



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N6

28 November 2023

This marking guideline consists of 7 pages.

QUESTION 1

1.1 $6,32 \text{ V} = 63,2\% \text{ or } 10 \text{ V} \checkmark$

It takes one time constant (the first one) for the capacitor voltage to reach 63,2% of the value of the supply to the circuit. $\checkmark$

Therefore:

$$1 T = RC$$

$$\hookrightarrow 100 \times 10^3 \times 22 \times 10^{-9}$$

$$2,2 \text{ ms} \checkmark$$

(3)

1.2 $\text{Solution: } \frac{1}{LC} = \frac{R^2}{4L} \checkmark$

$$4L = R^2 \cdot LC$$

$$C = \frac{4L}{R^2} \checkmark$$

$$\hookrightarrow \frac{4 \times 2}{10^2}$$

$$\hookrightarrow 0,08 \text{ F} \checkmark$$

(3)

1.3.1 85% of full brightness = 85% maximum current $\checkmark$

$$\therefore i = \frac{85}{100} \times I_{\max} \checkmark$$

$$\text{But } I_{\max} = \frac{V}{R} = \frac{120}{15} = 8 \text{ A} \checkmark$$

$$\therefore i = \frac{85}{100} \times 8 = 6,8 \text{ A} \checkmark$$

(4)

1.3.2 $T = \frac{L}{R} = \frac{3}{15} = 0,2 \text{ s} \checkmark$

$$i = I_M \left(1 - e^{\frac{-t}{T}} \right)$$

$$\hookrightarrow 8 \left(1 - e^{\frac{-0,3}{0,2}} \right) \checkmark$$

$$\hookrightarrow 6,125 \text{ A} \checkmark$$

(3)

[13]

QUESTION 2

- 2.1 Step 1: Calculate the value of the input voltage of the signal conditioning system.

$$C_{max} = V_{i(max)} \div \frac{V}{C}$$

$$\therefore V_{i(max)} = C_{max} \times \frac{V}{C} \checkmark$$

$$500 \times \frac{1 \times 10^{-3}}{10} \checkmark$$

$$50 \text{ mV} \checkmark$$

Step 2: Calculate the value of the metering resistor.

$$V_i = \frac{V_o \cdot R_M}{R_M + R_F} \checkmark$$

$$V_i (R_M + R_F) = V_o \cdot R_M$$

$$V_i \cdot R_M + V_i R_F = V_o \cdot R_M \checkmark$$

$$V_i \cdot R_M - V_o \cdot R_M = -V_i R_F$$

$$R_M (V_i - V_o) = -V_i R_F \checkmark$$

$$R_M = \frac{-V_i R_F}{(V_i - V_o)} \checkmark$$

$$50 \times \frac{100 \times 10^3}{50 \times 10^{-3} - 5} \checkmark$$

$$-(-1,01 \times 10^3) \checkmark$$

$$1,01 \text{ K}\Omega \checkmark$$

[10]**QUESTION 3**

- 3.1 Oxide film
- 3.2 Acoustic energy
- 3.3 Feedback circuit
- 3.4 Nodal line
- 3.5 Magnetostriction
- 3.6 Converse piezoelectric effect
- 3.7 Cavitation
- 3.8 Direct piezoelectric effect

3.9 Soft tool tip

3.10 Heated tool tip

(10 × 1) **[10]**

QUESTION 4

4.1 $Amplification = S^n$

↳ 4^6 ✓

↳ 4 096 ✓

(2)

4.2 $Supply\ rating = volts\ per\ stage \times no.\ of\ stages$

↳ 165×6 ✓

↳ 990 V ✓

(2)

4.3 $Tube\ sensetivity = cathode\ sensitivity \times A$

↳ $33 \times 10^{-6} \times 4096$ ✓

↳ 135,168 mA/lumen ✓

(2)

4.4 $I_{max} = max\ safe\ illumination \times tube\ sensitivity$

$max\ safe\ illumination = \frac{I_{max}}{tube\ sensitivity}$ ✓

↳ $\frac{3,3 \times 10^{-3}}{135,168 \times 10^{-3}}$ ✓

↳ 24,4 lumen ✓

(3)

[9]**QUESTION 5**

- 5.1
- | | |
|-------|---|
| 5.1.1 | B |
| 5.1.2 | B |
| 5.1.3 | D |
| 5.1.4 | A |
| 5.1.5 | C |

(5 × 1)

(5)

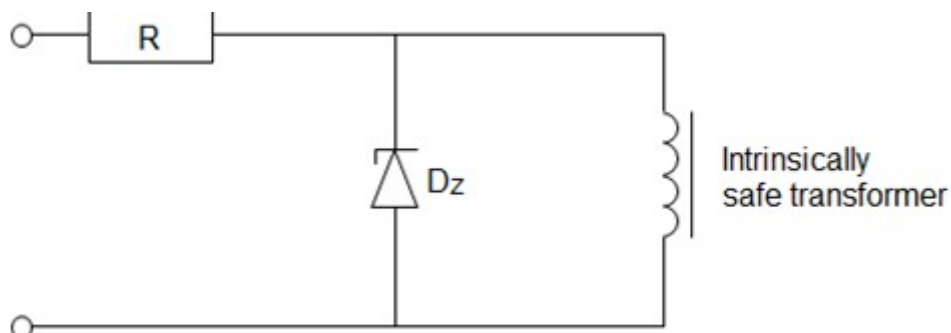
- 5.2
- To prevent damage to machinery
 - To prevent contamination of processed foods

(2)

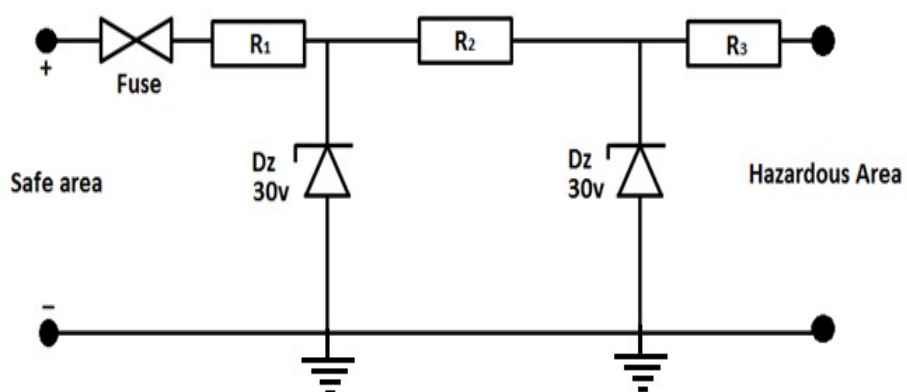
[7]

QUESTION 6

6.1

**Allocate one full mark for each correct label****(3)**

6.2

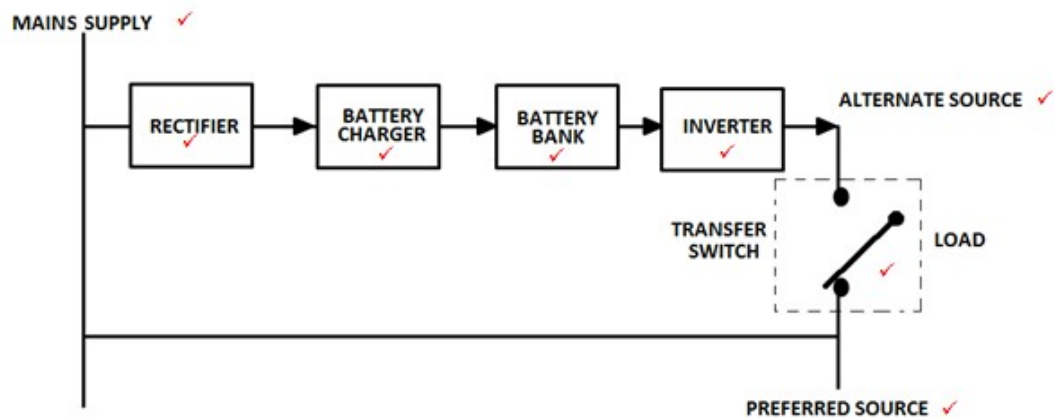
**Allocate one full mark for each correct label and symbol****(9)**
[12]**QUESTION 7**

7.1 Rectifier (1)

7.2 Inverter (1)

7.3 7.3.1 True
7.3.2 True**(2 × 1) (2)**

- 7.4 Name of UPS system: Transfer type
Standby type
Off-line type (Any ONE) (1)

(8)
[13]**QUESTION 8**

At switch-on $i(t) = I_M \left[1 - e^{-\frac{t}{T}} \right]$ ✓✓

But $I_M = \frac{V}{R} = \frac{200}{40} = 5 \text{ A}$ ✓

∴ $T = \frac{L}{R} = \frac{1}{40} = 25 \text{ ms}$ ✓

∴ $t = \text{pulse width} = 100 \mu\text{s}$ ✓

∴ $i(t) = I_M \left[1 - e^{-\frac{t}{T}} \right]$

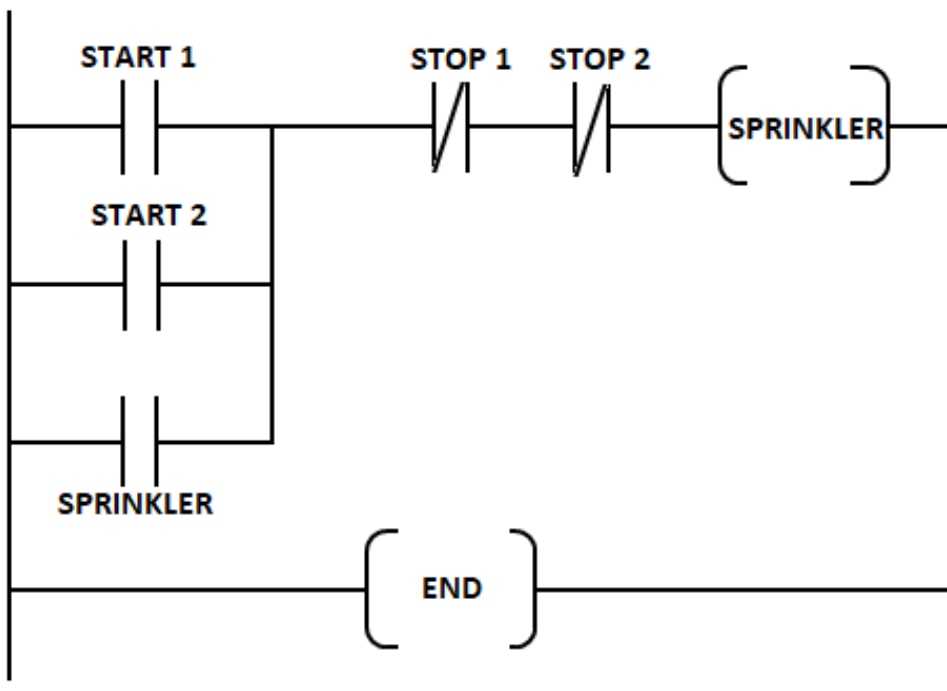
∴ $5 \left[1 - e^{-\frac{100 \times 10^{-6}}{25 \times 10^{-3}}} \right]$ ✓✓

∴ $19,96 \text{ mA}$ ✓

Logical reasoning and conclusion:

- The current at the end of the trigger pulse is 19,96 mA, while the latching current is 40 mA. ✓
- For the SCR to trigger, the current value at the end of the trigger pulse must either be equal to or greater ✓✓ than the latching current. Therefore, the SCR will NOT be triggered at the end of the supplied pulse. ✓

[12]

QUESTION 9

Allocate TWO full marks for each correct label and symbol

[14]

TOTAL: 100