

higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE
NOVEMBER EXAMINATION
INDUSTRIAL ELECTRONICS N4
24 NOVEMBER 2014

This marking guideline consists of 8 pages.

QUESTION 1

Short circuit V_2

$$V_{th1} = \frac{R_2}{R_1 + R_2} \times V_1$$

$$= \frac{15}{5 + 15}$$

$$= 11,25 \text{ V } \checkmark \checkmark$$

$$V_{thT} = V_{th1} - V_{th2}$$

$$= 11,25 - 2,5$$

$$= 8,75 \text{ V } \checkmark \checkmark$$

$$R_{th} = \frac{R_1 R_2}{R_1 + R_2}$$

$$= \frac{5 \times 15}{5 + 15}$$

$$= 3,75 \Omega \checkmark \checkmark$$

$$I_L = \frac{V_{th}}{R_L + R_{th}}$$

$$= \frac{8,75}{10 + 3,75}$$

$$= 0,636 \text{ A } = \checkmark \checkmark$$

Short circuit V_1

$$V_{th2} = \frac{R_1}{R_1 + R_2} \times V_2$$

$$= \frac{5}{5 + 15} \times 10$$

$$= 2,5 \text{ V } \checkmark \checkmark$$

[10]

QUESTION 2

$$\begin{aligned}
 2.1 \quad Z_1 &= \frac{V_T}{I_1} \\
 &= \frac{120 \angle 10^\circ}{15 \angle 20^\circ} \\
 &= 8 \angle -10^\circ \Omega = \checkmark \checkmark
 \end{aligned}
 \qquad
 \begin{aligned}
 Z_2 &= \frac{V_T}{I_2} \\
 &= \frac{120 \angle 10^\circ}{20 \angle 30^\circ} \\
 &= 6 \angle -20^\circ \text{ A } \checkmark \checkmark
 \end{aligned}
 \qquad (4)$$

$$\begin{aligned}
 2.2 \quad Z_T &= \frac{Z_1 Z_2}{Z_1 + Z_2} \\
 &= \frac{8 \angle -10^\circ \times 6 \angle -20^\circ}{7,878 - j1,389 + 5,638 - j2,052} \\
 &= \frac{48 \angle -30^\circ}{13,516 - j3,441} \\
 &= \frac{48 \angle -30^\circ}{13,947 \angle -14,283^\circ} \\
 &= 3,442 \angle -15,7^\circ \Omega \checkmark \checkmark \checkmark \checkmark
 \end{aligned}
 \qquad (4)$$

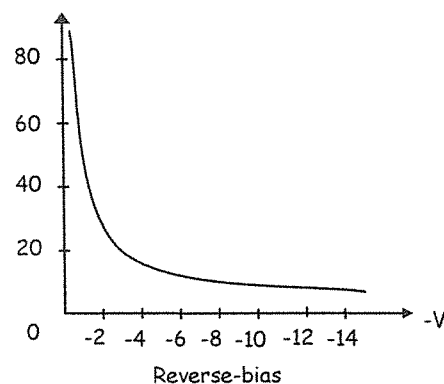
$$\begin{aligned}
 2.3 \quad I_T &= I_1 + I_2 \\
 &= 14,095 + j5,130 + 17,321 + j10 \\
 &= 31,416 + j15,130 \\
 &= 34,869 \angle 25,7^\circ \text{ A } \checkmark \checkmark
 \end{aligned}
 \qquad (2)$$

[10]

QUESTION 3

- 3.1 3.1.1 FM modulators ✓
Automatic frequency-control devices ✓
Adjustable band-pass filters ✓
Tuning circuit ✓ (Any 2 x 1) (2)

3.1.2



✓✓✓

(3)

- 3.1.3 The more the reverse-bias potential, the more the width of the depletion region increases and the lesser the capacitance becomes. ✓✓ (2)

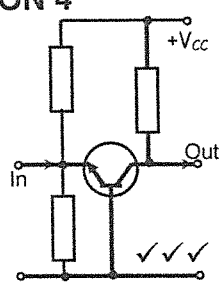
- 3.2 3.2.1 $V_S = V_T - V_Z = 20 - 15$
 $= 5 \text{ V} ✓$
- $$I_Z = \frac{P_Z}{V_Z} = \frac{3}{15} = 0,2 \text{ A} ✓$$
- $$I_S = I_Z + I_L$$
- $$= 0,2 + 0,15$$
- $$= 0,35 \text{ A} ✓$$
- $$R_S = \frac{V_S}{I_S} = \frac{5}{0,35} = 14,286 \Omega ✓$$
- (4)

- 3.2.2 $R_L = \frac{V_L}{I_L} = \frac{15}{0,15}$
 $= 100 \Omega ✓✓$ (2)

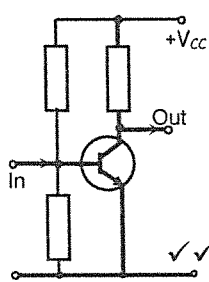
- 3.3 It has excessive ripple of 121% ✓
Poor efficiency of 40% ✓ (2)
[15]

QUESTION 4

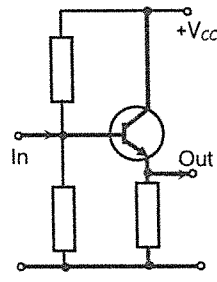
4.1



Common Base



Common Emitter



Common Collector

(9)

4.2

4.2.1

$$h_{ie} = \frac{\Delta V_{be}}{\Delta I_b} = \frac{6}{4 \times 10^{-6}}$$

$$= 1,5 \text{ M}\Omega \quad \checkmark\checkmark$$

(2)

4.2.2

$$h_{fe} = \frac{\Delta I_c}{\Delta I_b} = \frac{6 \times 10^{-3}}{4 \times 10^{-6}}$$

$$= 1\,500 \quad \checkmark\checkmark$$

(2)

4.2.3

$$\frac{1}{h_{oe}} = \frac{\Delta V_{ce}}{\Delta I_c} = \frac{8}{6 \times 10^{-3}}$$

$$= 1\,333,333 \, \Omega \quad \checkmark\checkmark$$

(2)
[15]**QUESTION 5**

5.1

$$V_O = \left[1 + \frac{R_f}{R_{in}} \right] \times V_{in}$$

$$R_{in} = \frac{R_f \cdot V_{in}}{V_O - V_{in}}$$

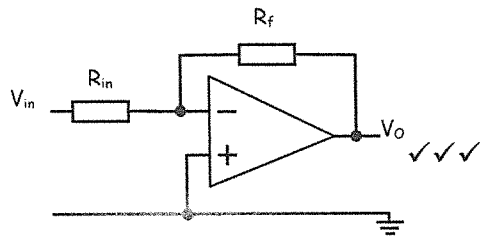
$$= \frac{2\,000 \times 2}{5 - 2}$$

$$= 1,333 \text{ k}\Omega \quad \checkmark\checkmark\checkmark\checkmark$$

(4)

- 5.2
- Infinite input resistance ✓
 - Zero output impedance ✓
 - Infinite bandwidth ✓
 - Infinite voltage gain ✓
 - Perfect balance or zero offset voltage ✓
 - Its characteristics are not affected by temperature ✓
- (Any 5 x 1) (5)

5.3



$$V_{out} = \frac{R_f}{R_{in}} \times V_{in}$$

$$= \frac{1\,000}{500} \times 1$$

$$= 2\,V$$

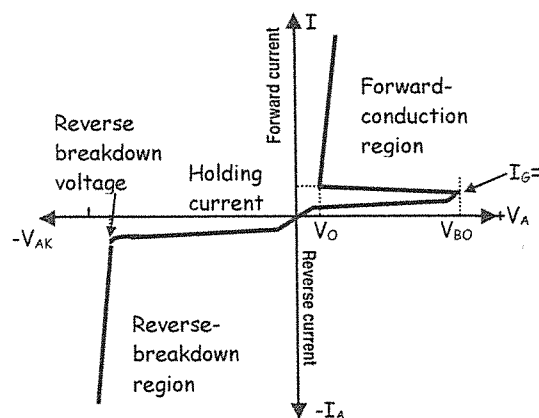
(3)

(2)

5.4 True ✓

(1)
[15]**QUESTION 6**

6.1 6.1.1



(3)

6.1.2

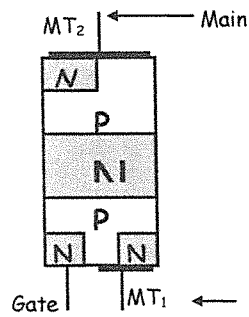
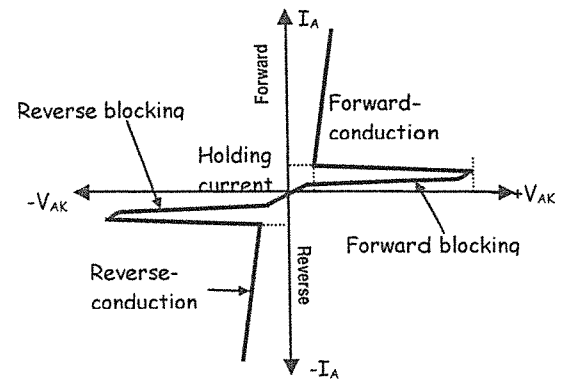


Fig 7.7a



(3)

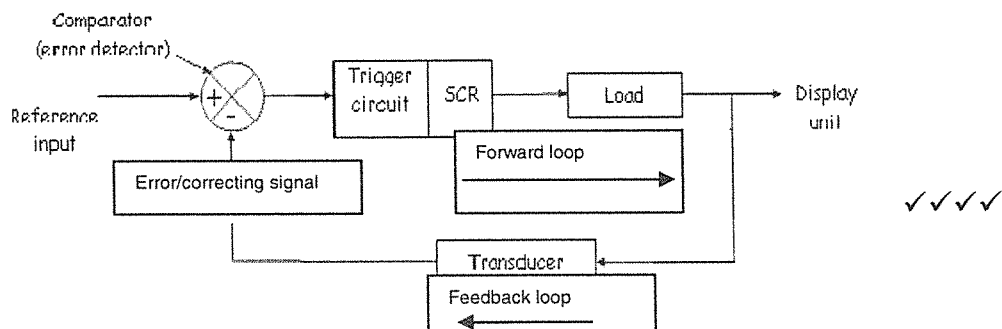
6.2

- Relay control ✓
- Heater control ✓
- Battery chargers ✓
- Time-delay circuits ✓
- Regulated power supply ✓
- Static switches ✓

(Any 3 x 1)

(3)

6.3



(4)

The comparator compares the output with the actual condition.

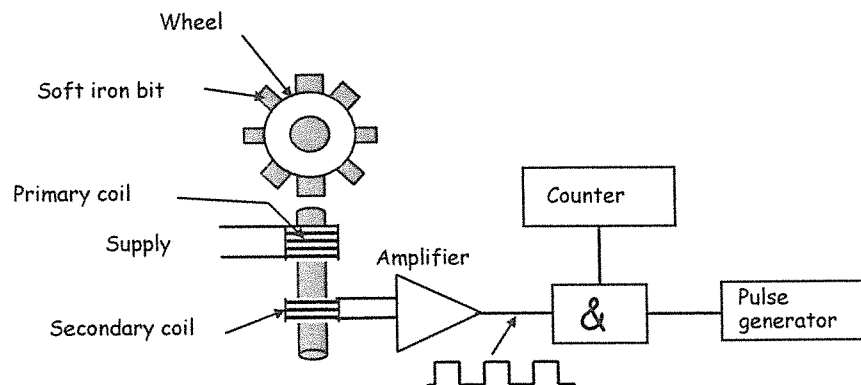
(2)

[15]

QUESTION 7

7.1 It converts the shaft position into a resistance that is directly proportional to the shaft angle. ✓✓ (2)

7.2



(4)

When the primary voltage is applied to the primary coil a magnetic field will be created around it and it will be induced in the secondary coil.

If a shaft turns the wheel, the soft iron bit increases magnetic coupling through the core. As the magnetic field in the primary coil increases, the soft iron bit passes the magnetic field, it drops producing a pulse at the output of the secondary coil.

The frequency of the pulses is directly proportional to the speed at which the wheel turns. In this way the speed of the wheel can be read off at the counter. ✓✓✓✓

(4)

[10]

QUESTION 8

8.1 C ✓✓

8.2 D ✓✓

8.3 B ✓✓

8.4 E ✓✓

8.5 A ✓✓

(5 x 2) [10]

TOTAL: 100