



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N3

20 November 2024

This marking guideline consists of 10 pages.

SECTION A

QUESTION 1

1.1	1.1.1	True	(5 × 1)	(5)
	1.1.2	True		
	1.1.3	False		
	1.1.4	True		
	1.1.5	False		
1.2	1.2.1	Maximum	(5 × 1)	(5)
	1.2.2	Unmonitored		
	1.2.3	Zero		
	1.2.4	Dual-beam		
	1.2.5	Piezoelectric		
1.3	1.3.1	A	(5 × 1)	(5)
	1.3.2	C		
	1.3.3	B		
	1.3.4	C		
	1.3.5	B		

[15]

TOTAL SECTION A: 15

SECTION B

QUESTION 2

2.1	2.1.1	In Loop 1: $V_T = V_6 + V_{4+5} + V_3$ $V_T = I_1 \cdot R_6 + I_2 \cdot R_{4+5} + I_1 \cdot R_3$ $24 = 225I_1 + (325 + 105)I_2 + 225I_1 \checkmark$ $24 = 450I_1 + 430I_2 \text{ (1) } \checkmark$	OR	$24 = 450I_1 + 430I_2$	(2)
	2.1.2	In Loop 2: $V_T = V_7 + V_1 + V_2 + V_{4+5}$ $V_T = (I_1 - I_2) \cdot R_7 + (I_1 - I_2) \cdot R_1 + (I_1 - I_2) \cdot R_2 - I_2 \cdot R_{4+5}$ $0 = (I_1 - I_2) \cdot 55 + (I_1 - I_2) \cdot 135 + (I_1 - I_2) \cdot 123 - I_2 \cdot (105 + 325)$ $0 = 55I_1 - 55I_2 + 135I_1 - 135I_2 + 123I_1 - 123I_2 - 430I_2 \checkmark$ $0 = 313I_1 - 743I_2 \text{ (2) } \checkmark$			

2.1.3 **Eq. (1)x743**

$$17832 = 334350I_1 + 319490I_2 \text{ _____(3)✓}$$

Eq. (2)x430

$$0 = 134590I_1 - 319490I_2 \text{ _____(4)✓}$$

Eq. (3)+(4)

$$17832 = 334350I_1 + 319490I_2 \text{ _____(3)}$$

$$0 = 134590I_1 - 319490I_2 \text{ _____(4)}$$

$$17832 = 468940I_1 \text{ ✓}$$

$$I_1 = \frac{17832}{468940}$$

$$I_1 = 0,038A \text{ ✓}$$

Replace I_1 in Eq.(1)

$$24 = 450(0,038) + 430I_2$$

$$24 - 17,1 = 430I_2 \text{ ✓}$$

$$I_2 = \frac{24 - 17,1}{430}$$

$$I_2 = 0,016A \text{ ✓}$$

(6)

2.2

$$f_R = \frac{1}{2\pi} \sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$$

$$C = \frac{1}{L[4\pi^2 f_R^2 + \frac{R^2}{L^2}]}$$

$$C = \frac{1}{40 \times 10^{-3} [4\pi^2 50^2 + \frac{16^2}{(40 \times 10^{-3})^2}]}$$

$$\underline{C = 96,639 \mu F}$$

OR

$$2.2 \quad X_L = 2\pi fL$$

$$X_L = 2\pi(50)(40 \times 10^{-3})$$

$$\underline{X_L = 12,566\Omega} \quad \checkmark$$

$$Z_L = \sqrt{R_L^2 + X_L^2}$$

$$Z_L = \sqrt{16^2 + 12,566^2}$$

$$\underline{Z_L = 20,345\Omega} \quad \checkmark$$

$$\theta_L = \cos^{-1} \frac{R}{Z_L}$$

$$\theta_L = \cos^{-1} \frac{16}{20,345}$$

$$\underline{\theta_L = 38,146^\circ} \quad \checkmark$$

$$I_{RL} = \frac{V}{Z_L}$$

$$I_{RL} = \frac{220}{20,345}$$

$$\underline{I_{RL} = 10,813A} \quad \checkmark$$

$$I_T = \min.$$

$$I_C = I_{RL} \sin \theta$$

$$I_C = 10,813 \cdot \sin 38,146^\circ \quad \checkmark$$

$$\underline{I_C = 6,679A} \quad \checkmark$$

$$X_C = \frac{V}{I_C}$$

$$X_C = \frac{220}{6,679} \quad \checkmark$$

$$\underline{X_C = 32,939\Omega} \quad \checkmark$$

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

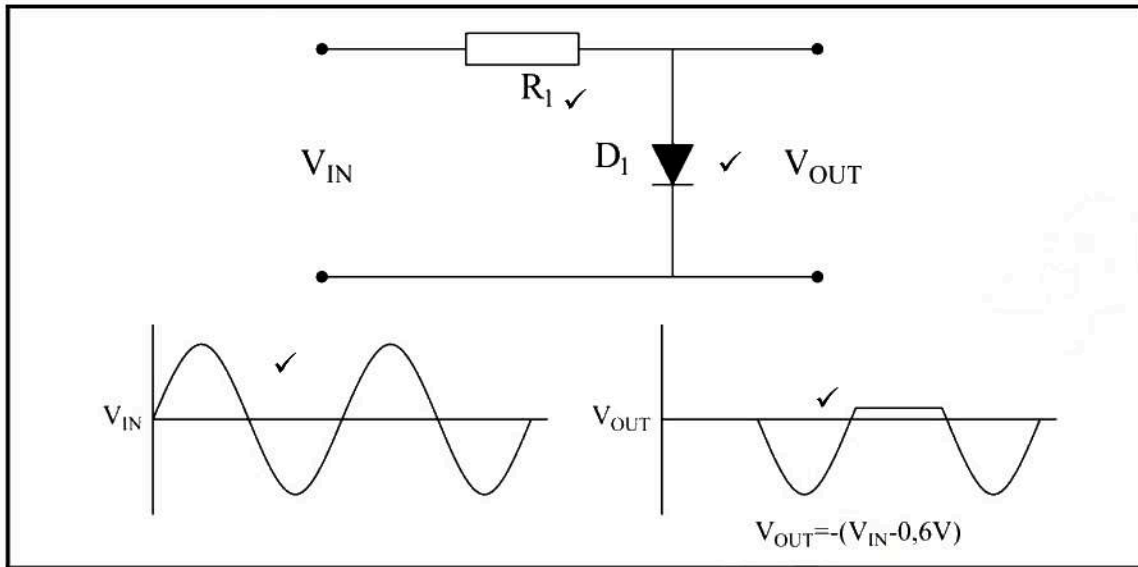
$$C = \frac{1}{2\pi fX_C}$$

$$C = \frac{1}{2\pi(50)(32,939)} \quad \checkmark$$

$$\underline{C = 96,636\mu F} \quad \checkmark$$

QUESTION 3

3.1

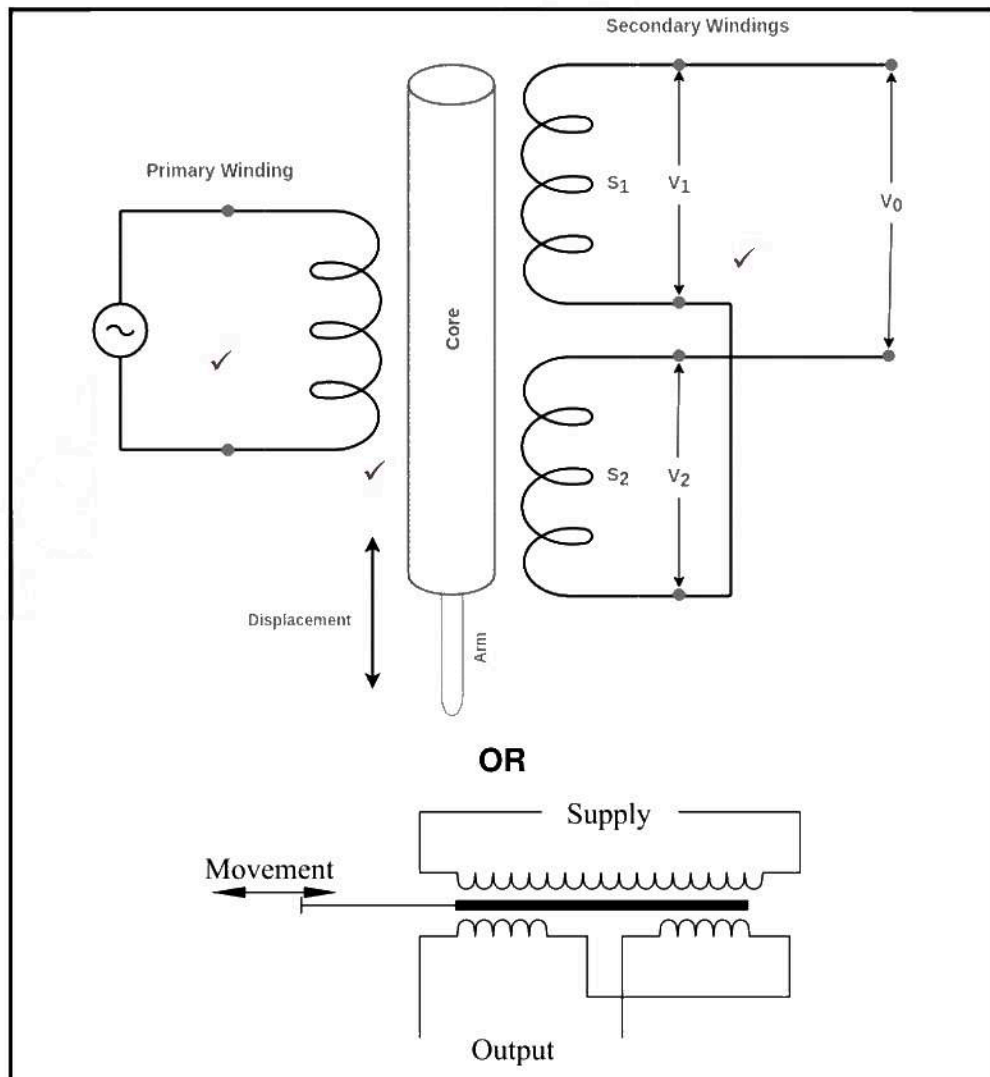


(Marker to use discretion)

(4)

3.2

3.2.1

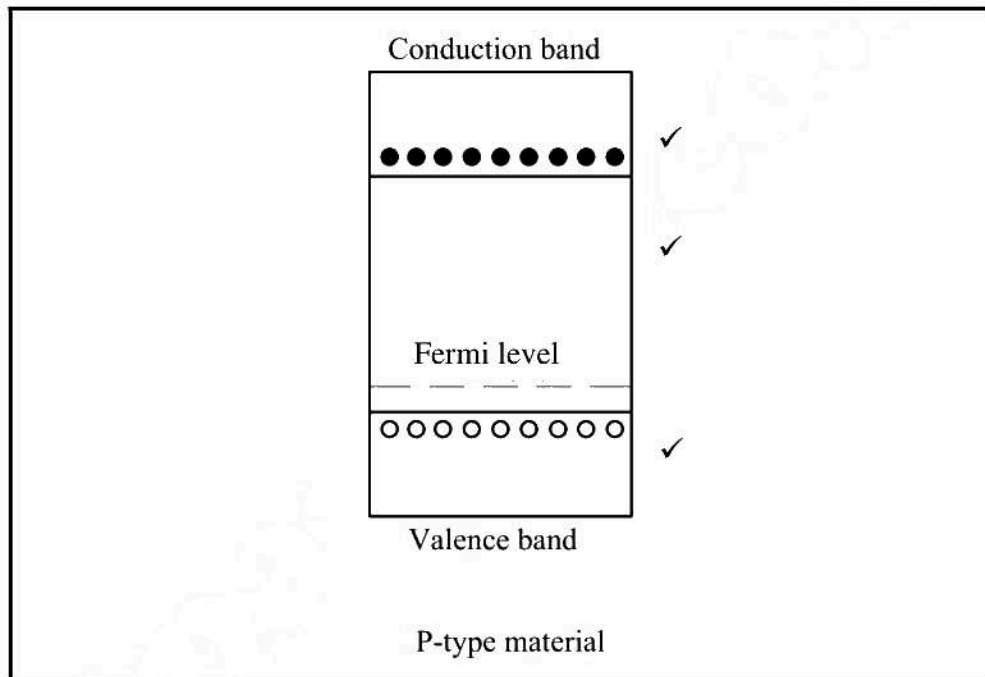


(Marker to use discretion)

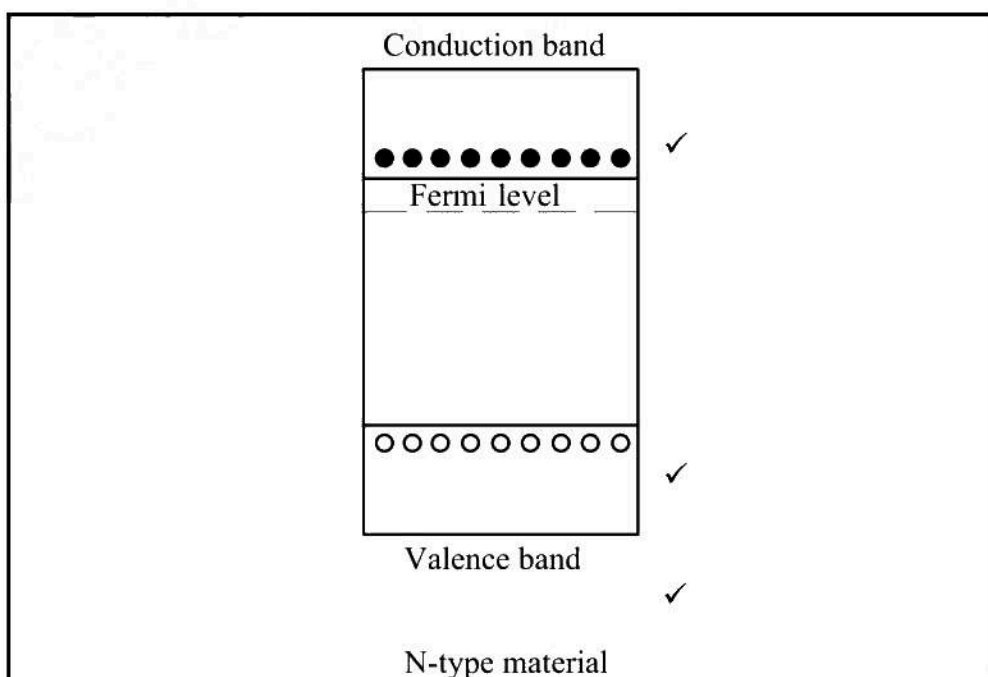
- 3.2.2
- Sound
 - Acceleration
 - Pressure changes
 - Vibration
- (Any 2 × 1) (2)

- 3.2.3
- Capacitive
 - Inductance
 - Resistive
 - Photosensitive
 - Piezoelectric
- (Any 2 × 1) (2)

3.3 3.3.1

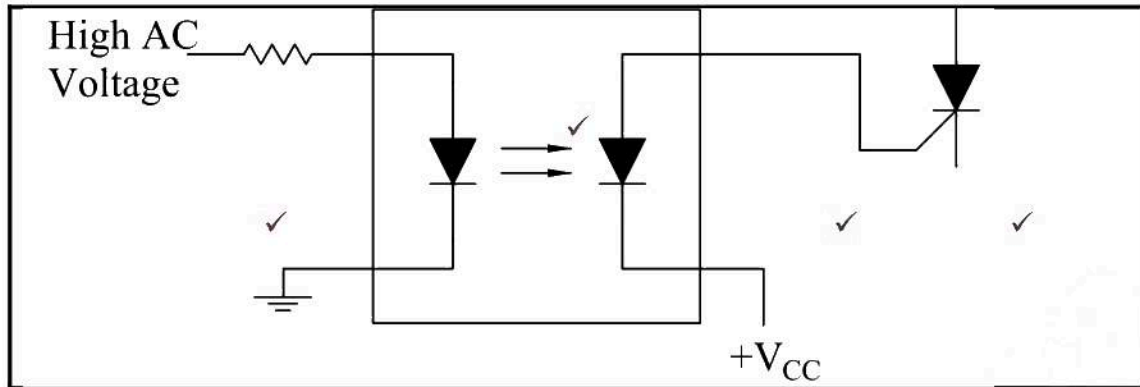


3.3.2



(2 × 3)

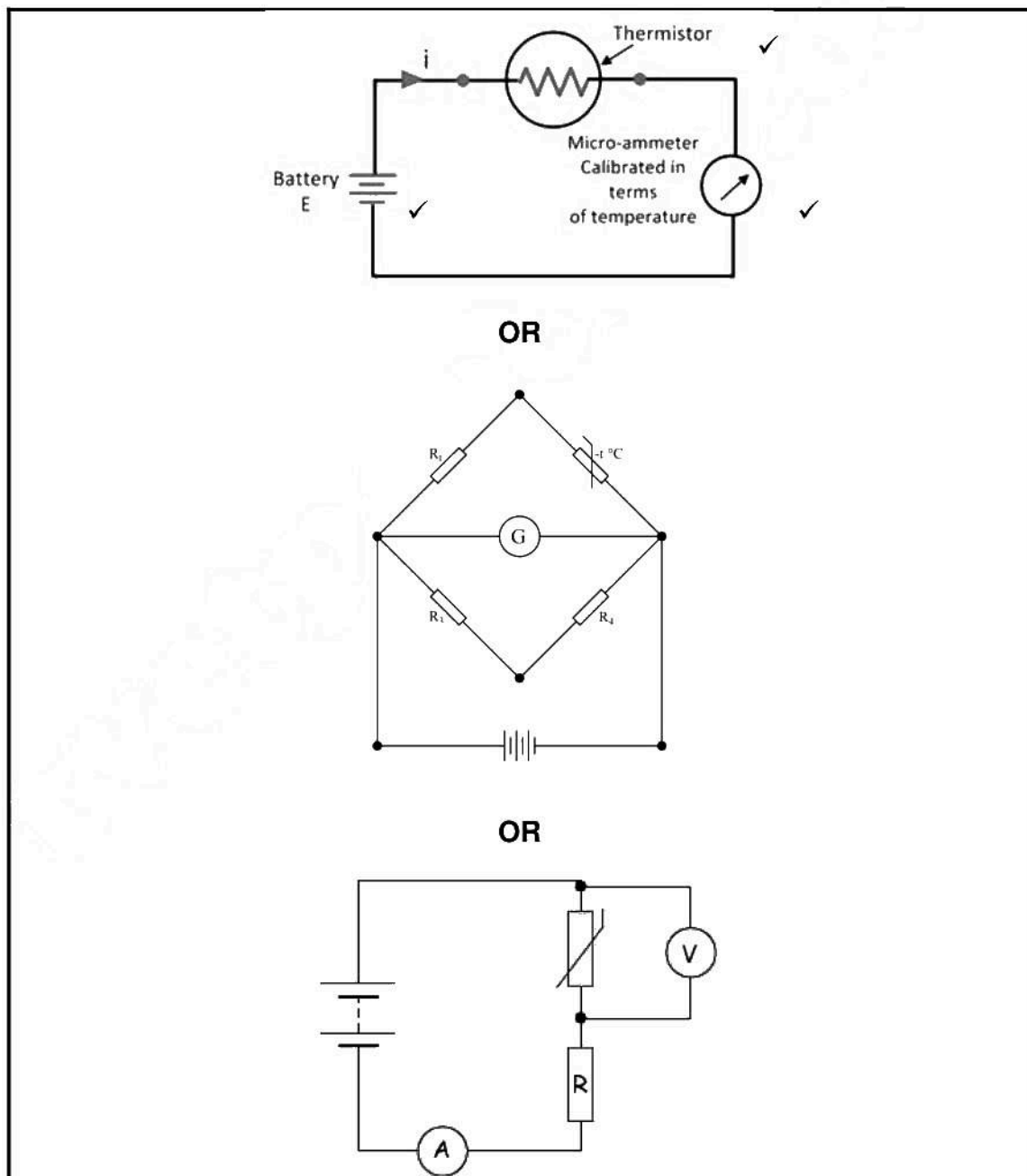
3.4



(Marker to use discretion)

(4)

3.5

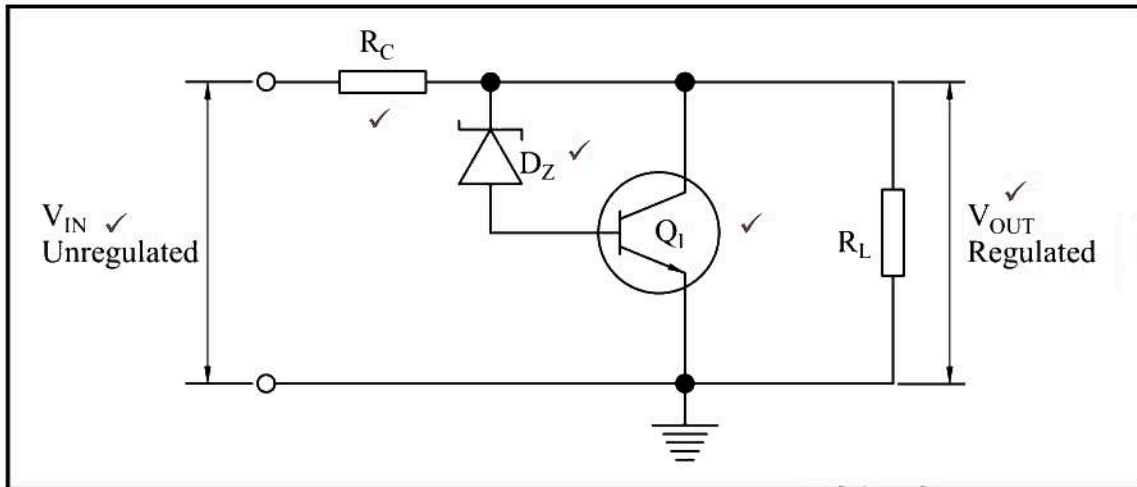


(4)

[251

QUESTION 4

4.1



(Marker to use discretion)

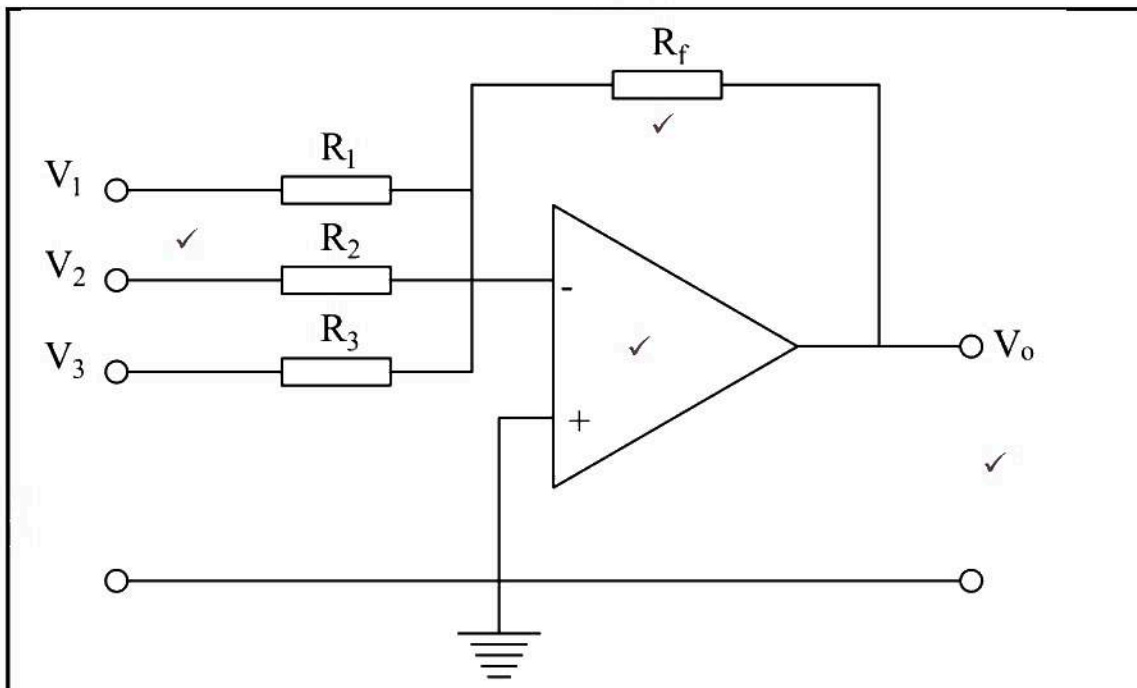
(5)

4.2

- There is no wear and tear on switchgear caused by aging.
- A small-base emitter current can switch the transistor on and off.
- Many switching times.
- Control over long distances.

(4)

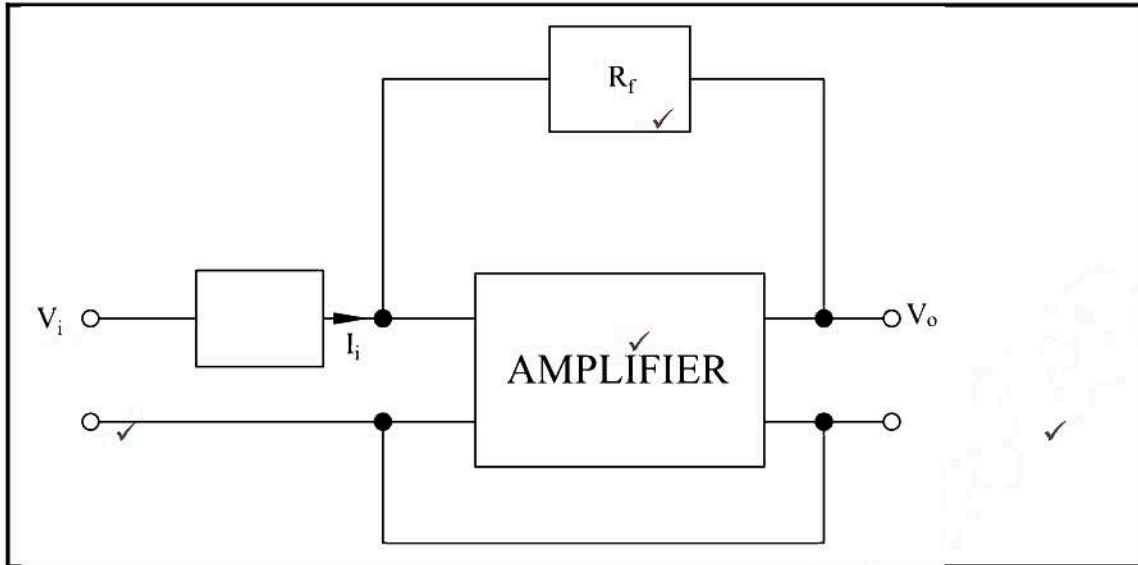
4.3



(Marker to use discretion)

(4)

4.4



(Marker to use discretion)

(4)

4.5

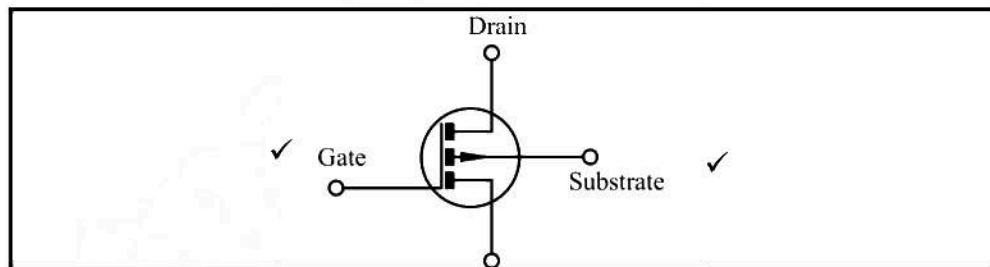
- High input impedance
- High voltage gain
- Low output impedance
- Wide bandwidth
- Low noise

(Any 3 × 1)

(3)

4.6

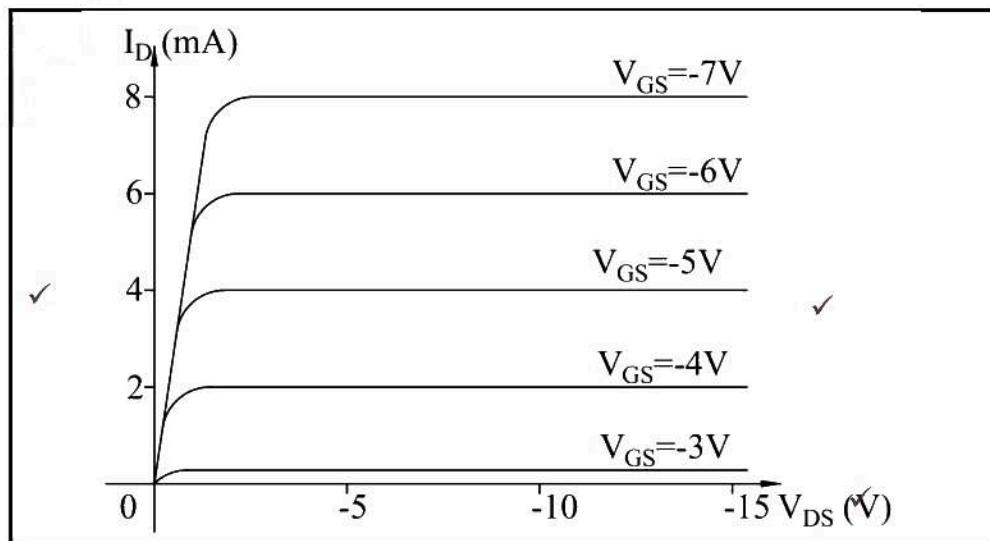
4.6.1



(Marker to use discretion)

(2)

4.6.2

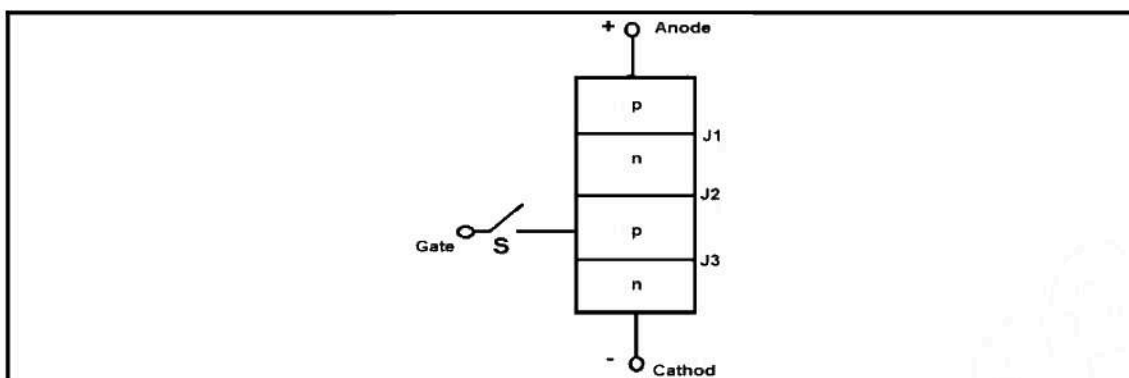


(Marker to use discretion)

(3)

QUESTION 5

5.1



- An additional forward voltage is applied between the anode and cathode.
- When the anode terminal is positive with respect to the cathode (V_{AK}), the junction J_1 and J_3 are forward-biased and junction J_2 is reverse-biased. No current flows due to the depletion region in J_2 which is reverse-biased.
- As V_{AK} is further increased, at a voltage V_{BO} (forward breakover voltage), the junction J_2 undergoes avalanche breakdown and so a current flows and the device tends to turn ON (even when the gate is open).

(2 marks for sketch and 4 marks for explanation)
(Marker to use discretion)

(6)

5.2

5.2.1 $V_{AVE} = V_M \times 0,637$

$$V_M = \frac{V_{AVE}}{0,637}$$

$$V_M = \frac{220 \times 10^{-3}}{0,637} \checkmark$$

$$V_M = 345,369mV \checkmark$$

(2)

5.2.2 $V_{RMS} = V_M \times 0,707$

$$V_{RMS} = 345,369 \times 10^{-3} \times 0,707 \checkmark$$

$$V_{RMS} = 243,915mV \checkmark$$

(2)

5.3

- At the start of measurement, the counter is reset to zero.
- The unknown voltage is compared to the internal reference voltage.
- If the unknown voltage is smaller than the reference voltage, the comparator's output is high and opens the AND gate to allow pulses from the clock pulse generator through.
- These pulses from the AND gate is counted by the counter.
- If the unknown voltage is equal to the reference voltage, the comparator's output is low and the AND gate closes.
- The counter stops counting and the last value is displayed on the display unit.

(Any 5 × 1)

(Marker to use discretion)

(5)

[15]

TOTAL SECTION B:
GRAND TOTAL:

05