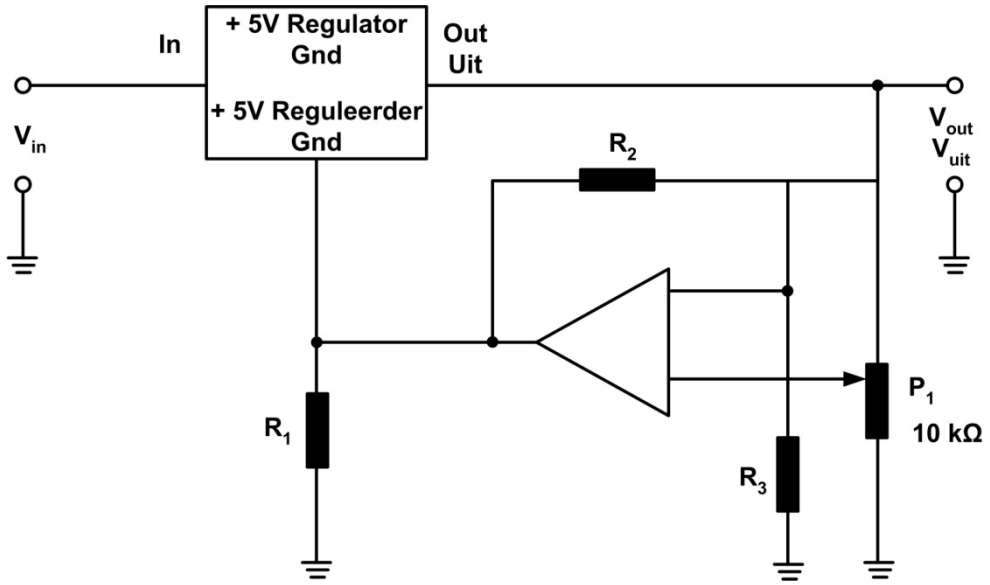
$$= 50\ mA$$

$$R_S = \frac{V_{i(max)} - V_2}{I_{Z(max)}}$$

$$= \frac{16 - 10}{50 \times 10^{-3}}$$

$$= 120\ \Omega \qquad (4)$$

2.3



HIGH STABLE ADJUSTABLE VOLTAGE REGULATOR (5)
[15]

QUESTION 3

3.1
- Inverse saturating current, I_{CO}, which doubles for each 10 °C increases in temperature.
- Base emitter voltage, V_{BE}, which decreases with 2,5 mV/°C.
- Current gain, β, which increases with temperature. (3 x 1) (3)

3.2 $V_en = \frac{1}{10} \times V_{CC}$

$= \frac{1}{10} \times 12$

$= 1,2\ V$

$I_C \cong I_E$

$\therefore I_E = \frac{V_E}{R_E}$

$I_C = \frac{V_E}{R_E}$

$= \frac{1,2}{120}$

$= 10\ mA$

$I_C = \beta \ . \ I_B$

$I_B = I_C / \beta$

$= \frac{10 \times 10^{-3}}{250}$

$= 40 \quad \mu A$

$R_C = \frac{V_{CC} - V_{CE} - V_E}{I_C}$

$V_{CE} = V_{CC} - V_E - (I_C \ . R_C)$

$= 12 - 1{,}2 - (10 \times 10^{-3} \times 480)$

$\therefore \ V_{CE} = 6 \text{ V}$

$V_B = \frac{R_{B_2}}{R_{B_2} + R_{B_1}} \times V_{CC}$ OR $V_B = V_E + V_{BE}$

$= \frac{3000}{3000 + 15947} \times 12$ $= 1{,}2 + 0{,}7$

$= 1{,}9 \text{V}$

$= 1{,}9 \text{ V}$ (10)

3.3 $Z_1 = h_{ie}$

$= 1{,}2 \text{ k}\Omega$

But $Z = R_{BT} \ || \ Z_1$

$\therefore \ R_{BT} = \frac{R_{B_1} \times R_{B_2}}{R_{B_1} + R_{B_2}}$

$= \frac{15947 \times 3000}{15946 + 3000}$

$= 2\,524{,}991 \ \Omega$

$$Z_I = \frac{2524{,}9908 \times 1200}{2524{,}9908 + 1200}$$

$$= 813{,}42\ \Omega$$

$$Z_2 = {}^{1}\!/_{h_{oe}}$$

$$= \frac{1}{20 \times 10^{-6}}$$

$$= 50\ k\Omega$$

$$Z_O = \frac{R_C \times Z_2}{R_C + Z_2}$$

$$= \frac{480 \times 50000}{480 + 50000}$$

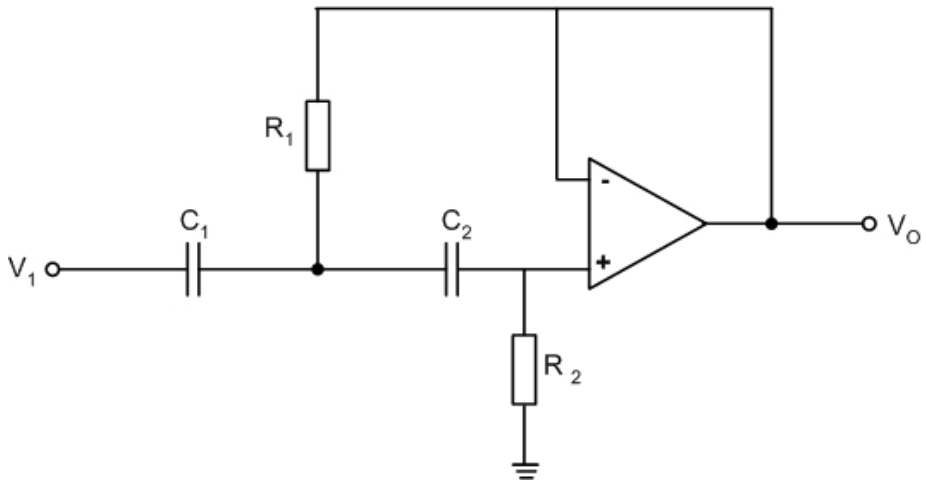
$$= 475{,}436\ \Omega$$ (5)

[18]

QUESTION 4

4.1 Drift is a slow variation on the output while the input remains constant. (2)

4.2



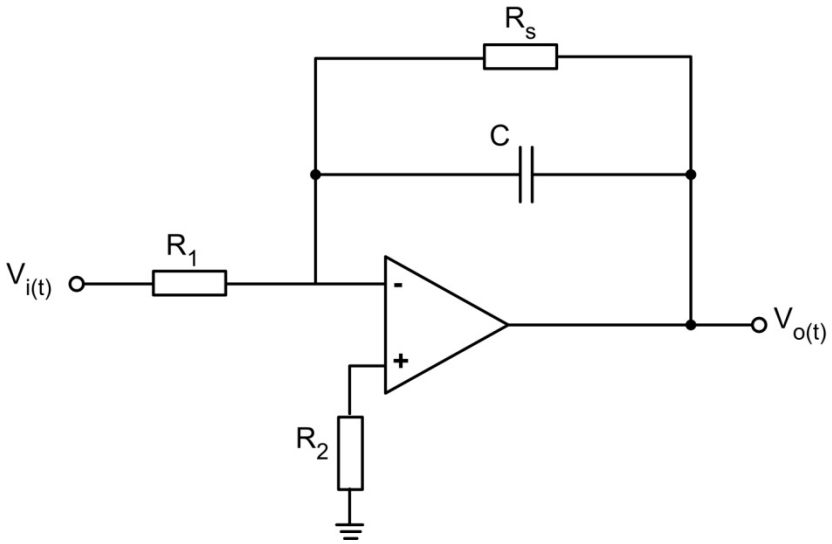
ACTIVE HIGH PASS FILTER (3)

4.3 $$f_o = \frac{1}{2 \cdot \pi \cdot C \cdot R}$$

$$= \frac{1}{2 \times \pi \times 0,1 \times 10^{-6} \times 1000}$$

= 1591,55 Hz (3)

4.4



PRACTICAL OPERATIONAL INTEGRATOR (3)
[11]

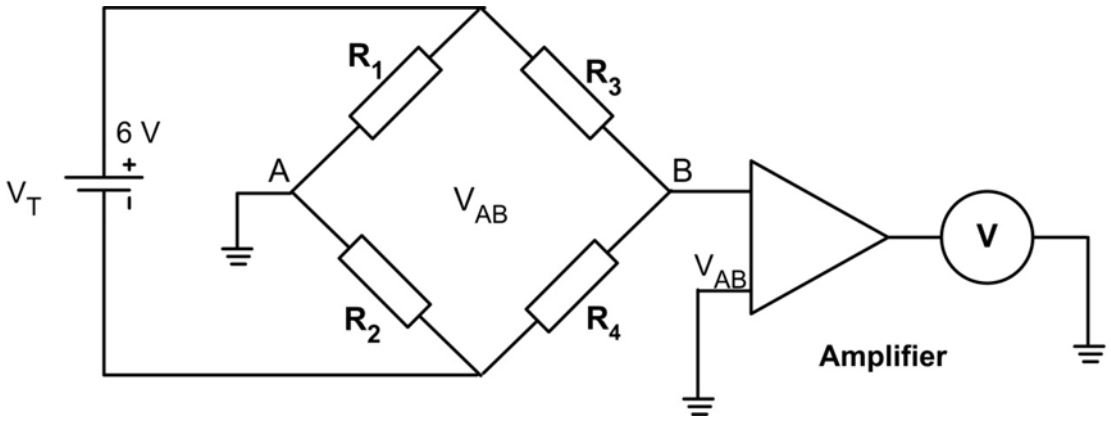
QUESTION 5

5.1 True
5.2 False
5.3 True

(3 x 1) **[3]**

QUESTION 6

6.1



THERMISTOR BRIDGE WITH DC-BIAS (4)

6.2 6.2.1 $T = {}^{0}C + 273$ (2)

$= 30 + 273$

$= 303\ K$

$\therefore R_T = A \cdot e^{\frac{B}{T}}$

$= 0{,}2169 \times e^{\frac{3200}{303}}$

$= 8372{,}747\ \Omega$

6.2.2 $V_{AB} = V_A - V_B$

$\therefore V_A = \frac{R_2}{R_1 + R_2} \times V_T$

$= \frac{10\ k\Omega}{10\ k\Omega + 10\ k\Omega} \times 10$

$= 5\ V$

$\therefore V_B = \frac{R_t}{R_t + R_3} \times 10$

$= \frac{8372,747}{8372,747 + 10000} \times 10$

$= 4,56\ V$

$\therefore V_{AB} = V_A - V_B$

$= 5 - 4,56$

$= 0,44\ V$

$\therefore$ Gain of amplifier (A_V)

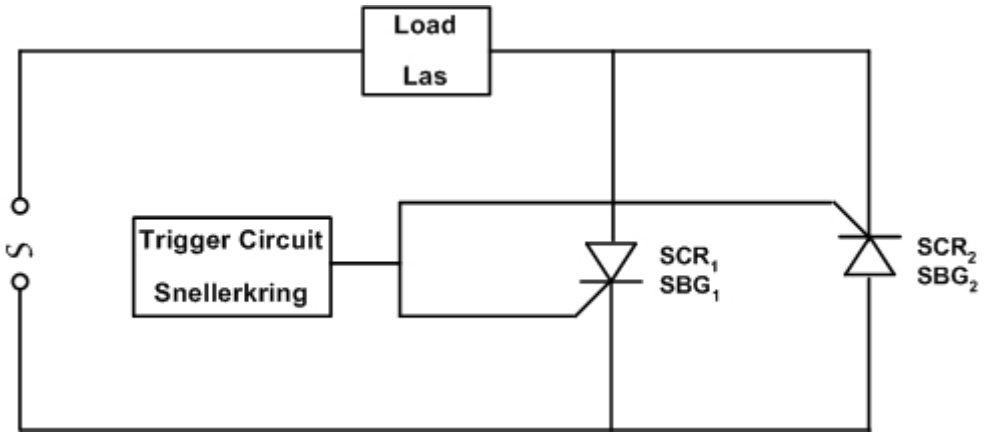
$= \frac{V_O}{V_i}$

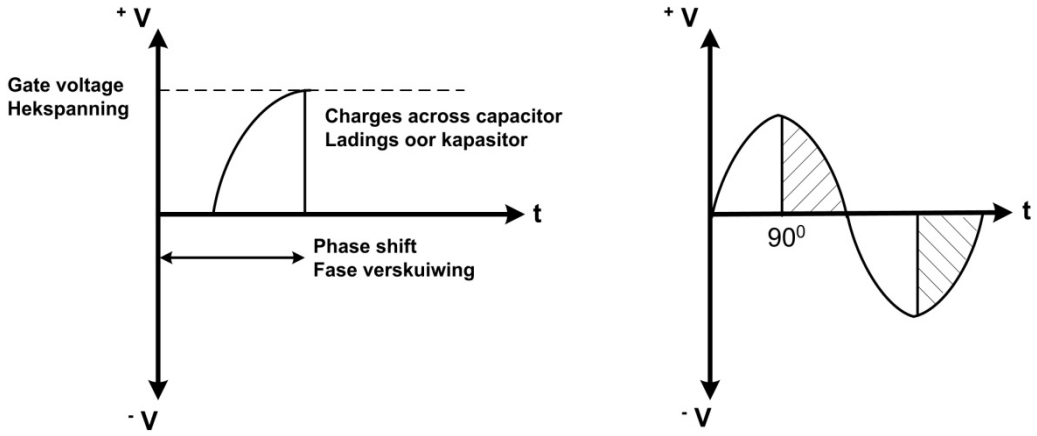
$= \frac{10}{0,44}$

$= 22,73$ (7)

[13]

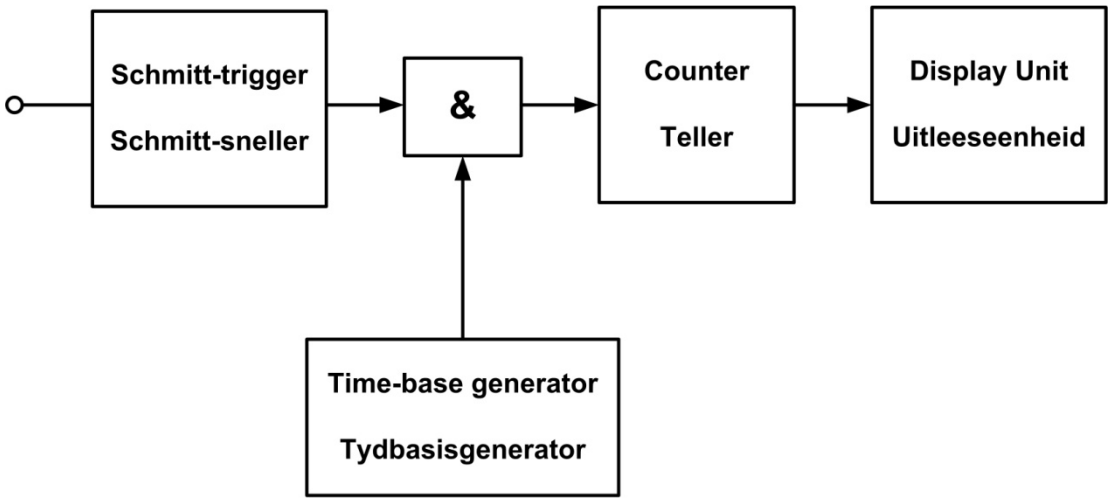
QUESTION 7





[6]

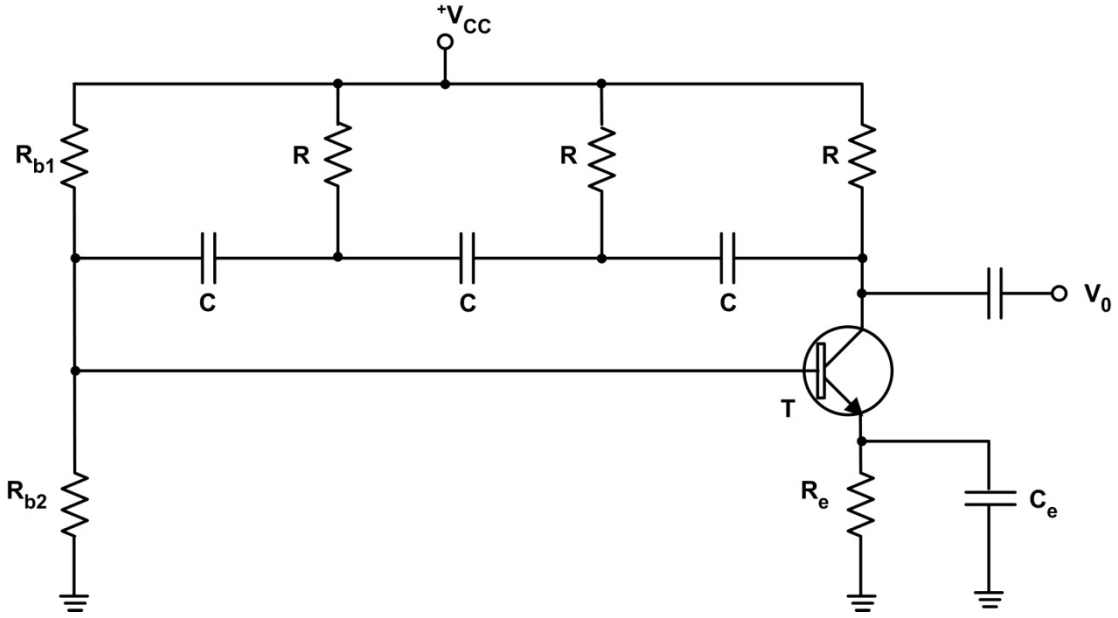
QUESTION 8



A FREQUENCY COUNTER **[5]**

QUESTION 9

9.1



THE R-C PHASE SHIFT OSCILLATOR (5)

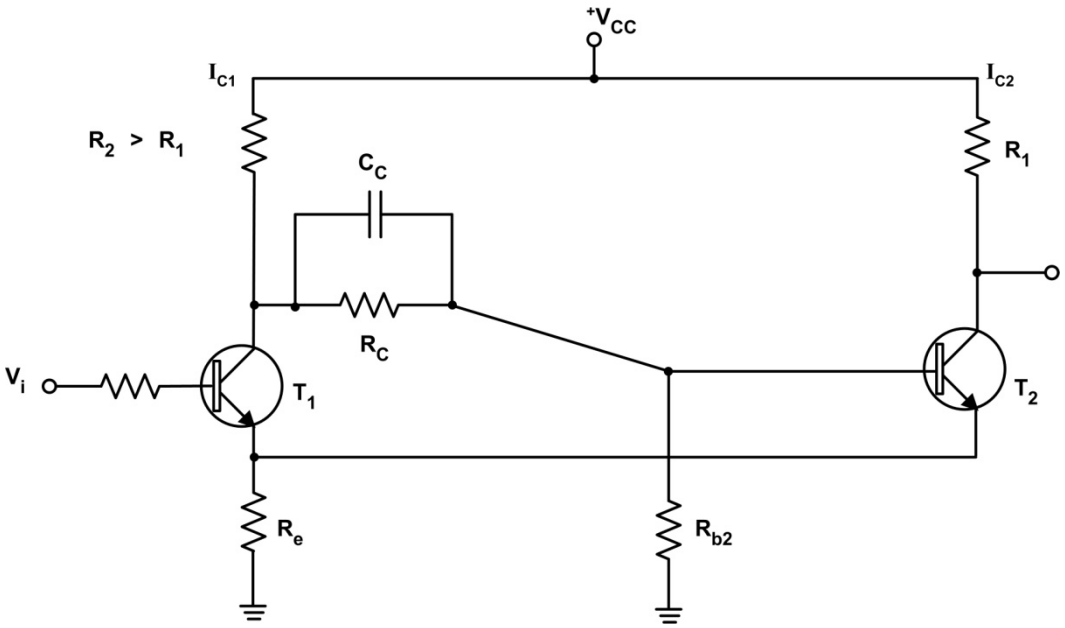
9.2 $$f = \frac{1}{2\pi.R.C\sqrt{6}}$$

$$\therefore R = \frac{1}{2\pi.f.C\sqrt{6}}$$

$$= \frac{1}{2 \times \pi \times 50 \times 10^{6} \times 10 \times 10^{-9} \times \sqrt{6}}$$

$$= 129{,}95\ \Omega$$ (3)

9.3



THE SCHMITT CIRCUIT (4)
[12]

TOTAL: 100

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