higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

APRIL EXAMINATION

INDUSTRIAL ELECTRONICS N3

1 APRIL 2015

This marking guideline consists of 7 pages.

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SECTION A

QUESTION 1

1.1	1.1.1	False		
	1.1.2	True		
	1.1.3	False		
	1.1.4	True		
	1.1.5	True		
			(5 × 1)	(5)
1.2	1.2.1	C		
	1.2.2	B		
	1.2.3	C		
	1.2.4	D		
	1.2.5	B		
			(5 × 1)	(5)
1.3	1.3.1	MOSFET		(1)
	1.3.2	(a) 180° (b) high (c) high		(3)
	1.3.3	(a) resistor (b) diode		(2)
	1.3.4	(a) dual beam (b) dual trace		(2)
	1.3.5	(a) piezo-electric (b) subjected to aforce		(2)
				[20]
			TOTAL SECTION A:	**20**

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SECTION B

QUESTION 2

2.1 2.1.1 Loop AFEDCBA

$$0 = 15(I_1 - I_2) - 15I_2$$
$$= 15I_1 - 15I_2 - 15I_2 \checkmark$$
$$= 15I_1 - 30I_2 \ldots\ldots\ldots\ldots\ldots\ldots [1] \checkmark$$

(2)

2.1.2 Loop ADCBA

$$-10 = -10I_1 - 15I_2 \ldots\ldots\ldots\ldots [2] \checkmark$$

$$[2] \times 2: \quad -20 = -20I_1 - 30I_2 \ldots\ldots\ldots\ldots [3] \checkmark$$

(2)

2.1.3 $[3] - [1]$: $-20 = -35I_1 \checkmark$

$$I_1 = 0{,}571\,A \checkmark$$

Substitute $I_1 = 0{,}571\,A$ in $[2]$:

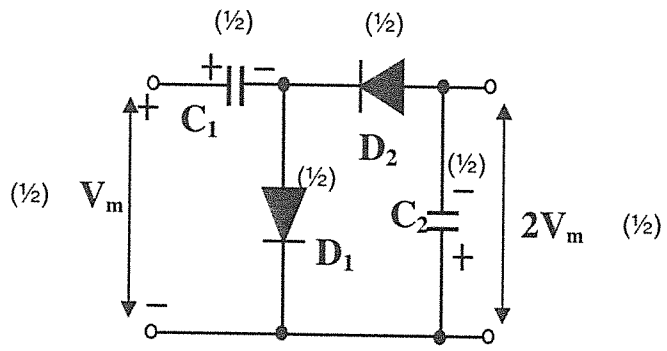
$$-10 = -10(0{,}571) - 15I_2$$
$$= -5{,}71 - 15I_2 \checkmark$$
$$-4{,}29 = -15I_2$$
$$I_2 = +0{,}286\,A \checkmark$$

(4)

2.2
2.2.1 pentavalent
2.2.2 electrons
2.2.3 donor
2.2.4 N-type
2.2.5 electrons
2.2.6 trivalent
2.2.7 holes
2.2.8 acceptor
2.2.9 P-type
2.2.10 holes

(10 x ½) (5)

2.3



(6 x ½) (3)

[16]

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QUESTION 3

3.1 3.1.1

$$X_L = \frac{V}{I_L}$$
$$= \frac{100}{2.122}$$
$$= 47{,}125\ \Omega \quad ✓$$

$$L = \frac{X_L}{2\pi f}$$
$$= \frac{47{,}125}{2 \times \pi \times 50} \quad ✓$$
$$= 150\ mH \quad ✓$$

(3)

3.1.2

$$X_C = \frac{V}{I_C}$$
$$= \frac{100}{3{,}14}$$
$$= 31{,}847\ \Omega \quad ✓$$

$$X_C = \frac{1}{2\pi f C}$$
$$C = \frac{1}{2\pi f X_c}$$
$$= \frac{1}{2\pi \times 50 \times 31{,}847} \quad ✓$$
$$= 100\ \mu F \quad ✓$$

(3)

3.1.3

$$I_T = \sqrt{I_R^2 + (I_C - I_L)^2}$$
$$= \sqrt{2^2 + (3{,}142 - 2{,}122)^2} \quad ✓$$
$$= 2{,}245\ A \quad ✓$$

(2)

3.1.4

$$Cos\theta = \frac{I_R}{I_T}$$
$$= \frac{2}{2.245}$$
$$= 0.891 \quad ✓$$

$$\theta = Cos^{-1} 0{,}891$$
$$= 27{,}010^0 \quad ✓$$

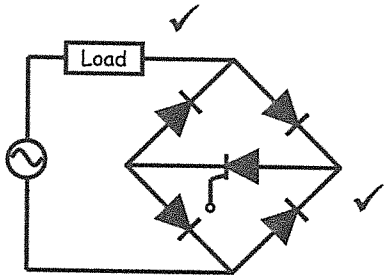
OR

$$\theta = Tan^{-1} \frac{I_x}{I_R}$$
$$= Tan^{-1} \frac{1{,}02}{2}$$
$$= 27{,}01^0$$

(2)

3.2 LC filters, Zener diodes, Tranzorps, Varistors (Any 2 × 1) (2)

3.3 3.3.1

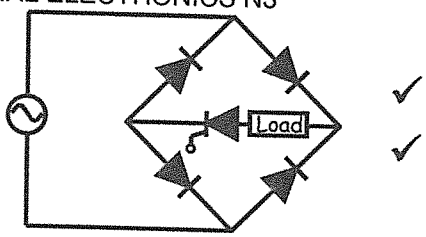


✓ ✓

(2)

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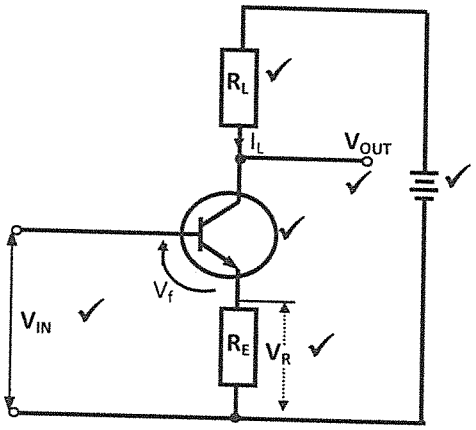
3.3.2



(2)
[16]

QUESTION 4

4.1



(6)

4.2
- 4.2.1 Delay time
- 4.2.2 Rise time
- 4.2.3 Turn-on-time
- 4.2.4 Storage time
- 4.2.5 Fall time
- 4.2.6 Turn-off time

(6 × 1) (6)

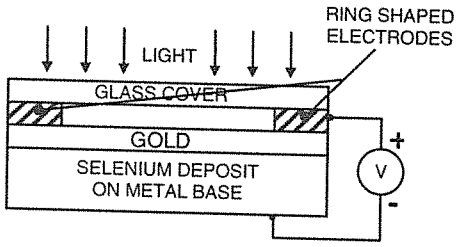
4.3 4.3.1 In Class-A amplifiers the bias point corresponds to the mid-point of the active region✓ of the characteristic curve and is selected so that the current flows during the whole of the input cycle✓. (2)

4.3.2 In Class-B amplifiers the bias point corresponds to the cut-off region✓ of the characteristic curve and the current flows only during the positive half-cycles of the signal voltage✓. (2)
[16]

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QUESTION 5

5.1 5.1.1



Drawing = 2 marks
Labels = 2 marks (4)

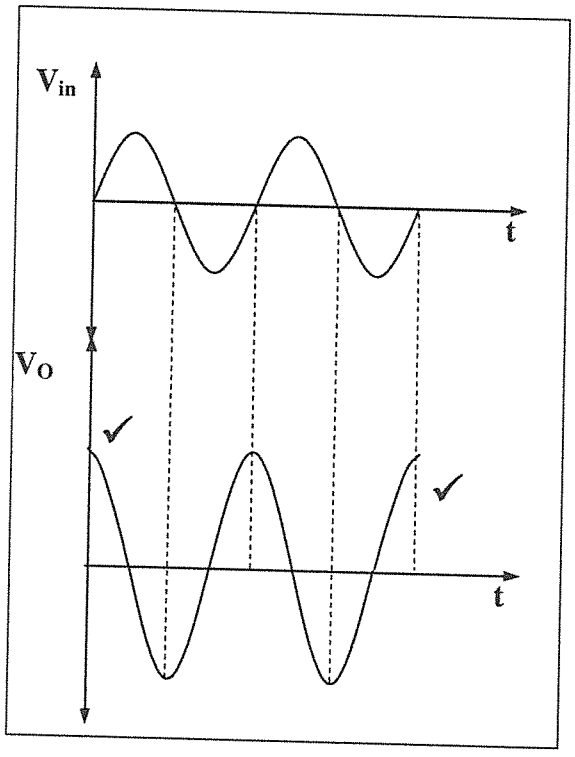
5.1.2 A voltage is generated in a semiconductor junction device ✓ when incident light activates the cell✓. (2)

5.1.3 Light intensity
OR
Solar energy (1)

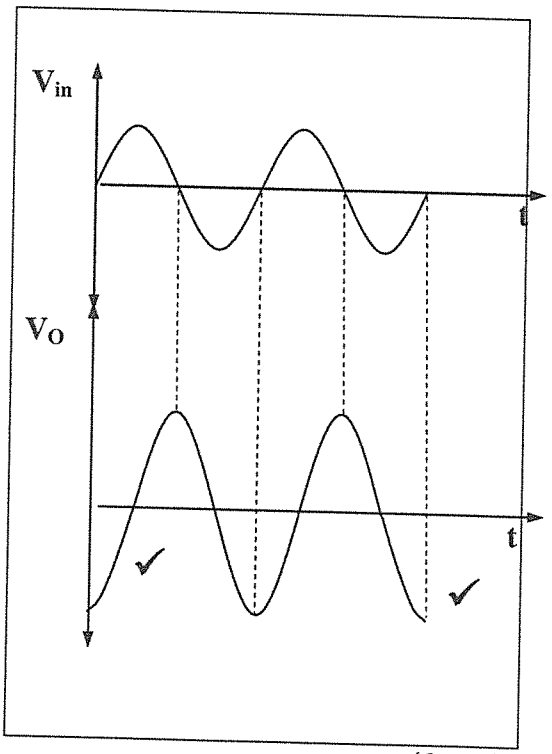
5.2
- Resistive
- Capacitive
- Inductive
- Photo-sensitive
- Piezo-electric

(5)

5.3 5.3.1



5.3.2



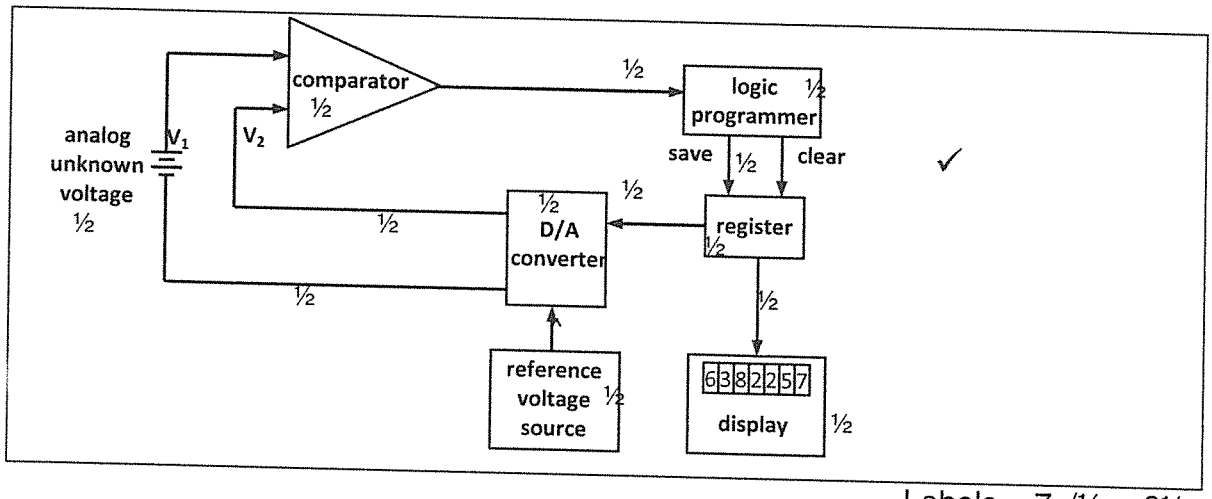
(2 x 2) (4)

[16]

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QUESTION 6

6.1



Labels = 7x/½ = 3½
Drawing = 7x/½ = 3½
Correctness = 1 (8)

6.2 The cathode-ray tube (CRT) produces a sharply focused beam of electrons ✓ and accelerates it to a very high velocity to strike the fluorescent screen with enough energy to light up in a small spot. ✓ (2)

6.3 6.3.1 In a PN-junction diode, the depletion region forms part of the dielectric. ✓ By adjusting the reverse bias voltage ✓ the depletion region widens or narrows moving the electrodes further apart or closer, certain specific values of junction capacitance can be controlled ✓, so that the diode can be used as a capacitor. (3)

6.3.2 When light falls on the PN-junction, ✓electron-hole pairs are created which increases the availability of minority carriers. The minority carriers under reverse-bias conditions cause an increase ✓ in the leakage current. As the light intensity increases, the leakage current increases ✓ and the diode becomes more conductive. (3)

[16]

TOTAL SECTION B: 80
GRAND TOTAL: 100

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