



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N4

5 April 2024

This marking guideline consists of 7 pages.

QUESTION 1

Consider loop ABDEFA

$$20 = 20 (I_1 - I_2) + 25 [(I_1 - I_2) + I_3]$$

$$20 = 20I_1 - 20I_2 + 25I_1 - 25I_2 + 25I_3$$

$$20 = 45I_1 - 45I_2 + 25I_3 \dots\dots\dots [1] \checkmark$$

Consider loop ABCEFA

$$20 = 10I_2 + 40 (I_2 - I_3)$$

$$20 = 50I_2 - 40I_3 \text{-----} [2] \checkmark$$

Consider loop ABCDEFA

$$20 = 10I_2 + 30I_3 + [25 (I_1 - I_2) + I_3]$$

$$20 = 10I_2 + 30I_3 + 25I_1 - 25I_2 + 25I_3$$

$$20 = 25I_1 - 15I_2 + 55I_3 \text{-----} [3] \checkmark$$

$$[1] \quad \times 5: 100 = 225I_1 - 225I_2 + 125I_3 \text{-----} [4] \checkmark$$

$$[3] \quad \times 9: 180 = 225I_1 - 135I_2 + 495I_3 \text{-----} [5] \checkmark$$

$$[5] - [4]: 80 = 90I_2 + 370I_3 \text{-----} [6] \checkmark$$

$$[2] \times [9]: 180 = 450I_2 - 360I_3 \text{-----} [7] \checkmark$$

$$[6] \times [5]: 400 = 450I_2 + 1850I_3 \text{-----} [8] \checkmark$$

$$[8] - [7]: 220 = 2210I_3 \checkmark$$

$$\therefore I_3 = 0,1A \checkmark$$

[10]

QUESTION 2

$$2.1 \quad R = \frac{X_L}{Q} = \frac{7500}{2,5} = 3k\Omega \checkmark \quad (1)$$

$$2.2 \quad 2.2.1 \quad Z_1 = 8 + j15 \quad Z_2 = 6 - j10 \quad Z_S = 0 - j12$$

$$= 17 \angle 61,9^\circ \checkmark \quad = 11,662 \angle -59^\circ \checkmark \quad = 12 \angle 90^\circ$$

$$Z_T = \frac{Z_1 Z_2}{Z_1 + Z_2} + Z_S$$

$$= \frac{17 \angle 61,9^\circ \times 11,662 \angle -59^\circ}{8 + j15 + 6 - j10} + 0 - j12 \checkmark \checkmark$$

$$= \frac{198,254 \angle 2,9^\circ}{14,866 \angle 19,7^\circ} + 0 - j12 \checkmark$$

$$= 13,336 \angle -16,8^\circ + 0 - j12 \checkmark$$

$$= 12,767 - j3,855 + 0 - j12 \checkmark$$

$$= 12,767 - j15,855$$

$$= 20,356 \angle -51,16^\circ \Omega \checkmark \quad (8)$$

$$2.2.2 \quad I_T = \frac{V_T}{Z_T}$$

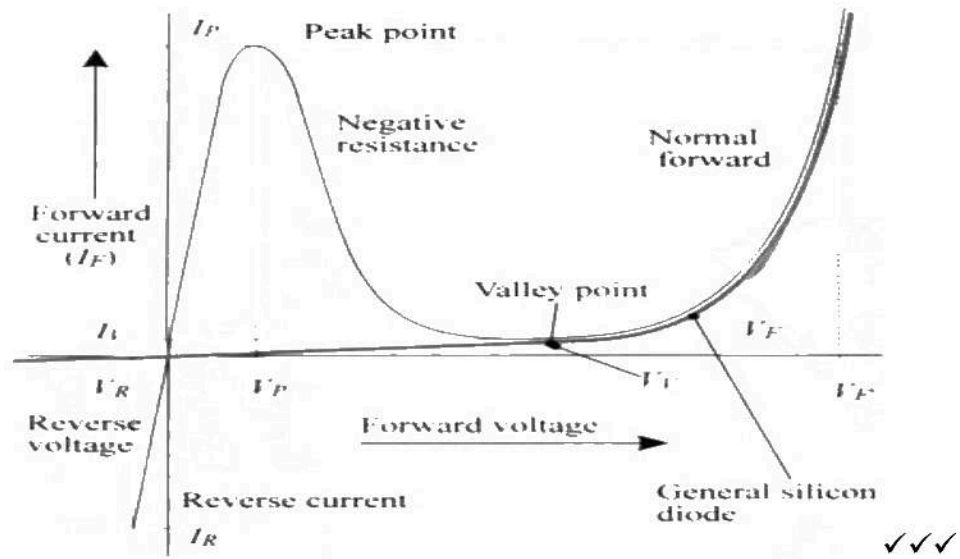
$$= \frac{200 \angle 0^\circ}{20,356 \angle -51,16^\circ} \checkmark$$

$$= 9,825 \angle 51,16^\circ A \checkmark \quad (2)$$

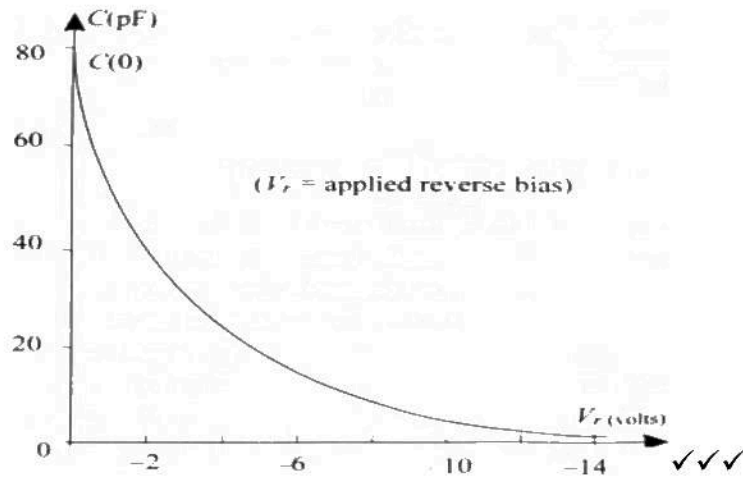
[11]

QUESTION 3

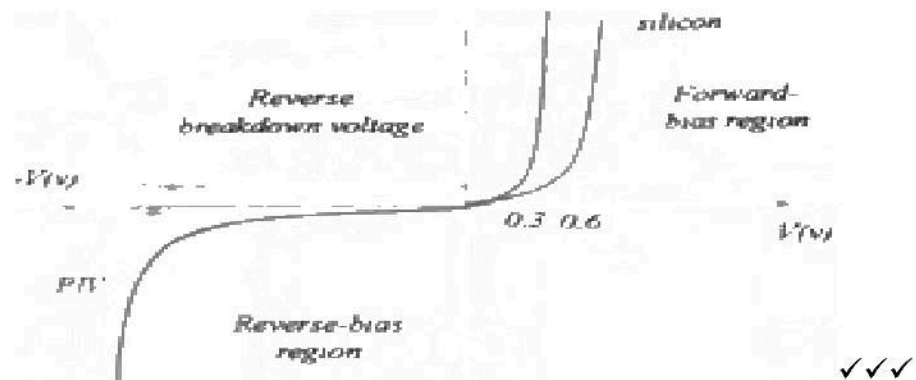
3.1 3.1.1



3.1.2



3.1.3



(3 × 3) (9)

3.2

$$i = I_S \left(e^{\frac{qV}{KT}} - 1 \right)$$

$$\therefore T = \frac{qV}{K \ln\left(\frac{i}{I_S} + 1\right)} = \frac{1.6 \times 10^{-19} \times 0,126}{1,38 \times 10^{-23} \times \ln\left(\frac{2 \times 10^{-3}}{15 \times 10^{-6}} + 1\right)} = 298.136 \text{ K} \checkmark \checkmark \checkmark \checkmark$$

$$^{\circ}\text{C} = 298.136 - 273 = 25.136 \text{ }^{\circ}\text{C} \checkmark$$

(5)
[14]

QUESTION 4

$$4.1 \quad 4.1.1 \quad V'_{DC} = V_{DC} \times \frac{R_L}{R_L + R_S} = 100 \times \frac{7 \times 10^3}{7 \times 10^3 + 20} = 99.715 \text{ V} \checkmark \checkmark \checkmark \checkmark$$

(3)

$$4.1.2 \quad V_{r(RMS)} = \frac{V_{r(P-P)}}{2\sqrt{3}} = \frac{10}{2\sqrt{3}} = 2.887 \text{ volt} \checkmark \checkmark$$

$$V'_{r(RMS)} = \frac{V_{r(RMS)}}{(4\pi f)^2 L \times C} = \frac{2.887}{(4\pi \times 50)^2 \times 1.5 \times 300 \times 10^{-6}} = 16,25 \text{ m volt} \checkmark \checkmark$$

$$r = \frac{V'_{r(RMS)}}{V'_{DC}} = \frac{16,25 \times 10^{-3}}{99.715} = 1.63 \times 10^{-4} \checkmark \checkmark$$

(6)

4.2 Voltage regulation may be defined as that change in the output voltage (full-load) for varying load conditions.

(2)

OR

It is the degree to which its output voltage remains constant despite changes in the amount of current drawn from the supply by the load.

$$4.3 \quad \% \text{ regulation} = \frac{V_{NL} - V_{FL}}{V_{FL}} \times 100 = \frac{30,5 - 23,4}{23,4} \times 100 = 30.342\% \checkmark \checkmark$$

(2)

[13]

QUESTION 5

- 5.1
- 5.1.1 True
 - 5.1.2 False
 - 5.1.3 False
 - 5.1.4 True
 - 5.1.5 True

(5 × 1) (5)

- 5.2
- No offset voltage when used as a switch.
 - Small gain bandwidth.
 - Low noise level.
 - Relatively immune to radiation.
 - Extremely high input impedance.
 - Good thermal stability.
- (Any 4 × 1) (4)

5.3

$$A_V = \frac{V_{OUT}}{V_{IN}}$$

$$= \frac{2,5}{600 \times 10^{-3}} \checkmark \checkmark$$

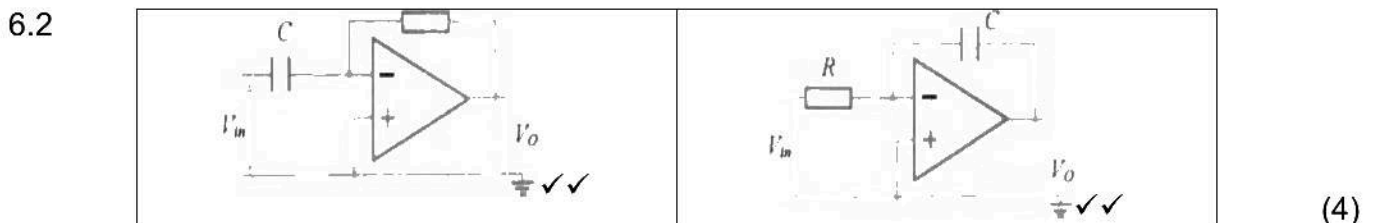
$$= 4,167 \checkmark \quad (3)$$

- 5.4
- h – with which we work (e.g. hybrid parameter).
 f – which characteristic (e.g. forward current gain).
 b – which configuration (e.g. common base).
- (3)
[15]

QUESTION 6

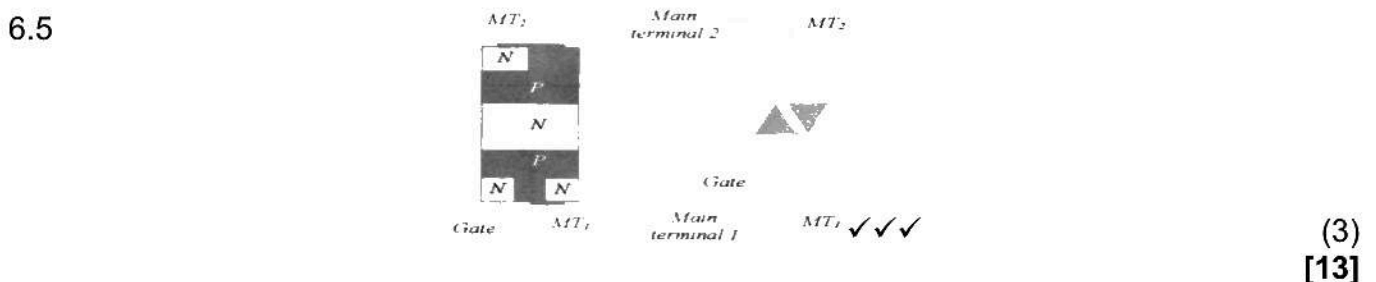
6.1

$$C = \frac{-V}{\text{Rate of change} \times R_{in}} = \frac{-4}{-3.3 \times 10 \times 10^3} = 12 \mu F \checkmark \checkmark \checkmark \quad (3)$$



- 6.3
- Relay control
 - Time delay circuits
 - Static switches
- (Any TWO) (2)

6.4 Two (2) (1)

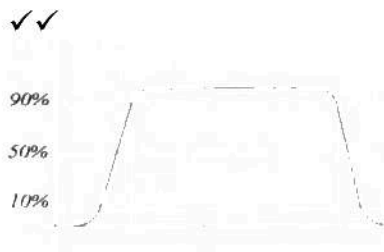


QUESTION 7

- 7.1
- The physical conditions in which the transducer would be used
 - The quality that must be measured
 - What kind of transducer would be suitable
- (3)
- 7.2
- PTC – Positive Temperature Coefficient✓ – The resistance increases with an increase in temperature.✓
 - NTC – Negative Temperature Coefficient✓ – The resistance decreases with an increase in temperature.✓
- (2 × 2) (4)
- 7.3
- The capacitor plates are isolated from the container and reach from the top to the bottom.
 - When the liquid level rises, the liquid, which serves as the di-electric, changes the capacitance between the plates.
 - The change in capacitance is detected by the bridge, amplified and an indication of the liquid level is observed on the indicator.
- (2 × 3) (6)
- [13]**

QUESTION 8

- 8.1
- Rise time - 10% to 90%✓
 - Fall time – 90% to 10%✓
 - Pulse width at 50% ✓



- 8.2
- | | |
|-------|---|
| 8.2.1 | B |
| 8.2.2 | A |
| 8.2.3 | D |
| 8.2.4 | G |
| 8.2.5 | F |
| 8.2.6 | E |

(5)

(6 × 1) (6)

[11]

TOTAL: 100