



# higher education & training

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Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

## **MARKING GUIDELINE**

**NATIONAL CERTIFICATE**

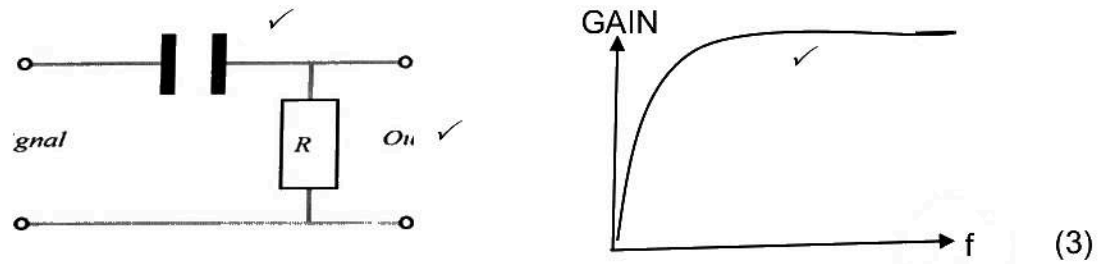
**INDUSTRIAL ELECTRONICS N5**

**4 August 2025**

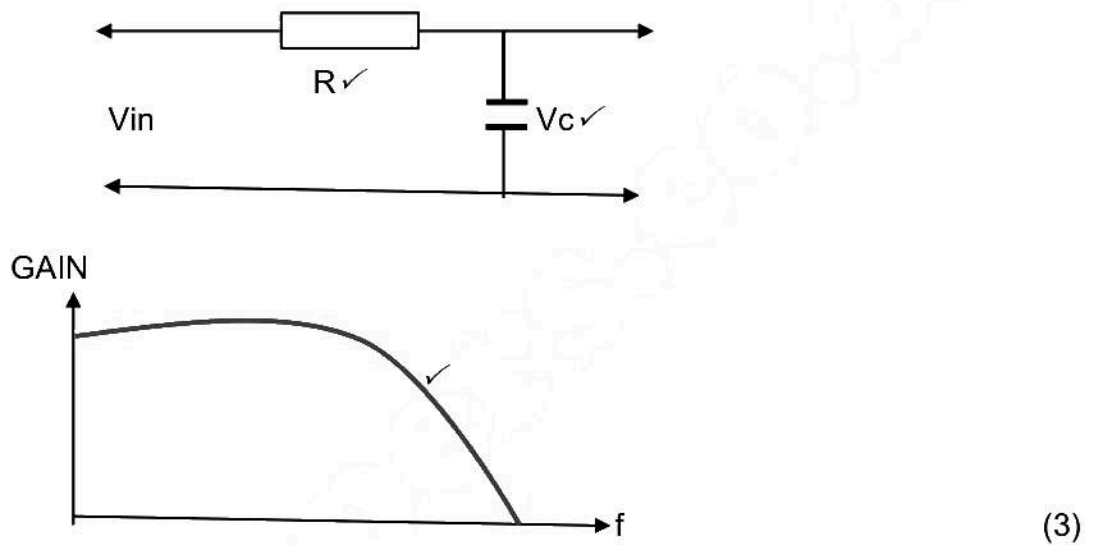
**This marking guideline consists of 8 pages.**

## QUESTION 1: AC THEORY

1.1 1.1.1



1.1.2



1.2 1.2.1

$$I_{Z1} = \frac{V_T}{Z_1}$$

$$= \frac{25 \angle 0^\circ}{15,81 \angle 71^\circ} \checkmark$$

$$= 1,582 \angle -71^\circ A \checkmark$$

$$I_{Z2} = \frac{V_T}{Z_2}$$

$$= \frac{25 \angle 0^\circ}{23,26 \angle -64,54^\circ} \checkmark$$

$$= 1,075 \angle 64,54^\circ A \checkmark$$

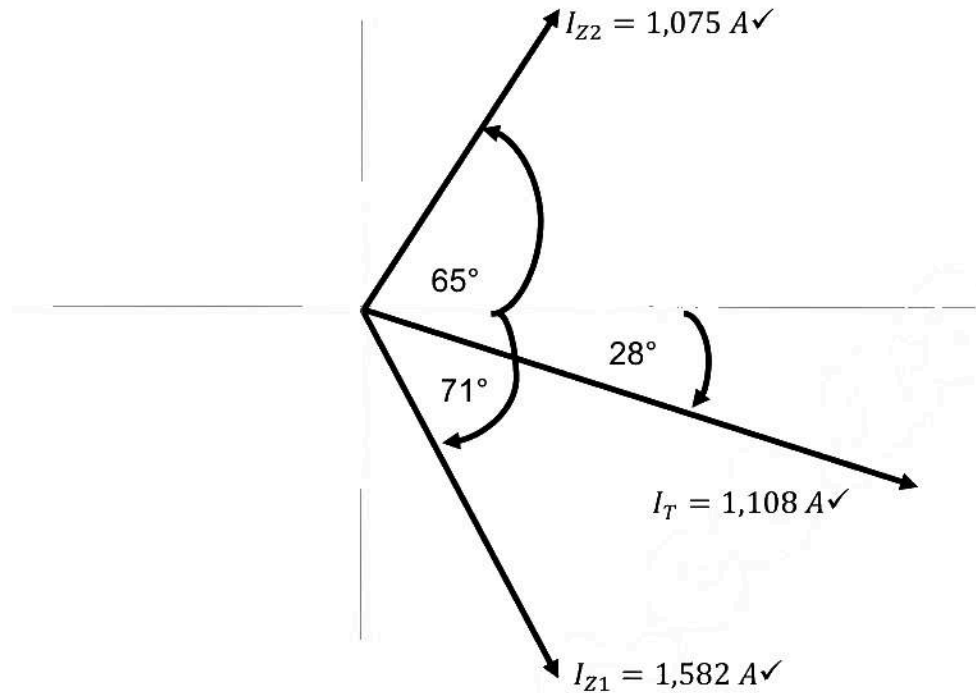
$$I_T = I_{Z1} + I_{Z2}$$

$$= (0,515 - j 1,496) + (0,46 + j 0,97) \checkmark$$

$$= 0,975 - j 0,526$$

$$= 1,108 \angle -28,3^\circ A \checkmark$$

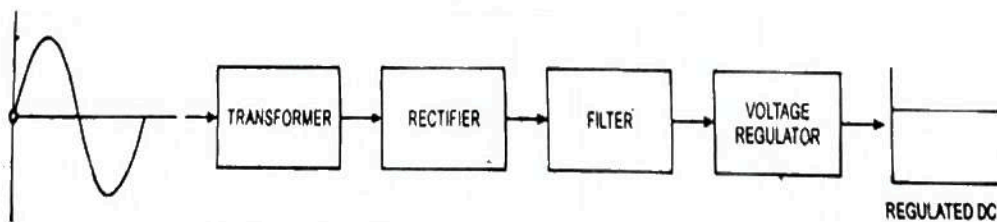
1.2.2



(3)  
[15]

## QUESTION 2: POWER SUPPLY

2.1



(ALLOCATE HALF MARK FOR EACH CORRECTLY LABELLED BLOCK INCLUDING INPUT AND OUTPUT WAVE)

(3)

2.2

2.2.1

$$V_{DC} = V_M - \frac{I_{DC}}{4fC}$$

$$V_{DC} = \frac{V_M}{\left(1 + \frac{1}{4fCR_L}\right)} \checkmark$$

$$= \frac{33,941 \checkmark}{\left(1 + \frac{1}{4 \times 50 \times 2200 \times 10^{-6} \times 220}\right)} \checkmark$$

$$= 33,594 V \checkmark$$

(4)

$$\begin{aligned}
 2.2.2 \quad I_{DC} &= \frac{V_{DC}}{R_{DC}} \\
 &= \frac{33,594}{220} \checkmark \\
 &= 0.153 \text{ A} \checkmark
 \end{aligned}
 \tag{2}$$

$$\begin{aligned}
 2.2.3 \quad r &= \frac{1}{4\sqrt{3}fCR_L} \\
 &= \frac{1}{4\sqrt{3} \times 50 \times 2200 \times 10^{-6} \times 220} \checkmark \\
 &= 0,006 \checkmark
 \end{aligned}
 \tag{2}$$

2.3 During positive half cycle across the transformer,  $\checkmark$   $D_1$  conducts and  $D_2$  is off.  $C_1$  charges to  $V_m$ .  $\checkmark$  During negative half cycle,  $D_2$  will conduct and  $D_1$  is off.  $C_2$  charges to  $V_m$ .  $\checkmark$  The voltage drop across both capacitors will therefore be  $2V_m$ .  $\checkmark$

(4)  
[15]

### QUESTION 3: AMPLIFIER

$$3.1 \quad 3.1.1 \quad A_i = h_{fe} = 80 \tag{1}$$

$$\begin{aligned}
 3.1.2 \quad A_V &= \frac{-h_{fe}Z_L}{h_{ie}} \\
 &= \frac{-80 \times 2400}{13000} \checkmark \\
 &= 14,76 \checkmark
 \end{aligned}
 \tag{2}$$

$$\begin{aligned}
 3.1.3 \quad Z_1 &= h_{ie} = 13k\Omega \checkmark \\
 Z_{IN} &= R_B // Z_1 \\
 &= \frac{300000 \times 13000}{300000 + 13000} \\
 &= 12,46k\Omega \checkmark
 \end{aligned}
 \tag{2}$$

$$3.1.4 \quad Z_2 = \frac{1}{h_{oe}} = \frac{1}{35 \times 10^{-6}} = 28,571 \text{ k}\Omega \checkmark$$

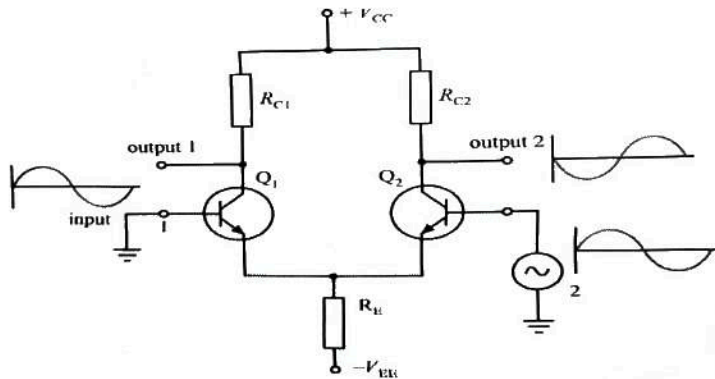
$$Z_{out} = R_C // Z_2$$

$$= \frac{2400 \times 28571}{2400 + 28571}$$

$$= 2,214 \text{ k}\Omega \checkmark$$

(2)

3.2



(Allocate one full mark for correctly labelled electrical components)

(5)

3.3

$$\frac{V_O}{V_{IN}} = 1 + \frac{R_f}{R_{in}}$$

$$R_f = \frac{120 \times 10^{-3} \checkmark}{20 \times 10^{-3}} - 1 \checkmark$$

$$= 10 \text{ k}\Omega \checkmark$$

(3)

[15]

#### QUESTION 4: IC AND TRANSDUCERS

4.1

- Very small
- Less weight
- Reduce cost
- High reliability
- Low power requirements
- Easy replacement

(Any 3 × 1))

(3)

4.2

- Troubleshooting electronic equipment or handling printed circuit boards without using an electronic wrist strap.
- Placement of synthetic materials on or near electronic equipment.
- Rapid movement of air near electronic equipment.

(3)

- 4.3      4.3.1      False  
             4.3.2      True  
             4.3.3      True  
             4.3.4      False  
             4.3.5      True

(5 × 1)      (5)

4.4       $R_t = Ae^{\frac{B}{T}}$

$10000 = Ae^{\frac{3600}{298}} \checkmark$

$A = 56,6878 \times 10^{-3} \checkmark$

$R_{t@30^\circ C} = Ae^{\frac{B}{T}}$

$= 56,6878 \times 10^{-3} e^{\frac{3600}{303}} \checkmark$

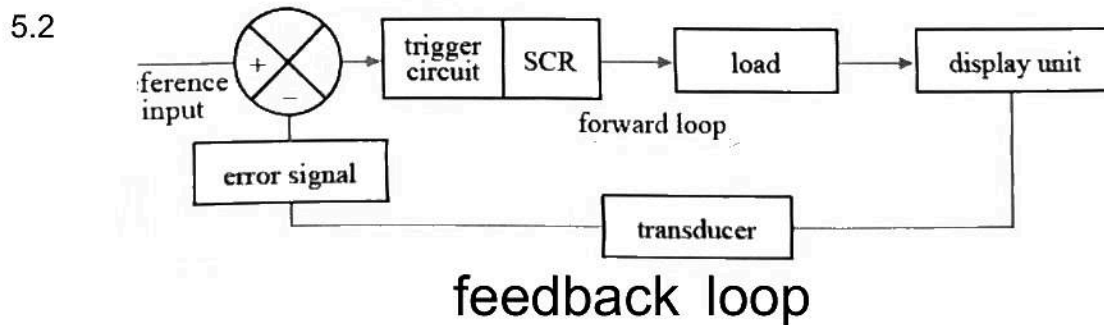
$= 8,193 \text{ k}\Omega \checkmark$

(4)  
 [15]

### QUESTION 5: ELECTRONIC PHASE CONTROL

- 5.1
  - SCR is a semiconductor diode that will only conduct once the gate has been triggered by a pulse to set it into conduction. ✓✓
  - TRIAC is component that will allow conduction in both directions, both half cycles provided that the gate has been triggered by a pulse to set it into conduction. ✓✓

(2 × 2)      (4)



(Allocate one mark for comparator, and half mark for each correctly labelled block in the diagram)

(4)

- 5.3
  - Tacho generator
  - Synchronous motor

(2)  
 [10]

## QUESTION 6: MEASURING INSTRUMENTS

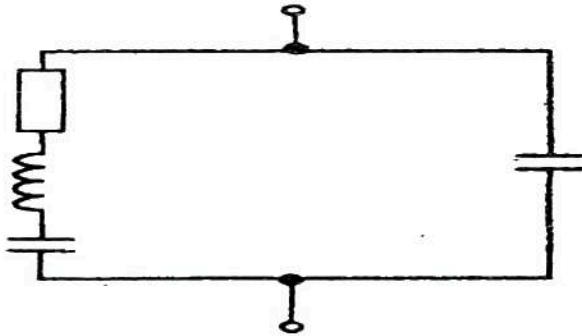
- 6.1 Digital signal is a signal that will vary between two definite values as time progresses.✓✓ (1 × 2) (2)
- 6.2
- The input voltage is attenuated and then applied to a null detector.
  - When the measurement starts, the logic control circuit sends a reset signal, which resets the counter and the DAC.
  - The output of the counter is fed to the DAC.
  - With each count, the ramp generated by DAC increases incrementally, producing the staircase ramp as the output.
  - The null detector receives the input voltage and the staircase ramp voltage produced by DAC as input.
  - The ramp is continuously compared with the input signal.
  - The ramp increment continues until it matches the input voltage.
  - Once the two voltages are equal, the null detector produces a signal, triggering the logical control circuit. (6 × 1) (6)
- 6.3
- Continuous balance digital voltmeter
  - Double slope voltmeter
  - Successive approximation voltmeter
  - Stair slope voltmeter (Any 2 × 1) (2)

[10]

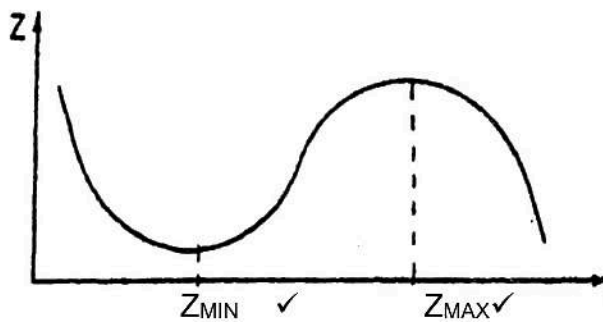
## QUESTION 7: OSCILLATORS

- 7.1
- Change in load conditions
  - An unstable supply voltage
  - Variations in the tuned circuit and transistors parameters. (3)
- 7.2
- When  $V_{in}$  is close to zero,  $Q_1$  is OFF while  $Q_2$  is ON, placing  $V_{out}$  at the mid-point of the potential divider.
  - As  $V_{in}$  decreases,  $Q_1$  starts to turn ON, starving  $Q_2$  of base current and causing it to turn OFF.
  - This process is hastened by positive feedback, leading  $Q_1$  to saturate and  $Q_2$  to turn OFF completely.
  - As  $v_{in}$  decreases back towards ZERO,  $Q_1$  begins to turn OFF, allowing  $Q_2$  to turn ON again gradually.
  - Positive feedback aids this transition, causing  $Q_1$  to turn OFF completely and  $Q_2$  to saturate, thus shifting  $V_{out}$  back to its initial state. (3)

7.3



Allocate 1 full for series and and 1 mark for parallel circuit)



(4)  
[10]

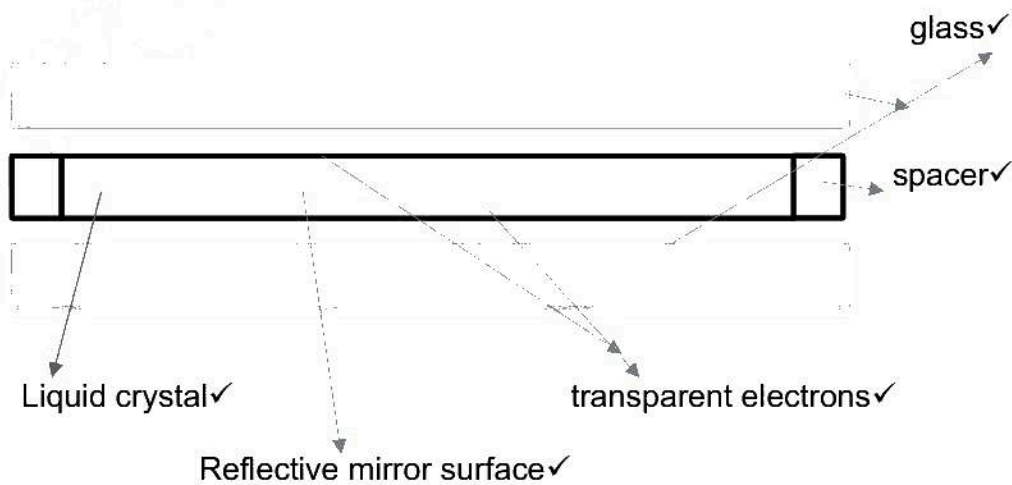
## QUESTION 8: LIQUID CRYSTAL DISPLAY

8.1

- Consume less power
- Cost low
- Provide excellent contrast
- Thin and lighter weight
- Long lifespan
- No burnt-in images

(Any 5 × 1) (5)

8.2



(5)  
[10]

**TOTAL: 100**