higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

NOVEMBER EXAMINATION

INDUSTRIAL ELECTRONICS N4

17 NOVEMBER 2016

This marking guideline consists of 8 pages.

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QUESTION 1

Consider loop ABEF

$V_1 = I_1R_1 + (I_1 – I_2)\ R_L$

$9 = 6\ I_1 + 10\ I_1 – 10\ I_2$✓

$9 = 16\ I_1 – 10\ I_2$----------(1)✓

Consider loop CDEB

$V_2 = I_2R_2 + (I_1 – I_2)\ R_L$

$5 = 12\ I_2 + 10\ I_1 – 10\ I_2$✓

$5 = 10\ I_1 + 2\ I_2$----------(2)✓

(1) × 10:90 = $160\ I_1 – 100\ I_2$----------(3)✓

(2) × 16:80 = $160\ I_1 + 32\ I_2$----------(4)✓

(3) – (4): $10 = –132\ I_2$

$I_2 = – 0,076$ A✓

Substitute I_2 in (1)

$9 = 16\ I_1 – 10(–0,076)$

$8,24 = 16\ I_1$✓

$I_1 = 0,515$ A✓

$I_1 + I_2 = 0,515 + (– 0,076)$

= 0,439 A✓ **[10]**

QUESTION 2

$$Xc = \frac{1}{2\pi fC} = \frac{1}{2 \times \pi \times 60 \times 160 \times 10^{-6}}$$

$= 16,576\ \Omega$ ✓

$X_L = 2\pi f X_L$

$= 2 \times \pi \times 60 \times 0,5$

$= 188,52\ \Omega$ ✓

2.1 $Z_T = R + j(X_L - X_C)$

$= 40 + j(188,52 - 16,576)$✓

$= 40 + j171,944$

$=176,535 \angle 76,9^0\Omega$✓ (4)

2.2 $$I_T = \frac{V_T}{Z_T}$$

$$= \frac{200 \angle 0^0}{176,535 \angle 76,9^0}$$ ✓

$= 1,133 - \angle 76,9^0$ A ✓ (2)

2.3 $V_L = I_T \times X_L$

$= 1,133 - 76,9^0 \times 188,52\ 90^0$ ✓

$= 213,593\ 13,1^0$ V ✓ (2)

2.4 $V_C = I_T \times X_C$

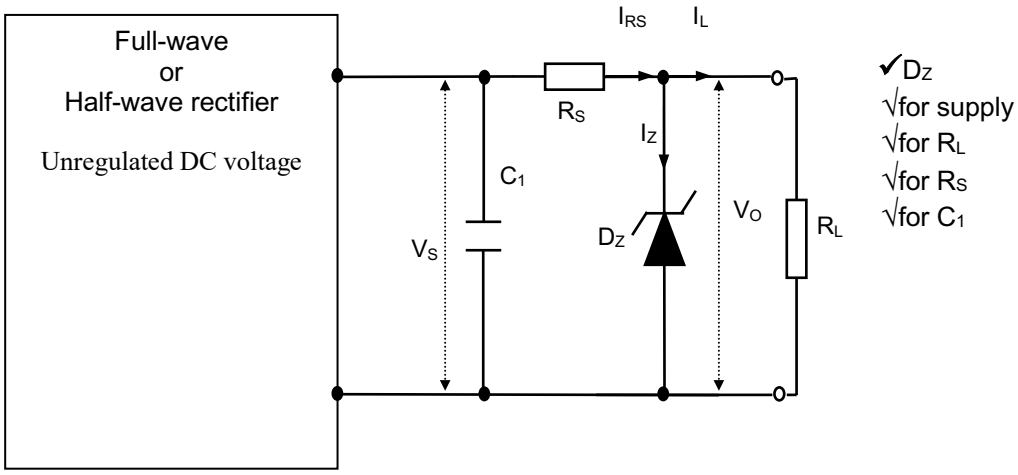
$= 1,133 - 76,9^0 \times 16,576 - 90^0$✓

$= 18,707 - 166,9^0$ V ✓ (2)

[10]

QUESTION 3

3.1



(3)

As the input voltage increases, the current through the Zener diode increases but the voltage drop remains constant.✓
The voltage drop across the resistor increases by an amount equal to the difference between the input voltage and the Zener voltage of the diode.✓
The voltage across R_L remains the same.✓ (3)

3.2 3.2.1

$$V'_{dc} = \frac{R_L}{R_L + R} \times V_{dc}$$

$$= \frac{5\,000}{5\,000 + 100} \times 100\checkmark$$

$$= 98{,}039 \text{ V} \checkmark$$

(2)

3.2.2

$$V_r\,('rms) = \frac{V_r(rms)}{4\pi^2 f^2 lc}$$

$$= \frac{10}{4\pi^2 \times 100^2 \times 2 \times 10 \times 10^{-6}}$$

$$= 1{,}267 \text{ V} \checkmark$$

(3)

3.2.3

$$r = \frac{V_{r(rms)}}{V_{dc}}$$

$$= \frac{10}{100} \checkmark$$

$$= 0{,}1\checkmark$$

(2)

3.2.4 $$r' = \frac{Vr'(rms)}{V'_{dc}}$$

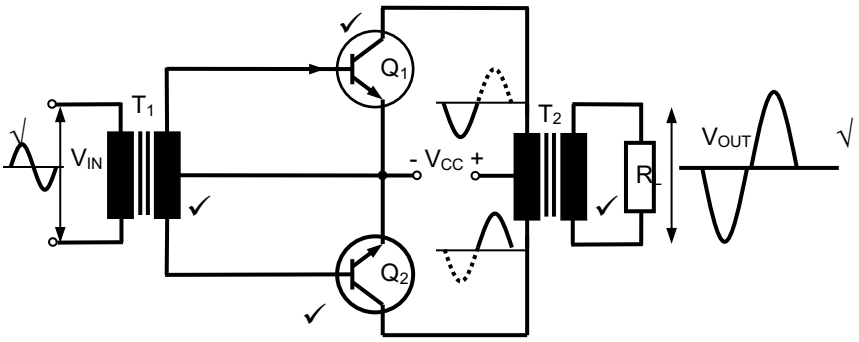
$$\frac{1,267}{98,039}\ \checkmark$$

$$= 0,013\ \checkmark$$

(2)
[15]

QUESTION 4

4.1



(5)

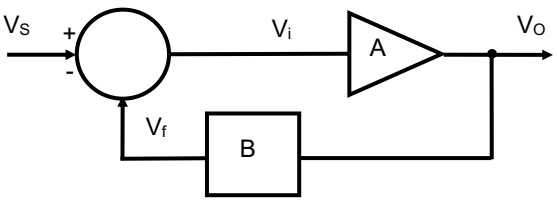
4.2 4.2.1 Both emitter/base and base/collector junctions are reverse biased. The transistor is used as an off switch.✓✓

4.2.2 The emitter/base junction is forward biased and the base/collector junction is reverse biased. The transistor is used as an amplifier.✓✓

4.2.3 Both emitter/base and base/collector junctions are forward biased. The transistor is used as an on switch.✓✓

(3 × 2) (6)

4.3



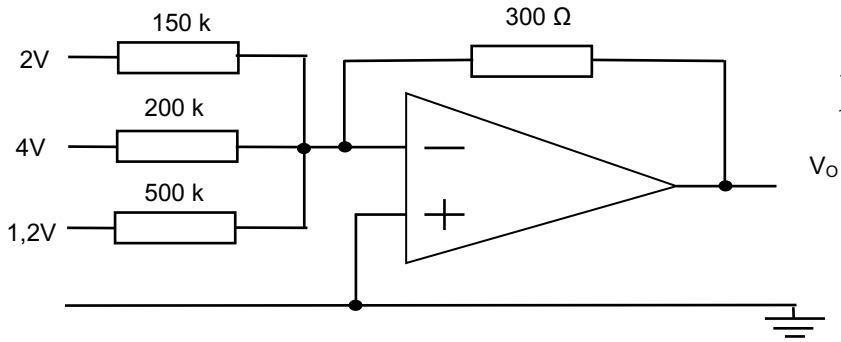
✓for each block

(3)

The feedback voltage V_f is taken from the output V_o and is fed back in anti-phase with the input voltage V_s. ✓ (1)
[15]

QUESTION 5

5.1



✓for amplifier
√ for all resistors

(3)

$$Vo = - R_f \left(\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3} \right)$$

$$= - 300 \times 10^3 \left(\frac{2}{150 \times 10^3} + \frac{4}{200 \times 10^3} + \frac{1,2}{500 \times 10^3} \right) \checkmark\checkmark$$

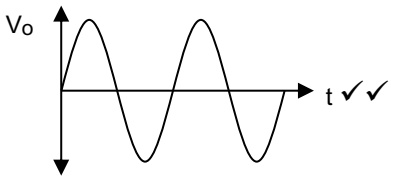
$$= -10,72 \text{ V} \checkmark$$

(3)

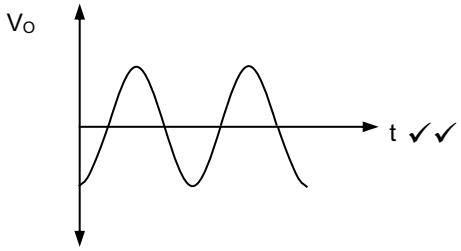
5.2
- Small size
- Cheap
- Highly stable
- Low power consumption
- Highly reliable

(5 × 1) (5)

5.3 5.3.1



5.3.2



(2 × 2) (4)
[15]

QUESTION 6

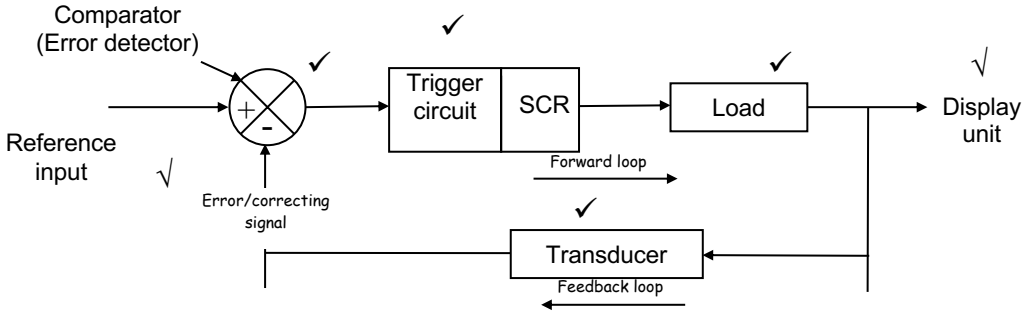
6.1
6.1.1 True
6.1.2 True
6.1.3 False
6.1.4 False
6.1.5 True

(5 × 1) (5)

6.2
- Reducing the line current to be less than the holding current
- Short–circuiting
- Reverse bias

(3 × 1) (3)

6.3



(5)

The comparator will give a signal to the thyristor/SCR which in turn together with the trigger circuit will adjust the power to the load accordingly. (2)

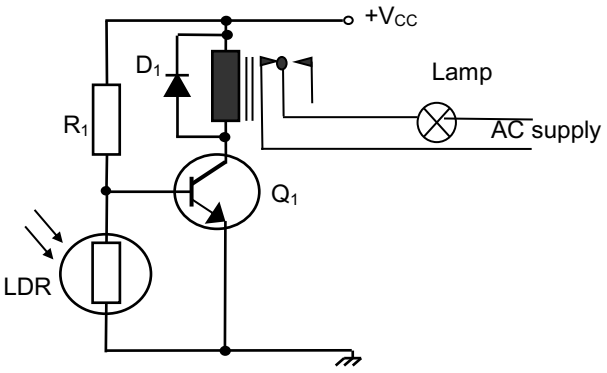
[15]

QUESTION 7

7.1
- Distance between the plates
- Area of the plates
- Dielectric constant

(3)

7.2



✓LDR
✓Transistor
✓Relay
✓Correct sketch

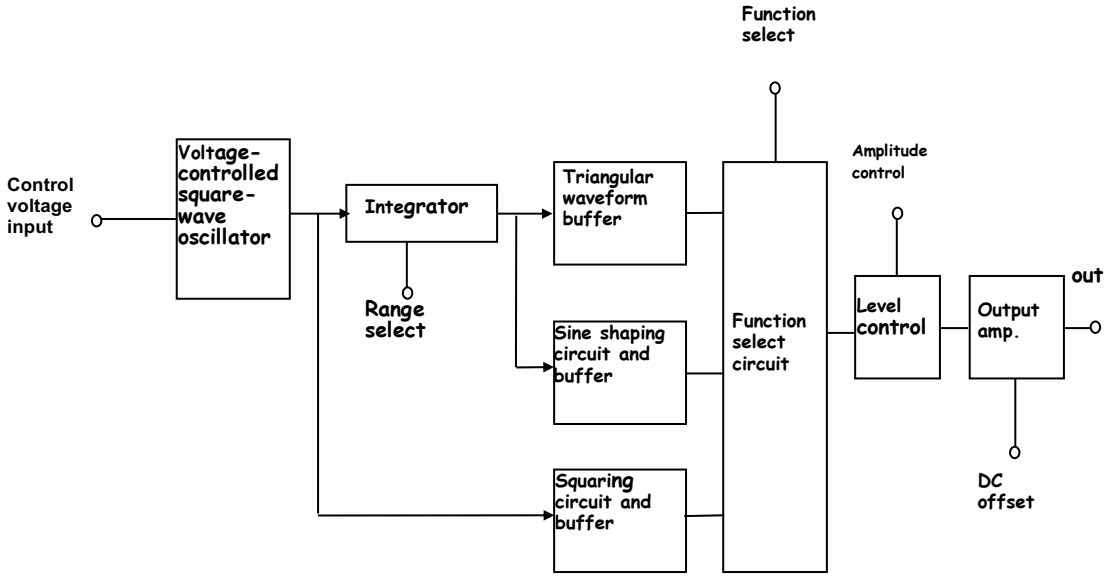
(4)

When there is no light the resistance of the LDR is very high, the transistor turns on, the relay coil becomes activated and the light switches on.✓√

When there is light, the resistance becomes less and the transistor turns off. There is no current flow through the relay and the light switches off.✓√ (3)
[10]

QUESTION 8

8.1



Half mark for each block
Half mark for control voltage input and output (5)

8.2
- Electron–beam generation
- Focusing system
- Deflection system
- Glass envelope
- Fluorescent screen (5 × 1) (5)
[10]

TOTAL: 100

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