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.

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SECTION A

QUESTION 1

1.1
1.1.1 True
1.1.2 True
1.1.3 False
1.1.4 True
1.1.5 False

(5 × 1) (5)

1.2
1.2.1 Maximum
1.2.2 Unmonitored
1.2.3 Zero
1.2.4 Dual-beam
1.2.5 Piezoelectric

(5 × 1) (5)

1.3
1.3.1 A
1.3.2 C
1.3.3 B
1.3.4 C
1.3.5 B

(5 × 1) (5)
[15]

TOTAL SECTION A: 15

SECTION B

QUESTION 2

2.1 2.1.1 **In Loop 1:**

$V_T = V_6 + V_{4+5} + V_3$

$V_T = I_1.R_6 + I_2.R_{4+5} + I_1.R_3$

$24 = 225I_1 + (325+105)I_2 + 225I_1$ ✓ **OR** $24 = 450I_1 + 430I_2$

$24 = 450I_1 + 430I_2$ _____(1) ✓ (2)

2.1.2 **In Loop 2:**

$V_T = V_7 + V_1 + V_2 + V_{4+5}$

$V_T = (I_1 - I_2).R_7 + (I_1 - I_2).R_1 + (I_1 - I_2).R_2 - I_2.R_{4+5}$

$0 = (I_1 - I_2).55 + (I_1 - I_2).135 + (I_1 - I_2).123 - I_2.(105+325)$

$0 = 55I_1 - 55I_2 + 135I_1 - 135I_2 + 123I_1 - 123I_2 - 430I_2$ ✓

$0 = 313I_1 - 743I_2$ _____(2) ✓ (2)

2.1.3 **Eq. (1)x743**

$17832 = 334350I_1 + 319490I_2$ _____(3)✓

Eq. (2)x430

$0 = 134590I_1 - 319490I_2$ _____(4)✓

Eq. (3)+(4)

$17832 = 334350I_1 + 319490I_2$ _____(3)

$0 = 134590I_1 - 319490I_2$ _____(4)

$17832 = 468940I_1$ ✓

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

$I_1 = 0,038A$ ✓

Replace I_1 in Eq.(1)

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

$24 - 17,1 = 430I_2$ ✓

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

$I_2 = 0,016A$ ✓ (6)

2.2

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

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

$$C = \frac{1}{40\times10^{-3}[4\pi^2 50^2 + \frac{16^2}{(40\times10^{-3})^2}]}$$

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

OR

2.2 $X_L = 2\pi fL$

$X_L = 2\pi(50)(40\times10^{-3})$

$\underline{X_L = 12,566\Omega}$ ✓

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

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

$\underline{Z_L = 20,345\Omega}$ ✓

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

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

$\underline{\theta_L = 38,146°}$ ✓

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

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

$\underline{I_{RL} = 10,813A}$ ✓

$I_T = \min.$

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

$I_C = 10,813.\sin 38,146$ ✓

$\underline{I_C = 6,679A}$ ✓

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

$X_C = \frac{220}{6,679}$ ✓

$\underline{X_C = 32,939\Omega}$ ✓

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

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

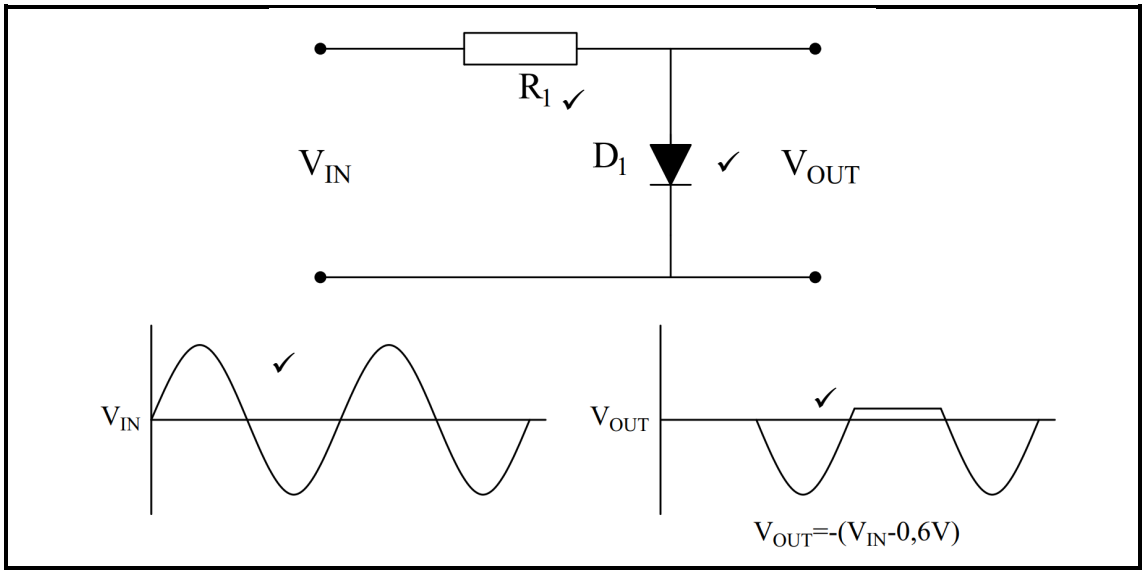
$C = \frac{1}{2\pi(50)(32,939)}$ ✓

$\underline{C = 96,636\mu F}$ ✓

(10)
[20]

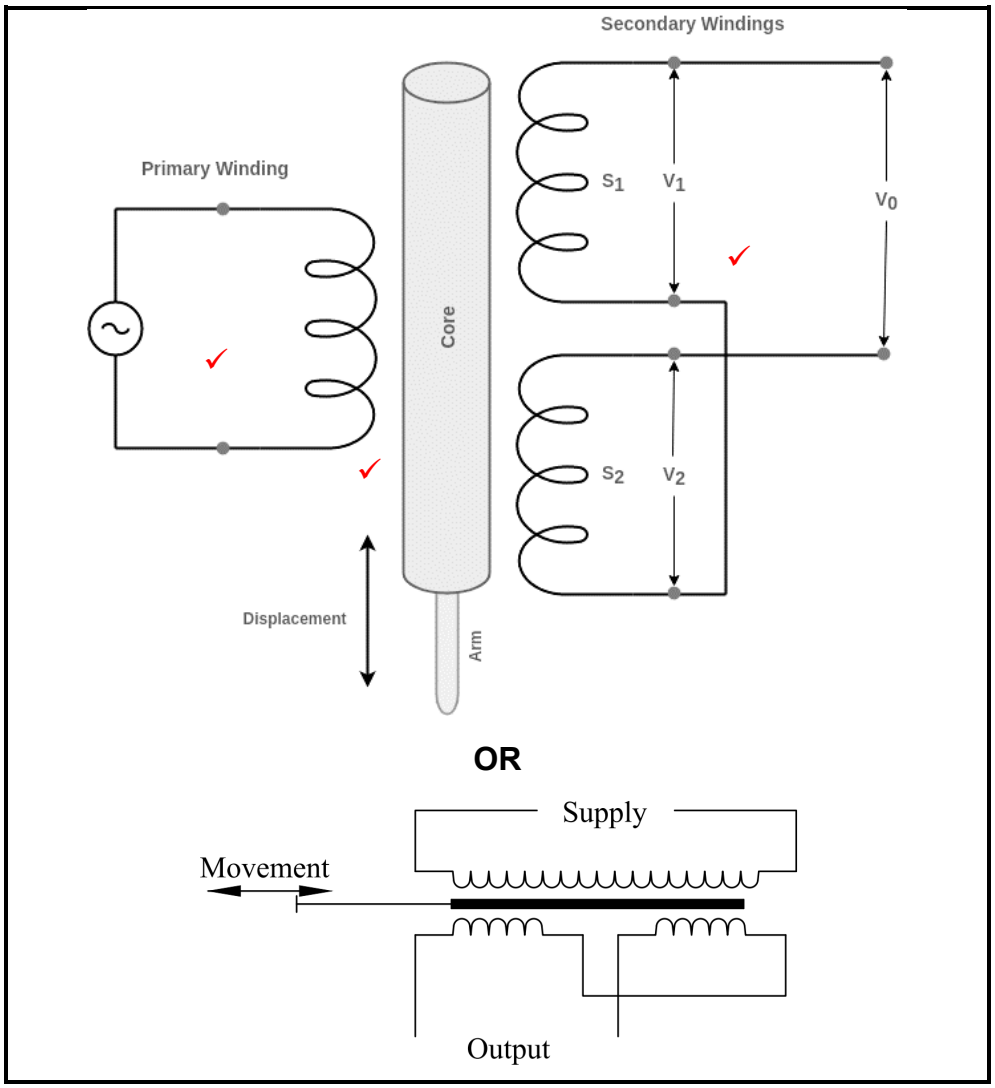
QUESTION 3

3.1



(Marker to use discretion) (4)

3.2 3.2.1

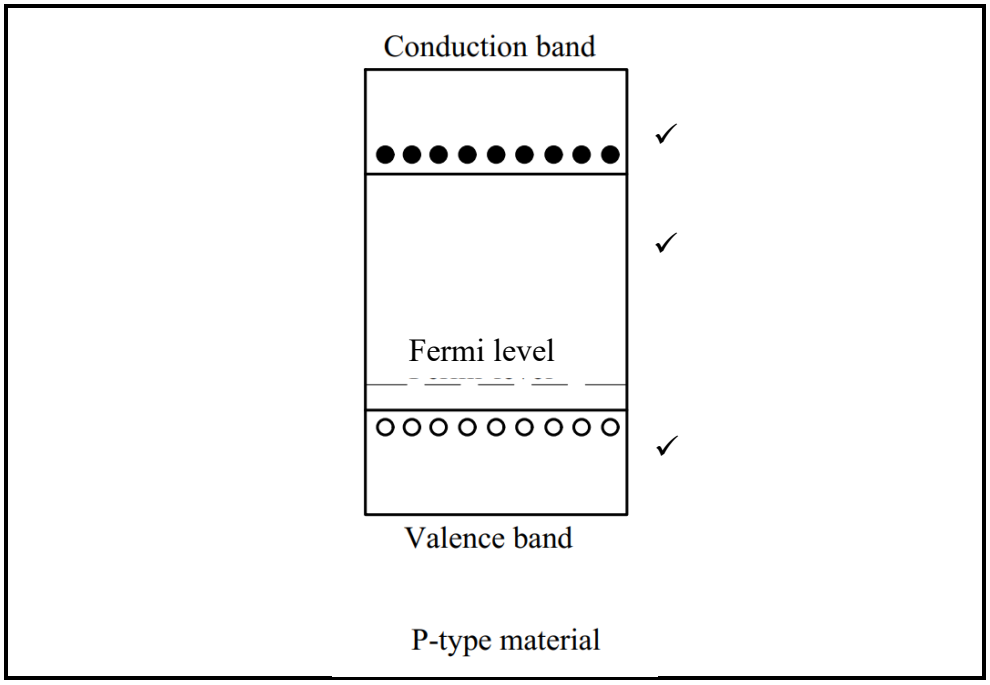


(Marker to use discretion) (3)

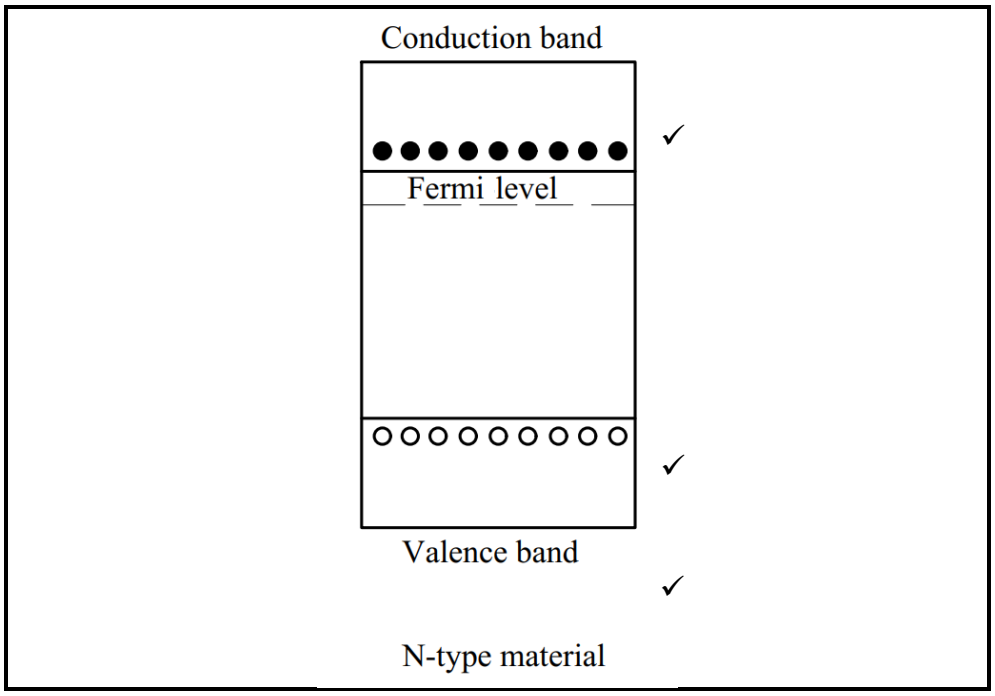
3.2.2
- Sound
- Acceleration
- Pressure changes
- Vibration (Any 2 × 1) (2)

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

3.3 3.3.1

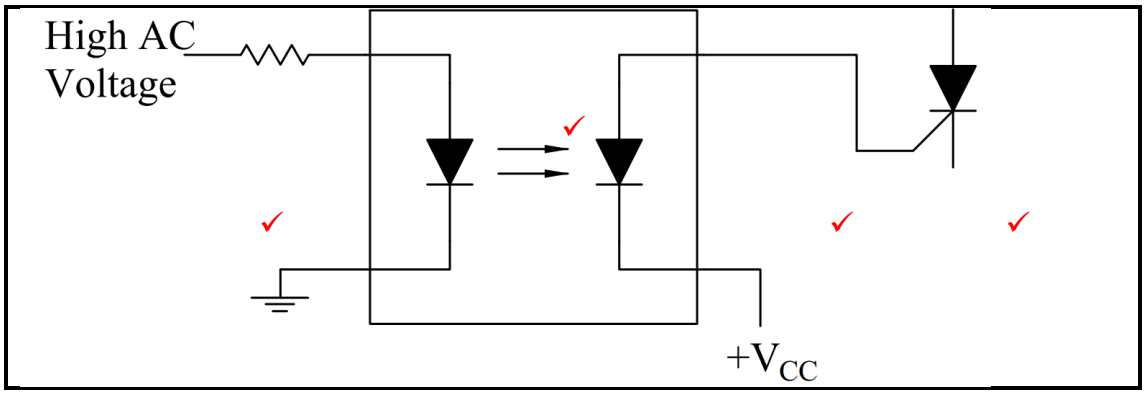


3.3.2



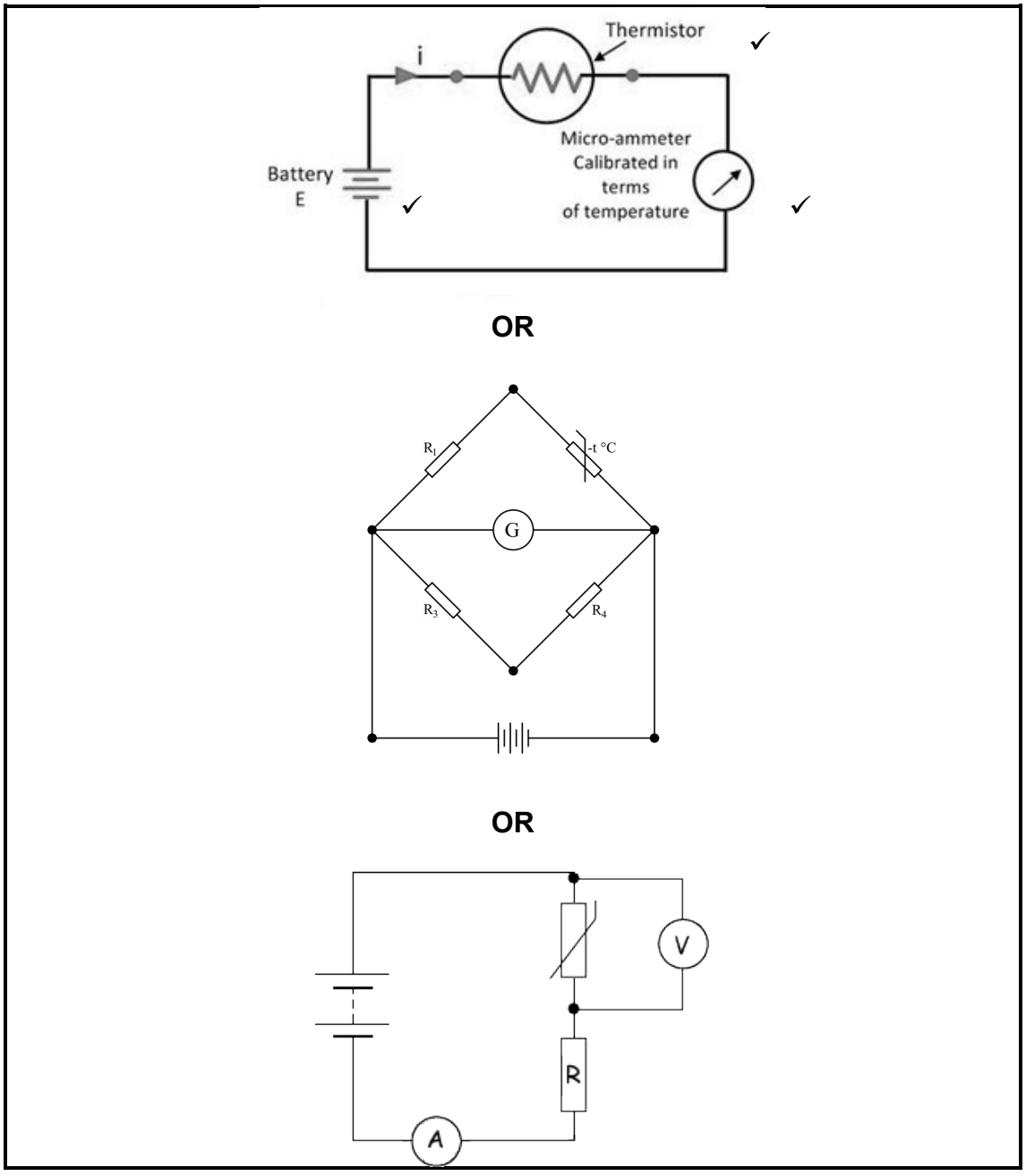
(2 × 3) (6)

3.4



(Marker to use discretion) (4)

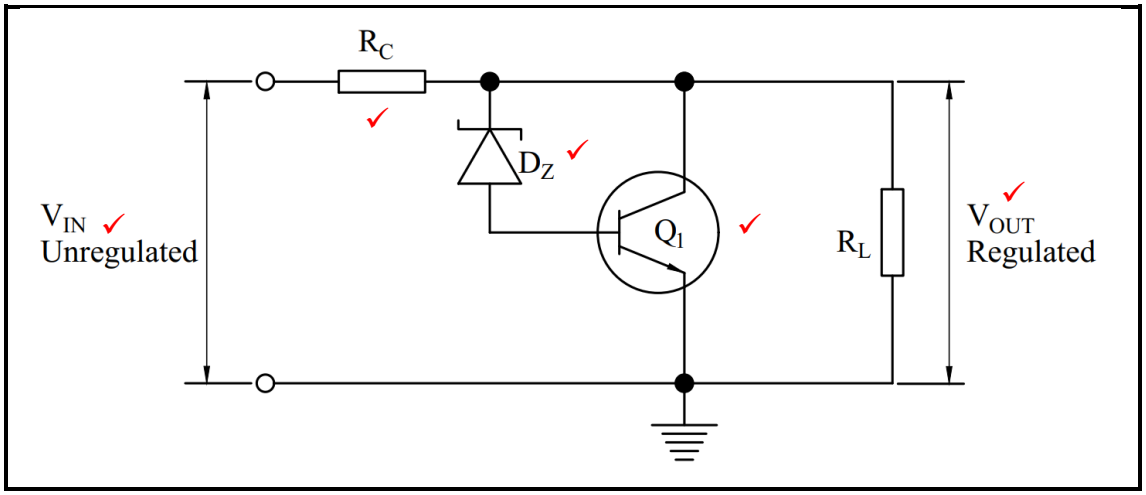
3.5



(4)
[25]

QUESTION 4

4.1

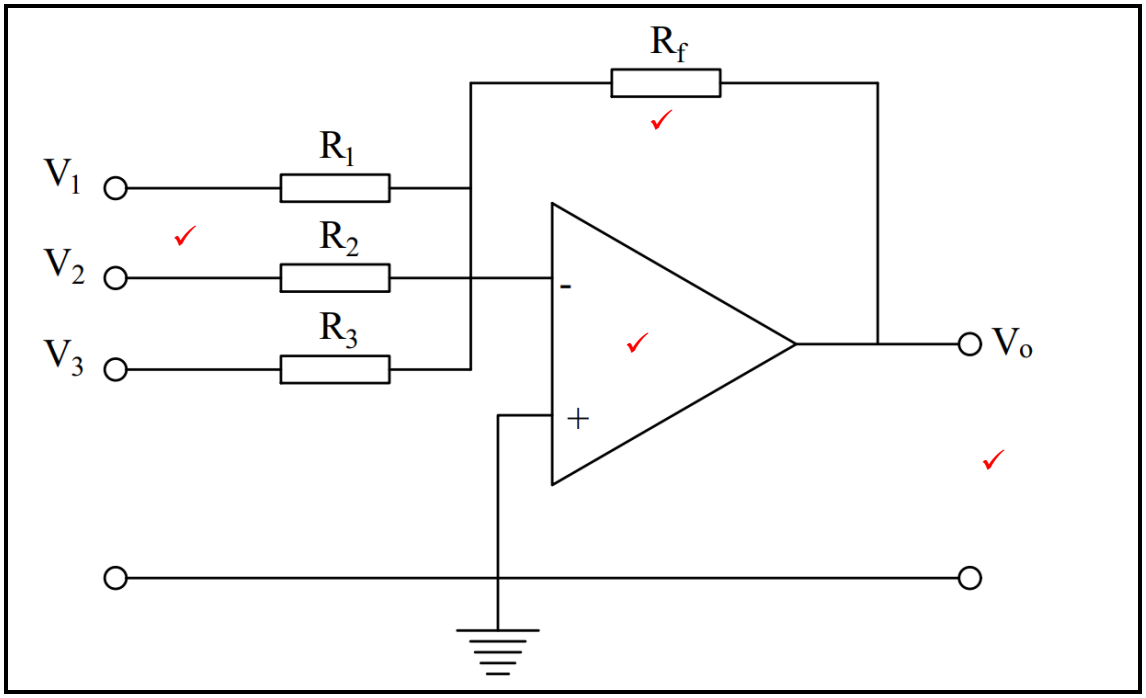


(Marker to use discretion) (5)

4.2

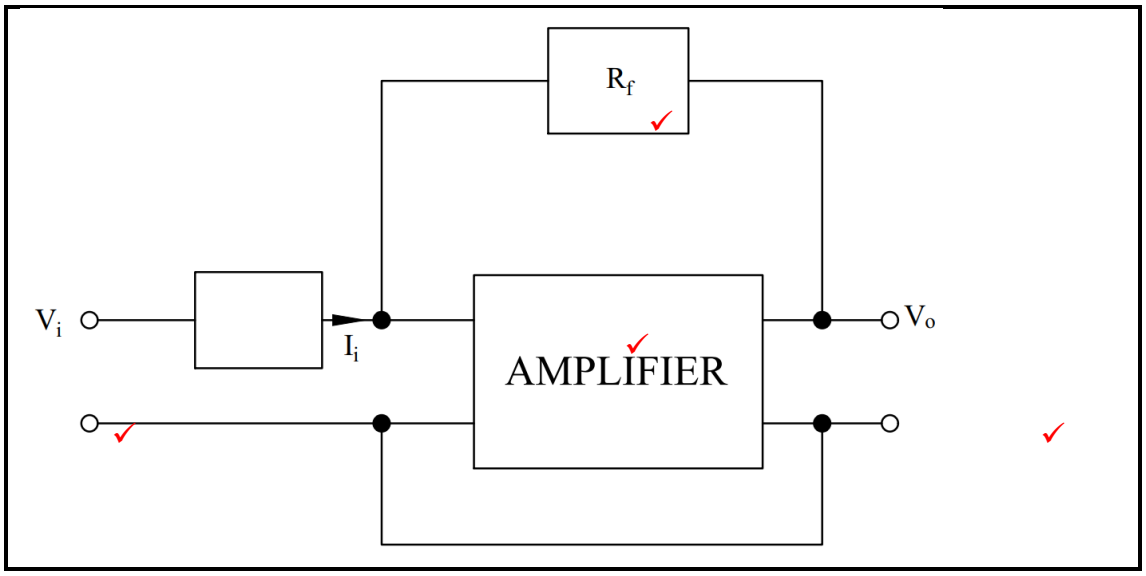
- There is no wear and tear on switchgear caused by aging.
- A small-base emitter current can switch the transistor on and off.
- Many switching times.
- Control over long distances. (4)

4.3



(Marker to use discretion) (4)

4.4



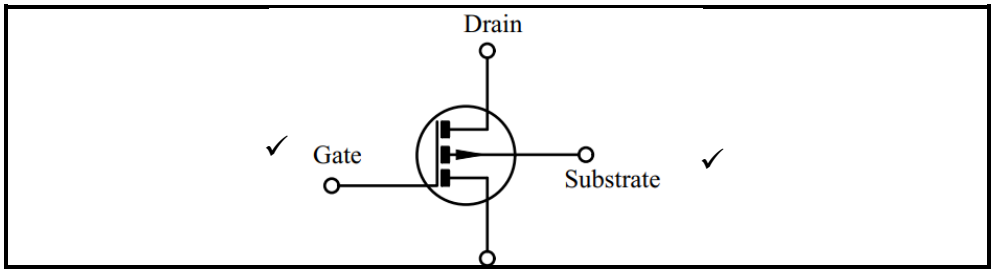
(Marker to use discretion) (4)

4.5

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

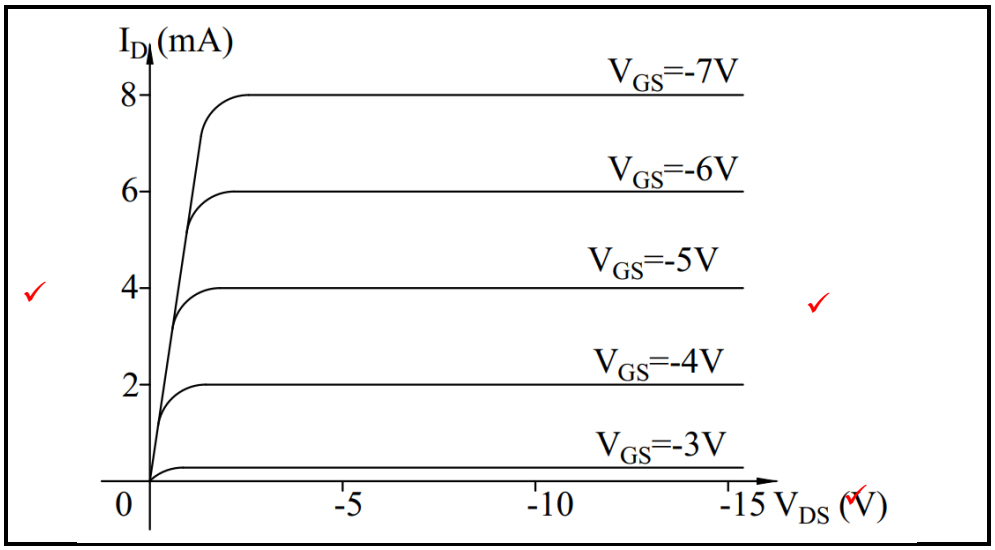
(Any 3 × 1) (3)

4.6 4.6.1



(Marker to use discretion) (2)

4.6.2

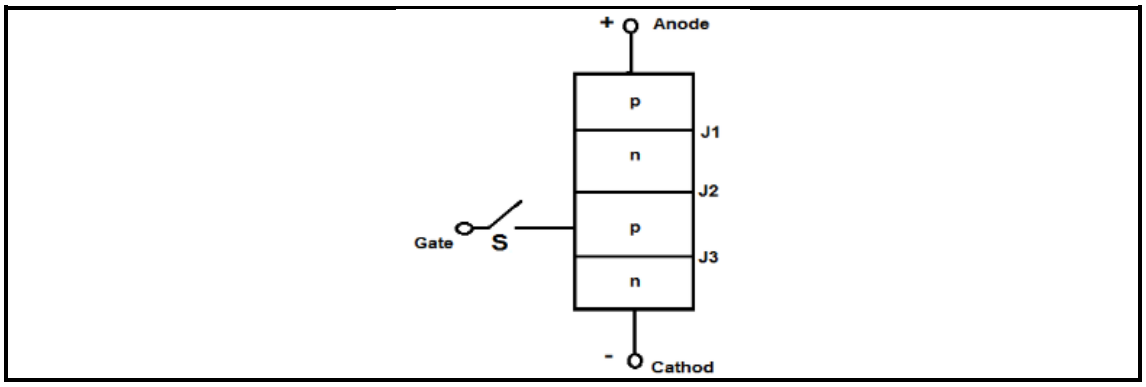


(Marker to use discretion) (3)

[25]

QUESTION 5

5.1



- An additional forward voltage is applied between the anode and cathode.
- When the anode terminal is positive with re Cathode he 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: 85
GRAND TOTAL: 100

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