higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

NOVEMBER EXAMINATION

INDUSTRIAL ELECTRONICS N5

21 NOVEMBER 2014

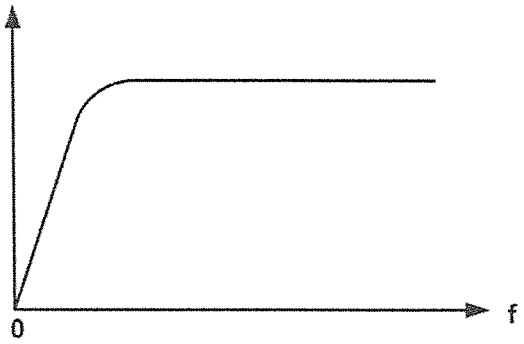
This marking guideline consists of 11 pages.

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QUESTION 1

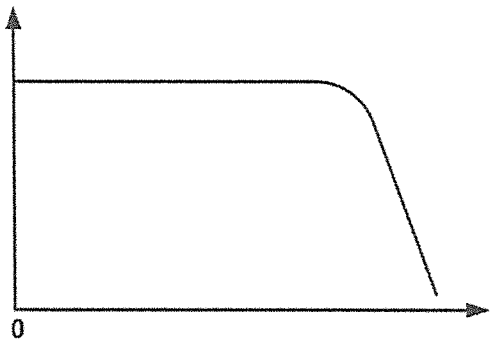
1.1 The rate at which the capacitor is charged, is determined by its capacitance and the resistance in the circuit. (2)

1.2 Gain



Gain/frequency response (2)

Gain



Gain/frequency response (2)

1.3 1.3.1

$$XC = \frac{1}{2.\pi.f.C}$$

$$C = \frac{1}{2\times\pi\times f\times X_c} \quad \text{but } XC = 31{,}62\ \Omega$$

$$\therefore C = \frac{1}{2\times\pi\times 503{,}29\times 31{,}62}$$

$$= 10\ \mu f$$

$$XL = 2.\pi.f.L$$

$$L = \frac{X_L}{2\pi f}$$

$$\therefore L = \frac{31,62}{2\times\pi\times503,29}$$

$$= 10 \text{ mH}$$

$$Zd = \frac{L}{C\times R}$$

$$= \frac{10\times10^{-3}}{10\times10^{-6}\times5}$$

$$= 199,965\ \Omega$$ (6)

1.3.2 $$I_C = \frac{V_T}{X_C}$$

$$= \frac{40\angle0^0}{31,62\angle-90^0}$$

$$= 1,265\angle90^0 \text{ A}$$

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

$$= \frac{40\angle0^0}{32,013\angle81^0}$$

$$= 1,249\angle-81^0 \text{ A}$$ (4)

(4)
[16]

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QUESTION 2

2.1 2.1.1 $r = \frac{1}{4\sqrt{3}.f.C.R_L}$

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

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

2.1.2 $I_{dc} = \frac{V_{dc}}{R_L} = \frac{12}{100}$

$$= 120\ mA$$

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

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

$$= 12 + \frac{0,12}{4 \times 50 \times 962,25 \times 10^{-6}}$$

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

2.2 For min. value of series resistor (RS):

$$VL = IL \times RL$$

$$= 100 \times 10\text{-}3 \times 120$$

$$= 12\ V$$

$$VL = VZ = 12\ V$$

$$RL(min) = \frac{V_Z}{V_{T(min)} - V_Z} . R_S$$

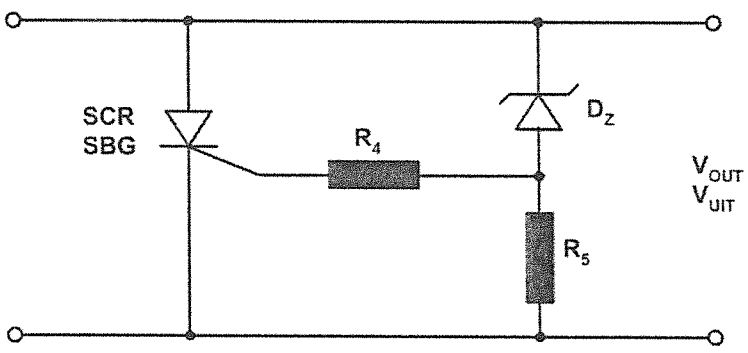
$$\therefore RS = \frac{R_L(V_{T(min)} - V_Z)}{V_Z}$$

$$= \frac{120\ (14 - 12)}{12}$$

$$= 20\ \Omega$$ (5)

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2.3



Over voltage protection (3)

2.4 The voltage at which the circuit will limit is determined by the reverse breakthrough voltage of the zener diode. As soon as the output voltage is high enough to drive the zener diode into conduction, a pulse will be supplied to the gate of the SCR. The SCR will start conducting and therefore provides a virtual short circuit across the output terminals. (3)
[17]

QUESTION 3

3.1 3.1.1 Transistor Amplifiers

$$RC = \frac{V_{cc} - V_{ce}}{I_c}$$

$$= \frac{12 - 6}{10 \times 10^{-3}}$$

$$= \underline{600\ \Omega} \rightarrow (2)$$ (2)

3.1.2

$$RB = \frac{V_{CC} - V_{BE}}{I_B}$$

$$= \frac{12 - 0,6}{50 \times 10^{-6}}$$

$$= \underline{228\ k\Omega} \rightarrow$$ (3)

3.1.3

$$Z_i = h_{ie} - \frac{h_{fe}.h_{re}.Z_L}{1 + h_{oe}.Z_L}$$

$$= 1300 - \frac{60 \times 2 \times 10^{-4} \times 600}{1 + \left(20 \times 10^{-6} \times 600\right)}$$

$$= \underline{1292,885\ \Omega} \rightarrow$$ (2)

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3.1.4 $$A_i = \frac{h_{fe}}{1 + h_{oe}Z_L} \times \frac{R_b}{R_b + Z_1}$$

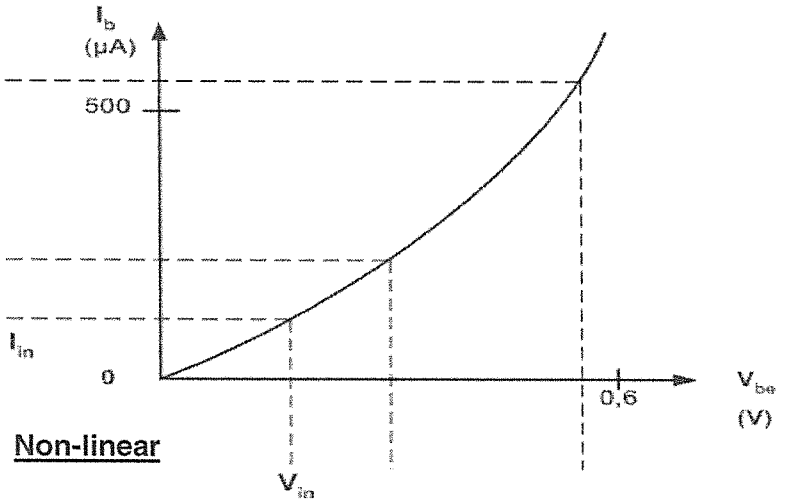
$$= \frac{60}{1 + 20\times10^{-6}\times600} \times \frac{228000}{228000 + 1292,885}$$

$$= \underline{58,954} \rightarrow$$ (3)

3.1.5 $$A_V = \frac{-h_{fe}.Z_L}{h_{ie} + \left(h_{ie}.h_{oe} - h_{fe}.h_{re}\right)Z_L}$$

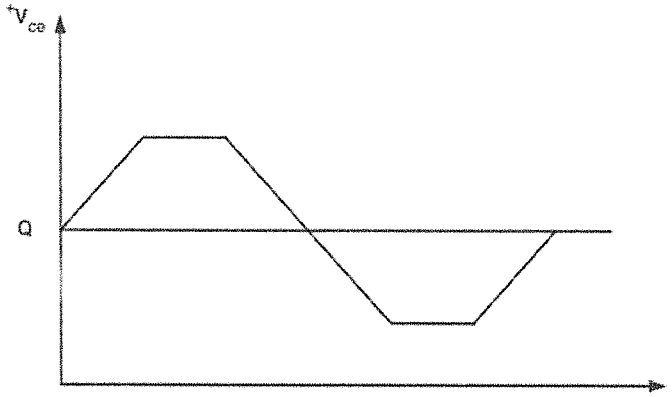
$$= \frac{-60\times600}{1300 + \left(1300\times20\times10^{-6} - 60\times2\times10^{-4}\right)600}$$

$$= \underline{-27,515} \rightarrow$$ (3)



Non-linear

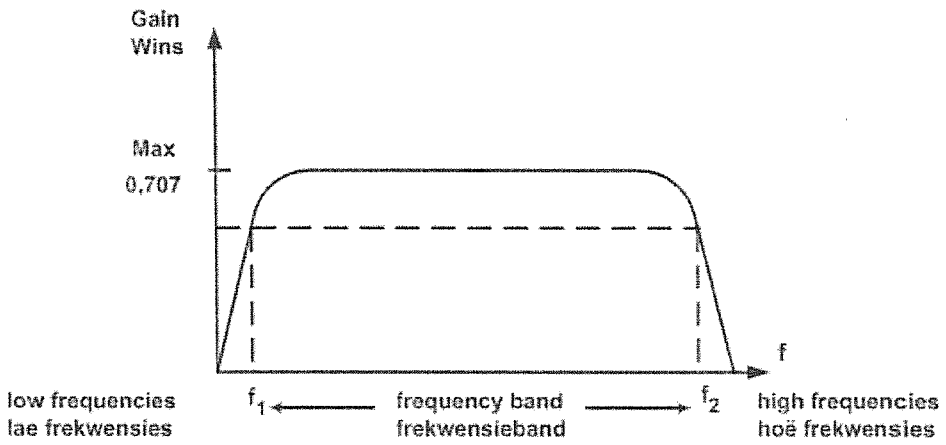
3.2 3.2.2



Chopping because of over driven input

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3.2.3



Frequency distortion

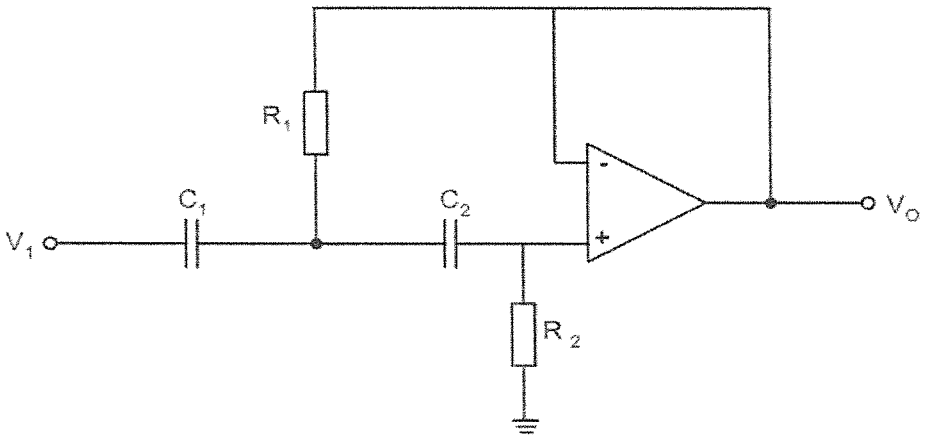
(3 x 2) (6)
[19]

QUESTION 4

4.1 Drift as applicable to amplifiers:

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

4.2



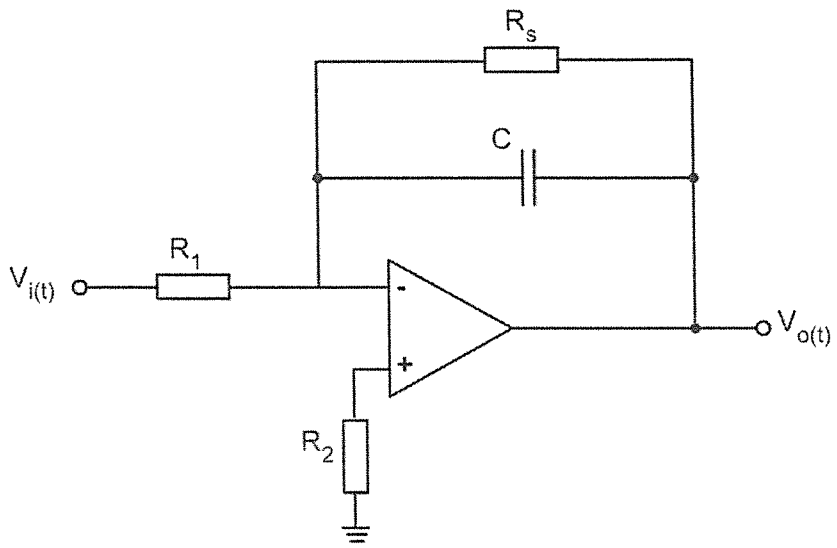
Active High Pass Filter (3)

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

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

$$= \underline{1591{,}55 \text{ Hz}}$$ (3)

4.4



Practical Operational Integrator (3)
[11]

QUESTION 5

- Earth soldering tips.
- Use earthed wrist bands.
- Earth all test equipment.
- Switch off the power as soon as you work on the circuit
- Connect unused inputs to VDD or VSS (Any 3 x 1) **[3]**

QUESTION 6

6.1

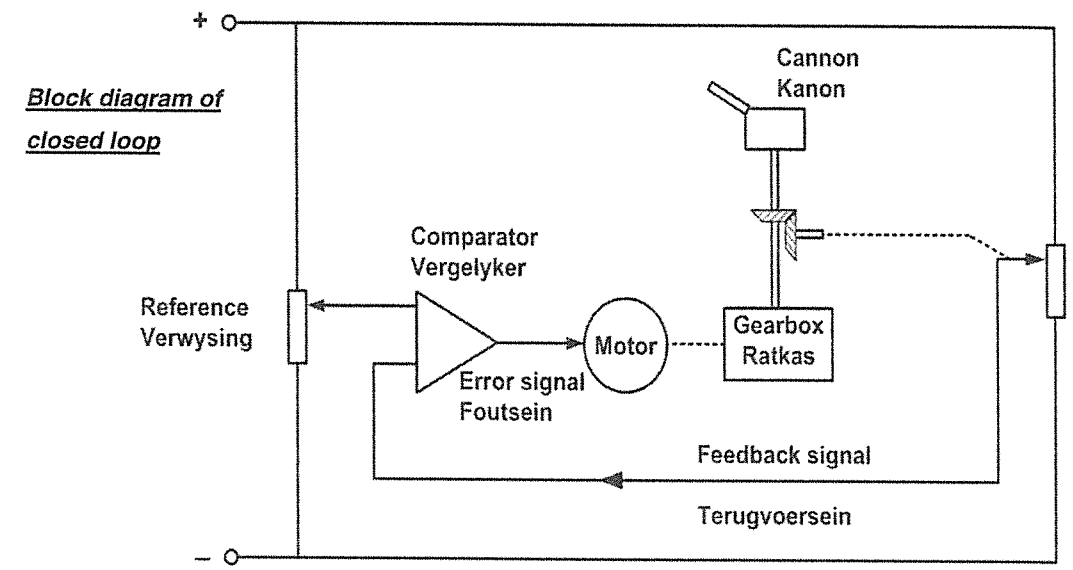
$$\% \text{ Resolution} = \frac{1}{\#\text{ of Turns}} \times 100$$

$$= \frac{1}{1000} \times 100$$

$$= 0{,}1\ \%$$

(2)

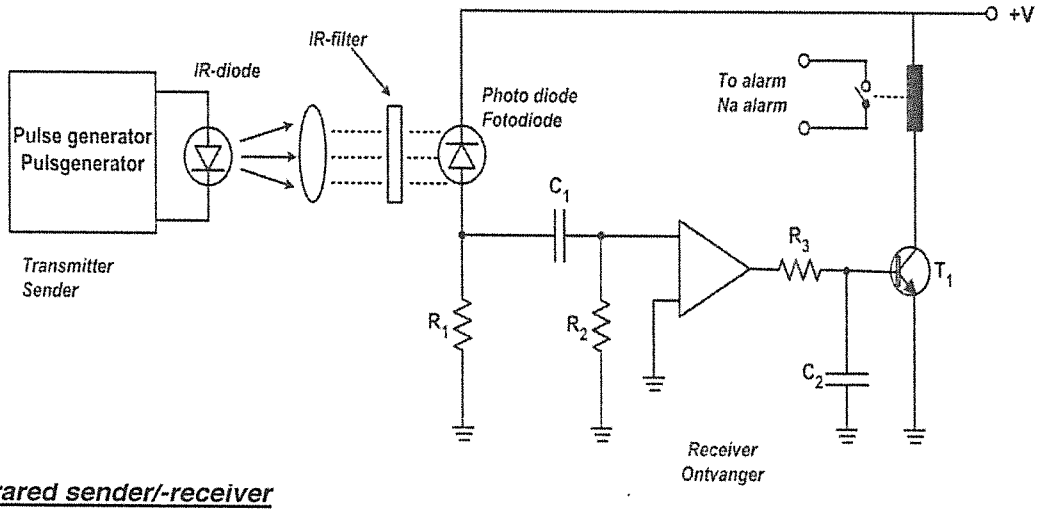
6.2



Block diagram of closed loop

(6)

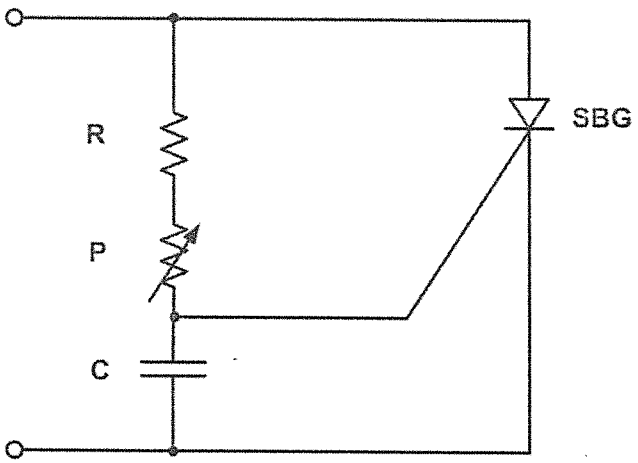
6.3



Infrared sender/-receiver

(6)
[14]

QUESTION 7



Trigger

[3]

QUESTION 8

Unknown voltage (V_U) = 13 V and an 4-bit code is used.

Start 0000

Step 1: 1000 (8 V) $V_r < V_U$: Keeps 1

Step 2: 1100 (12 V) $V_r < V_U$: Keeps 1

Step 3: 1110 (14 V) $V_r > V_U$: Resets 1 to 0

Step 4: 1101 (13 V) $V_r = V_U$: Keeps 1 **[5]**

QUESTION 9

9.1 $$C_T = \frac{C_1 \times C_2}{C_1 + C_2}$$

$$= \frac{10\times10^{-9} \times 20\times10^{-9}}{10\times10^{-9} + 20\times10^{-9}}$$

$$= 6{,}667 \text{ nf}$$

$$f = \frac{1}{2\pi\sqrt{L.C_T}}$$

$$= \frac{1}{2\times\pi\sqrt{100\times10^{-6}\times6{,}667\times10^{-9}}}$$

$$= 194{,}924 \text{ kHz}$$ (4)

(4)

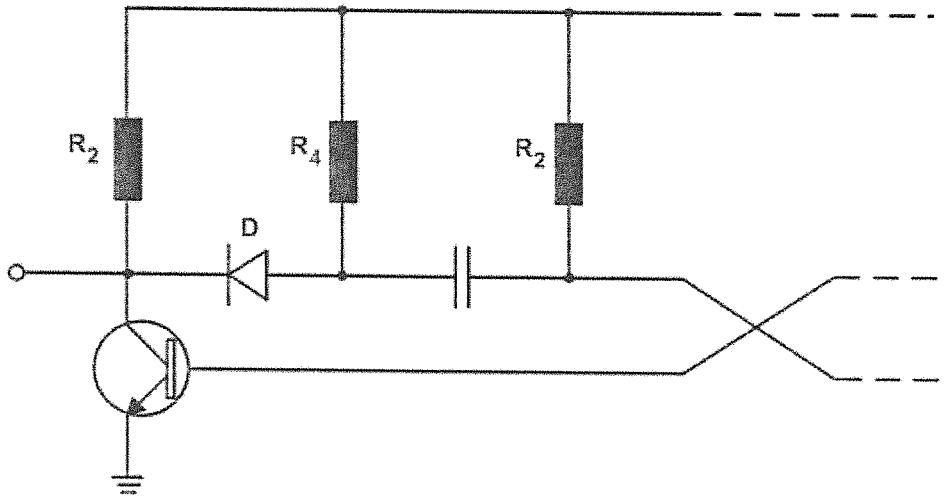
9.2 9.2.1 Two

9.2.2 Square

(2 x 1) (2)

9.3 To increase the rise time at the collector of a transmitter, TR1
At the end of a quasi-stable condition the emitter-junction of TR1 is reverse biased and the collector voltage will start increasing. This reverse biases the diode and therefore the capacitor will be isolated from TR1 and will charge through R2. If a load with a high value is connected to the collector of TR1, a square wave will be obtained

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(6)
[12]

TOTAL: 100

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