higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N5

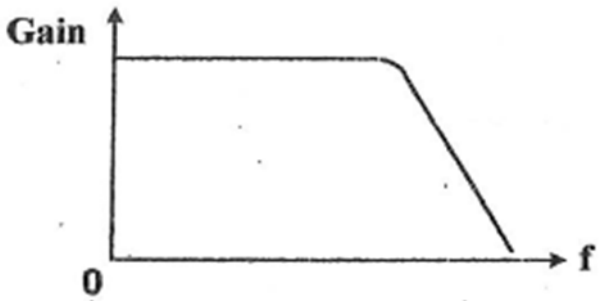
6 April 2020

This marking guideline consists of 9 pages.

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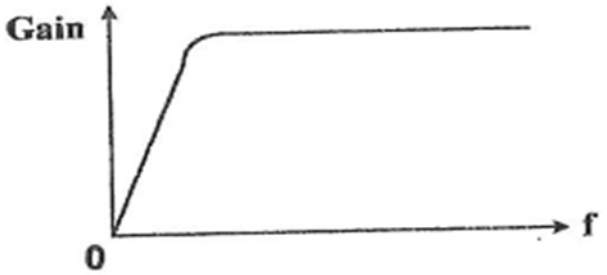
QUESTION 1: ALTERNATING CURRENT THEORY

1.1 1.1.1



LOW-PASS FILTER

1.1.2



HIGH-PASS FILTER

(2 × 2) (4)

1.2
- Tuned amplifiers
- Radio antenna couplings
- Radio receivers
- Load impedance

(Any 2 × 1) (2)

1.3 1.3.1 $X_L = X_C$ (At $I_{(MAX)}$)

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

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

$= 20\ \Omega \leftarrow \checkmark$

$$Q = \frac{X_L}{R}$$

$X_L = Q \times R$

$= 125 \times 20 \checkmark$

$= 2\ 500\ \Omega \leftarrow \checkmark$

$X_L = 2\pi fL$

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

$$= \frac{2500}{2 \times \pi \times 5 \times 10^3} \checkmark$$

$= 79{,}58$ mA ←✓

$$X_C = \frac{1}{2\pi fC}$$

$$C = \frac{1}{2\pi f X_C}$$

$$= \frac{1}{2 \times \pi \times 5 \times 10^3 \times 2500} \checkmark$$

$= 12{,}732$ nf✓ → (8)

1.3.2 $V_C = X_C \times I_T$
$= 2\,500 \times 10 \times 10^{-3}$✓
$= 25$ V✓ → (2)
[16]

QUESTION 2: POWER SUPPLIES

2.1

$$X_C = \frac{1}{2\pi fC}$$

$$= \frac{1}{2 \times \pi \times 60 \times 250 \times 10^{-6}}$$

$= 10{,}61\ \Omega$ ←✓

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

$$= \frac{10{,}61}{\sqrt{10^2 + (10{,}61)^2}} \times 5 \checkmark$$

$= 3{,}64$ V ← ✓

$$r' = \frac{V'_{r(rms)}}{V'_{DC}}$$

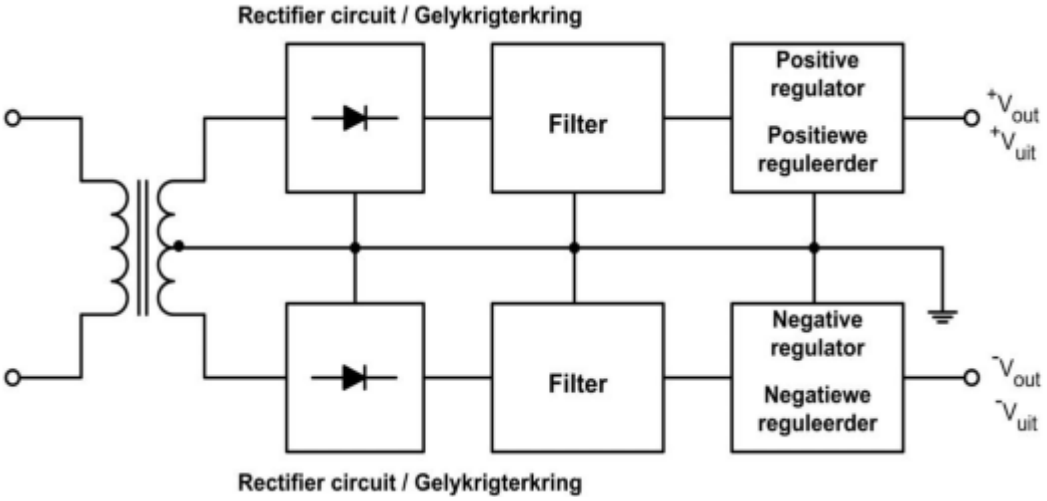
$$= \frac{3{,}64}{15} \checkmark$$

$= 0{,}243$ ✓ (5)

2.2 2.2.1 It is used as soon as a higher voltage✓ is required from a transformer secondary voltage.✓ (2)

2.2.2 It cannot maintain✓ a large load current.✓ (2)

2.3



DOUBLE-VOLTAGE POWER SUPPLY

(1 mark for each block + 1 mark for transformer + 1 mark for output) (8)
[17]

QUESTION 3: TRANSISTOR AMPLIFIERS

3.1 3.1.1 Limits the collector current I_C during an increase in temperature

3.1.2 Prevents the negative feedback by keeping the voltage at the emitter stable

(2 × 1) (2)

3.2 3.2.1

$$R_e = \frac{V_e}{I_e}$$

$$\therefore V_e = R_e . I_e$$

$$= 150 \times 12 \times 10^{-3} \checkmark$$

$$= 1{,}8\ V \leftarrow \checkmark$$

$$V_e = \frac{1}{10} V_{CC}$$

$$\therefore V_{CC} = 10 . V_e$$

$$= 10 \times 1{,}8$$

$$= 18\ V \checkmark \rightarrow$$

3.2.2

$$R_{b2} = \frac{1}{10}\beta R_e$$

$$\therefore \beta = \frac{10xR_{b2}}{R_e} \checkmark$$

$$= \frac{10 \times 3 \times 10^3}{150} \checkmark$$

$$= 200 \checkmark \rightarrow$$

3.2.3

$$R_{b1} = \frac{R_{b2}(V_{CC} - V_b)}{V_b}$$

$$\therefore V_b = \frac{R_{b2}.V_{CC}}{R_{b1} + R_{b2}} \checkmark$$

$$= \frac{3 \times 10^3 \times 18}{17 \times 10^3 + 3 \times 10^3} \checkmark$$

$$= 2{,}7\ V \checkmark \rightarrow$$

(3 × 3) (9)

3.3 3.3.1

$$Z_L = \frac{R_C.R_L}{R_C + R_L}$$

$$= \frac{240 \times 10000}{240 + 10000} \checkmark$$

$$= 234{,}375\ \Omega \checkmark$$

$$A_i = \left(\frac{h_{fe}}{1 + h_{oe}.Z_L}\right)$$

$$= \left(\frac{250}{1 + 20 \times 10^{-6} \times 234{,}375}\right) \checkmark$$

$$= 248{,}834 \checkmark \rightarrow$$ (4)

3.3.2

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

$$= \frac{-250 \times 234{,}375}{1300 + (1300 \times 20 \times 10^{-6} - 250 \times 2 \times 10^{-4}) \times 234{,}375} \checkmark$$

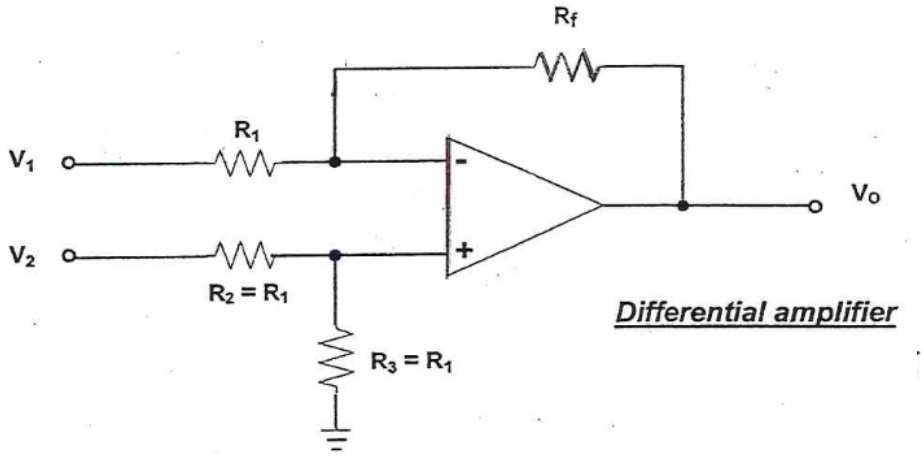
$$= -45{,}268 \checkmark \rightarrow$$ (3)

[18]

QUESTION 4: OPERATIONAL AMPLIFIERS

4.1
- Acts as buffer between stages
- Impedance matching
- Power amplification (Any 2 × 1) (2)

4.2 4.2.1



(3)

4.2.2

$$V_o = \frac{R_f}{R_1}(V_2 - V_1)$$

$$15 = \frac{10000}{2000}(V_2 - V_1) \checkmark$$

$$\frac{15}{5} = (V_2 - V_1) \checkmark$$

$$(V_2 - V_1) = 3\,V \checkmark \rightarrow$$ (3)

4.3

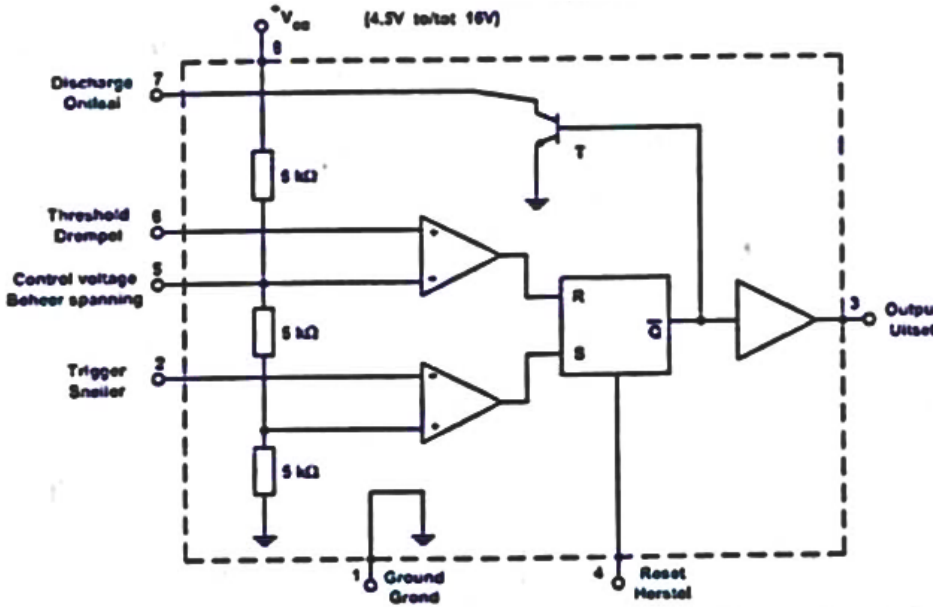
$$F_o = \frac{1}{2\pi CR}$$

$$= \frac{1}{2 \times \pi \times 2 \times 10^{-9} \times 12 \times 10^{3}} \checkmark$$

$$= 6631{,}456\ Hz \checkmark$$ (2)

[10]

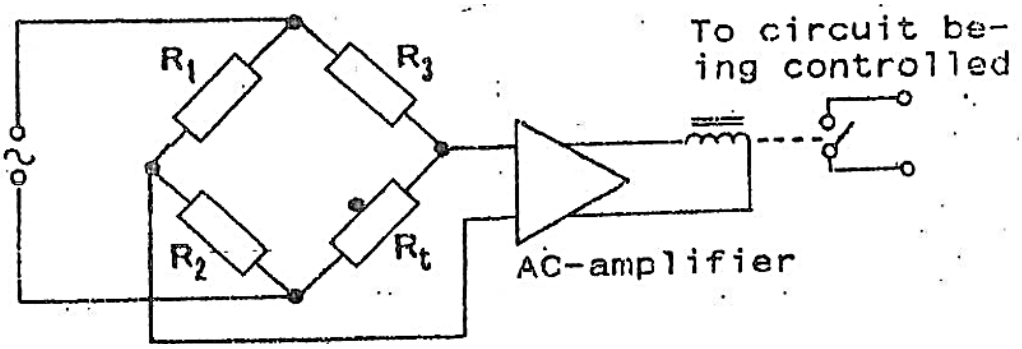
QUESTION 5: INTEGRATED CIRCUITS



[8]

QUESTION 6: TRANSDUCERS

6.1



(4)

6.2 6.2.1 $T = °C + 273$

$= 30 + 273$

$= 303\,K \leftarrow$

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

$= 7 \times 10^{-11} \times e^{\frac{9800}{303}}$ ✓

$= 7790{,}875\,\Omega$ ✓→ (2)

6.2.2 $V_{AB} = V_A - V_B$

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

$= \frac{10000}{10000 + 10000} \times 12$ ✓

$= 6\ V \leftarrow$ ✓

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

$= \frac{7790,875}{7790,875 + 10000} \times 12$ ✓

$= 5,255\ V \leftarrow$ ✓

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

$= 6 - 5,255$

$= 0,745\ V$ ✓

$\therefore A_V = \frac{V_O}{V_i}$

$= \frac{10}{0,745}$ ✓

$= 13,423$ ✓ → (7)

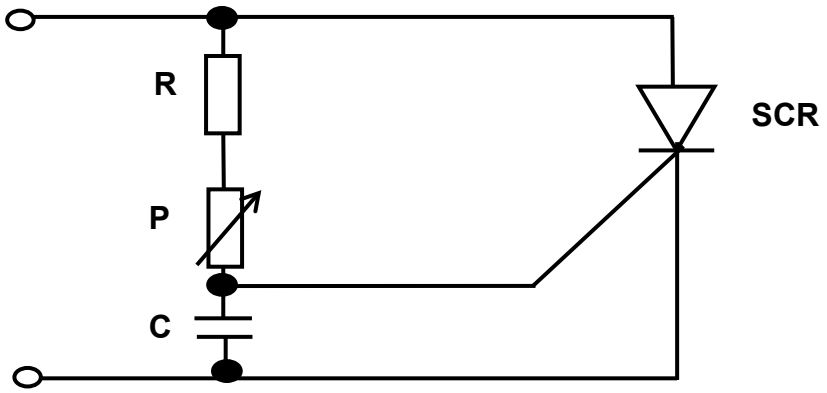
[13]

QUESTION 7: ELECTRONIC PHASE CONTROL

7.1 7.1.1 True
7.1.2 False
7.1.3 False

(3 × 1) (3)

7.2

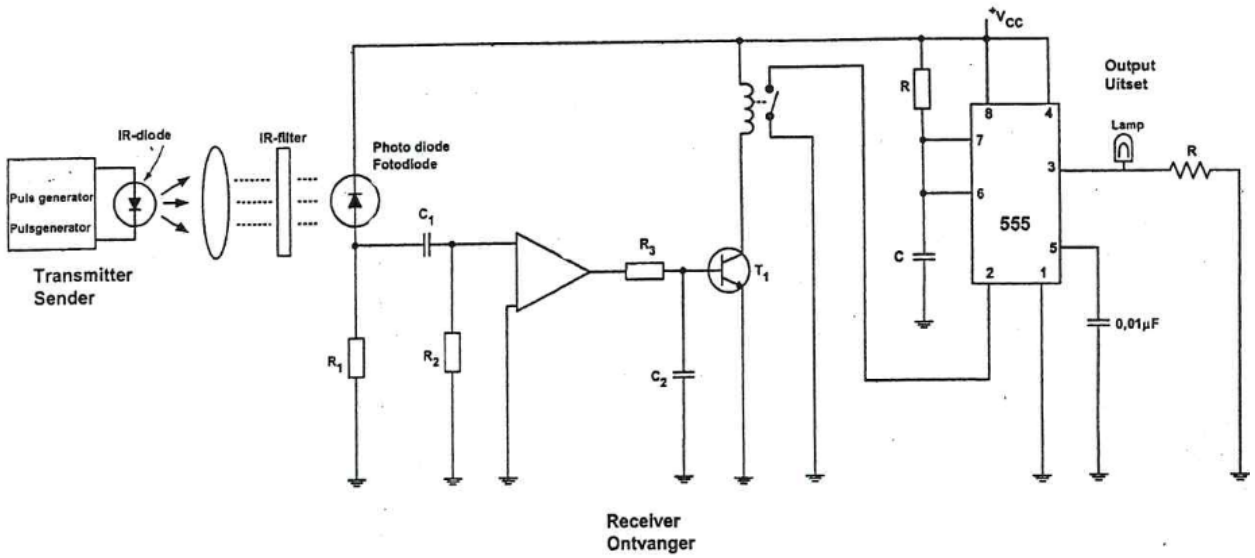


(½ for each component) (2)
[5]

QUESTION 8: TEST EQUIPMENT

The counter counts through its full capacitor during the charging period of the capacitor.✓ A carry pulse is sent to the flip-flop, which causes switch 'S' to switch. Discharge through V_r and the counter counts until C is discharged.✓ This count is proportional to the discharging period and also proportional to the voltage V_u.✓ **[3]**

QUESTION 9: OSCILLATORS



Value of the resistor:

$T = 1{,}1RC$
$60 = 1{,}1 \times R \times 470 \times 10^{-6}$
$R = 116{,}054\ k\Omega$ **[10]**

TOTAL: 100

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