higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N3

6 April 2021

This marking guideline consists of 9 pages.

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SECTION A

QUESTION 1

1.1	1.1.1	C		
	1.1.2	B		
	1.1.3	C		
	1.1.4	B		
	1.1.5	C	(5 × 1)	(5)
1.2	1.2.1	False		
	1.2.2	False		
	1.2.3	True		
	1.2.4	False		
	1.2.5	True	(5 × 1)	(5)
1.3	1.3.1	C		
	1.3.2	A		
	1.3.3	F		
	1.3.4	B		
	1.3.5	E	(5 × 1)	(5)
1.4	1.4.1	Conductors		
	1.4.2	Ionic bond		
	1.4.3	Electrical characteristics		
	1.4.4	Optocoupler		
	1.4.5	Positive feedback	(5 × 1)	(5)
				[20]

TOTAL SECTION A: 20

SECTION B

QUESTION 2

2.1 2.1.1 $Loop1:$

$V = R_1 I_1 + R_2 I_2$ ✓

$24 = 680I_1 + 330I_2 ___(1)$ ✓ (2)

2.1.2 $Loop2:$

$V = R_1 I_1 + R_3(I_1 + I_2) + R_4(I_1 + I_2)$

$24 = 680I_1 + 560(I_1 + I_2) + 680(I_1 + I_2)$ ✓

$24 = 1920I_1 + 1240I_2 ___(2)$ ✓ (2)

2.1.3 $(1)\times 124$

$2976 = 84320I_1 + 40920I_2 __(3)$

$(2)\times 33$ ✓

$792 = 63360I_1 + 40920I_2 __(4)$

$(3)-(4)$

$2976 = 84320I_1 + 40920I_2 __(3)$

$\underline{-792 = -63360I_1 - 40920I_2 __(4)}$ ✓

$2184 = 20960I_1$

$I_1 = \frac{2184}{20960}$

$\underline{I_1 = 0,104A}$ ✓

Replace I_1 in (1):

$24 = 680(0,104) + 330I_2$

$I_2 = \frac{46,72}{330}$

$\underline{I_2 = 0,141}$

= 0,142 A ✓ (4)

2.2 2.2.1 $I_Y = I_2 + I_3$ ✓✓ (2)

2.2.2 $I_X = I_T - (I_1 + I_2 + I_3)$ ✓✓ (2)

2.3 2.3.1 $X_L = 2\pi fL$

$X_L = 2\pi \times 60 \times 10^3 \times 66 \times 10^{-3}$

$X_L = 24,881 \times 10^3 \Omega$

$\underline{X_L = 24,881k\Omega}$ ✓ (1)

2.3.2 $X_C = \frac{1}{2\pi fC}$

$X_C = \frac{1}{2\pi \times 60 \times 10^3 \times 530 \times 10^{-12}}$

$X_C = 5004,872\Omega$

$\underline{X_C = 5,004k\Omega}$ ✓ (1)

2.3.3 $Z = \sqrt{R^2 + \left(X_L - X_C\right)^2}$

$Z = \sqrt{(75\times10^3)^2 + \left(24,881\times10^3 - 5004,872\right)^2}$ ✓

$Z = 77589,049\Omega$

$\underline{Z = 77,589k\Omega}$ ✓ (2)

2.3.4 $I = \frac{V}{Z}$

$I = \frac{120}{77,589\times10^3}$ ✓

$I = 1,547\times10^{-3}A$

$\underline{I = 1,547mA}$ ✓ (2)

2.3.5 $V_C = I.X_C$

$V_C = 1,547\times10^{-3}\times5004$ x10³ ✓

$\underline{V_C = 7,741V}$ ✓ (2)

2.3.6 $V_L = I.X_L$

$V_L = 1,547\times10^{-3}\times24,881\times10^3$ ✓

$\underline{V_L = 38,491V}$ ✓ (2)

2.3.7 $\Theta = \cos^{-1}\frac{R}{Z}$

$\Theta = \cos^{-1}\frac{75\times10^3}{77,589\times10^3}$

$\underline{\Theta = 14,843°}$ ✓ (1)

2.3.8 $f_r = \frac{1}{2\pi\sqrt{LC}}$

$f_r = \frac{1}{2\pi\sqrt{530\times10^{-12}\times66\times10^{-3}}}$ ✓

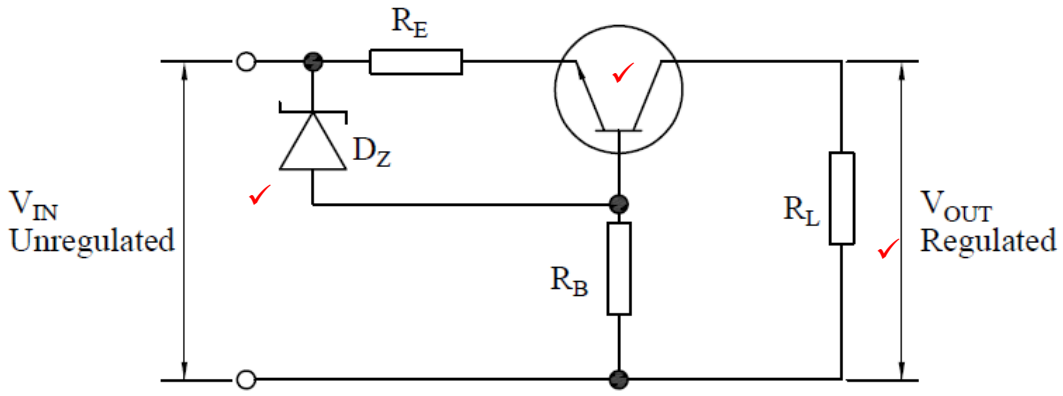
$f_r = 26909,785Hz$

$\underline{f_r = 26,909kHz}$ ✓ (2)

[25]

QUESTION 3

3.1



(3)

3.2 3.2.1

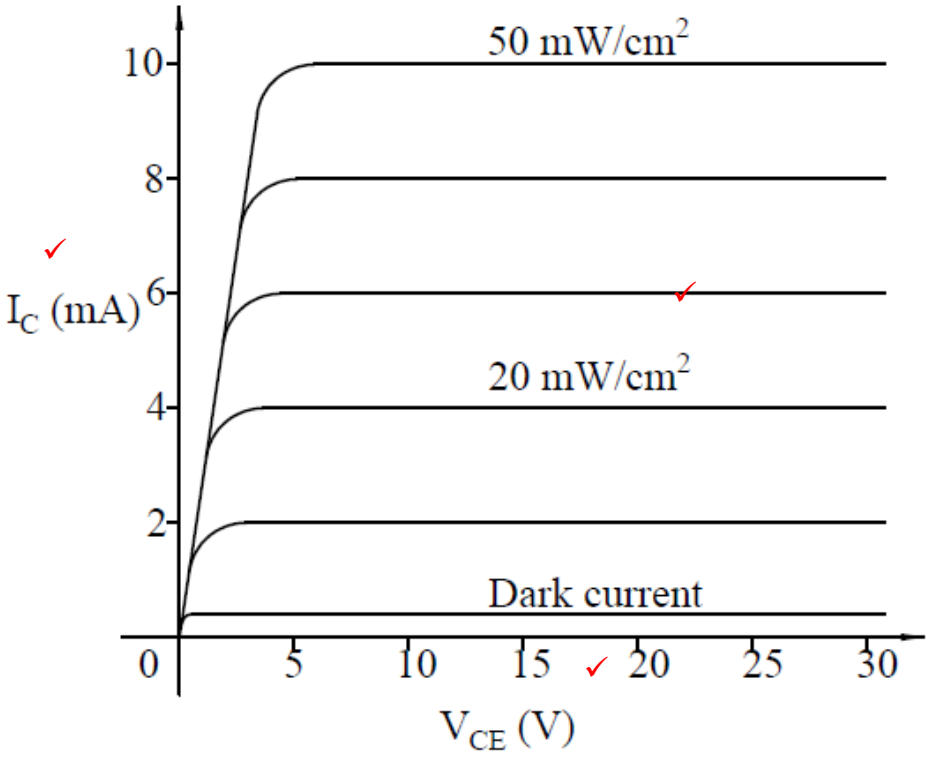
- The bias point is at the cut-off point.
- Only the positive half of the input will show on the output.
- The output is shown as only half of the amplified version of the input. (Any 2 × 1)

3.2.2

- The bias point is below the cut-off point.
- Less than one half of the input is shown on the output.
- The output is shown as less than half of the amplified version of the input. (Any 2 × 1)

(2 × 2) (4)

3.3 3.3.1



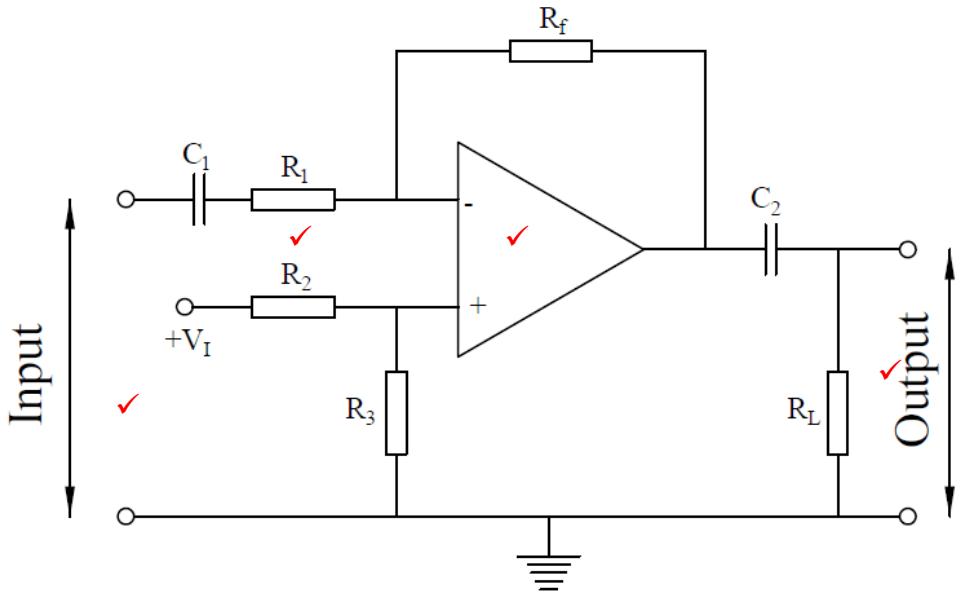
(3)

3.3.2

- The photo transistor Q1 drives the BJT Q2.
- When light falls on Q1, it switches on and drives the base of Q2 into saturation.
- The emitter current through the relay energises it.
- The diode across the relay prevents large voltage transients at the collector of Q2 when the transistor is switched off.

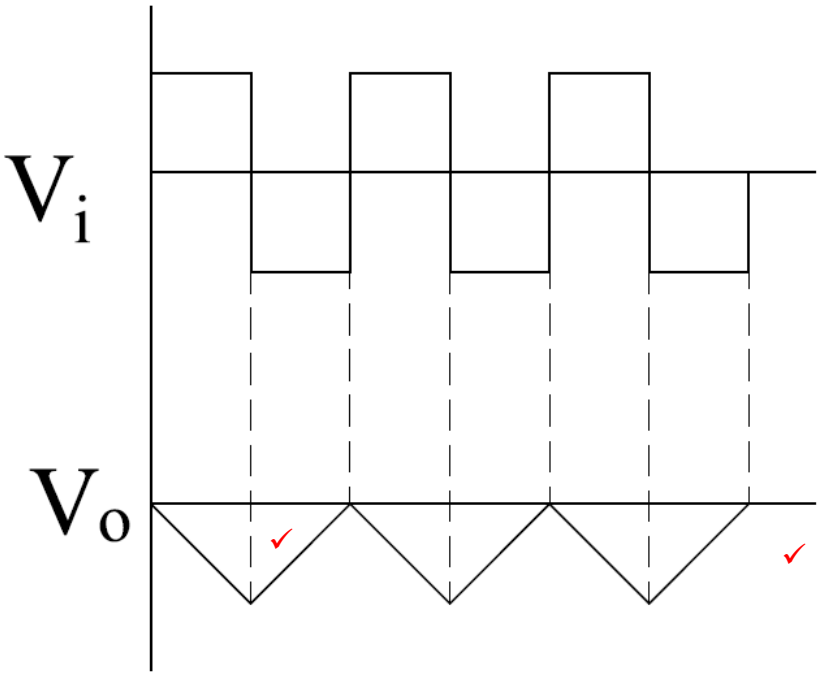
(Any 2 × 1) (2)

3.4



(4)

3.5

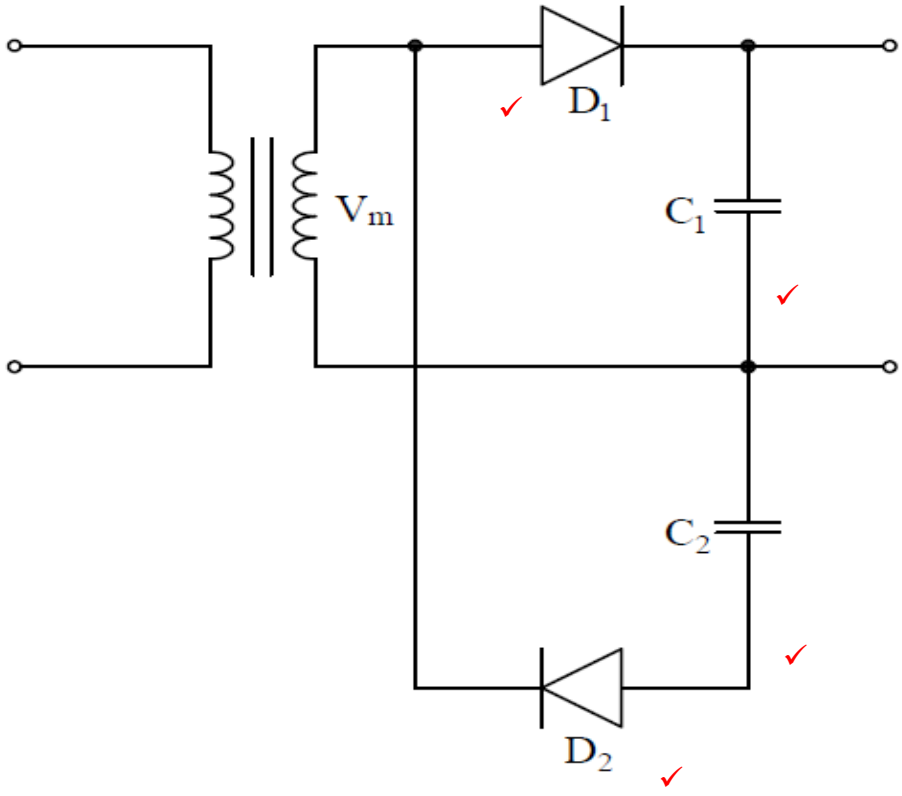


(2)
[18]

One for inversion, the other for form and alignment with Vi

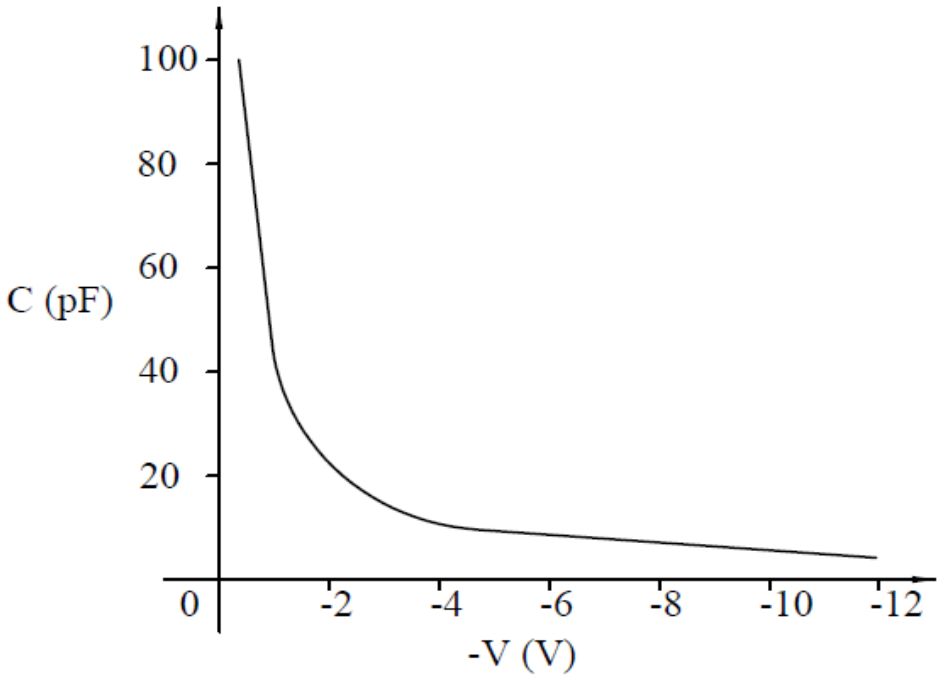
QUESTION 4

4.1



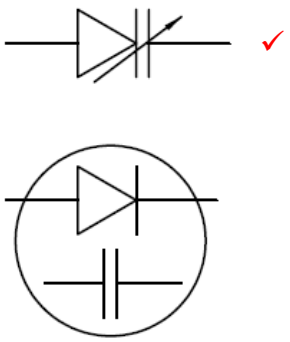
(4)

4.2 4.2.1



(3)

4.2.2



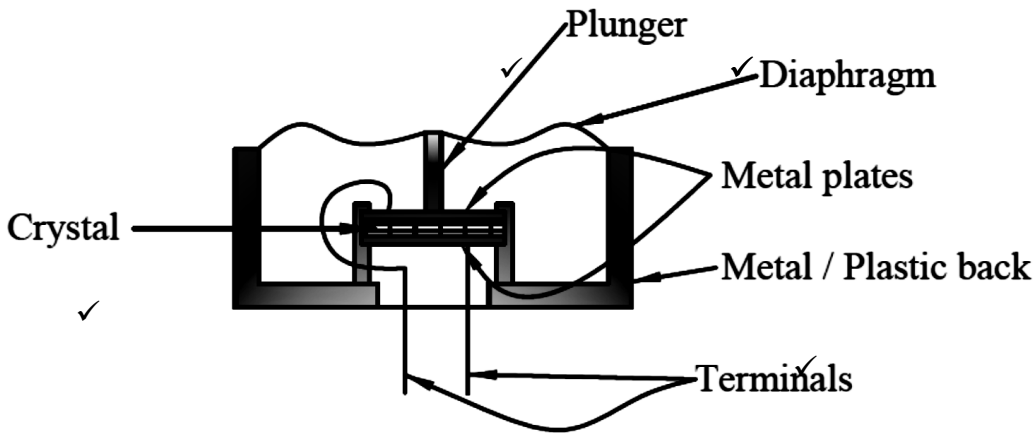
(1)

4.2.3
- Tuning capacitor in televisions
- Variable capacitor in resonant circuits
- Variable capacitor in a band pass circuit (Any ONE) (1)

4.3 The resistance of the photo conductor decreases✓ with the increase in light.✓ (2)

4.4
- The Wheatstone bridge has four resistive arms, connected to a supply and a null detector galvanometer.
- The current through the galvanometer depends on the value of the resistors. If they are equal, no current flows through the galvanometer. (2)

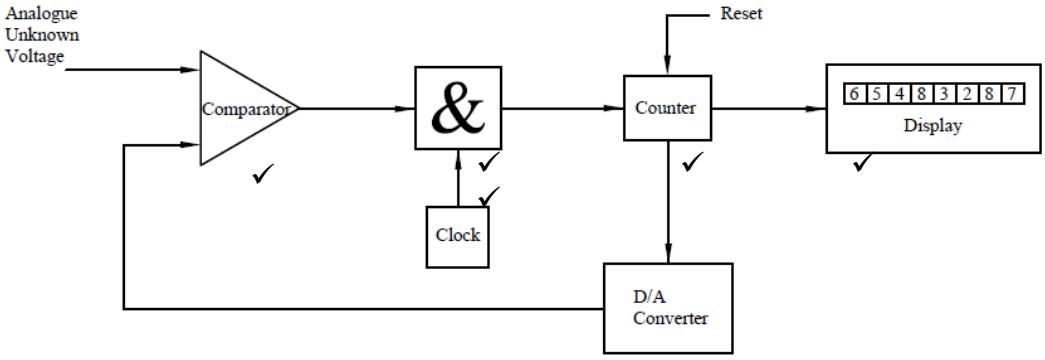
4.5



(4)
[17]

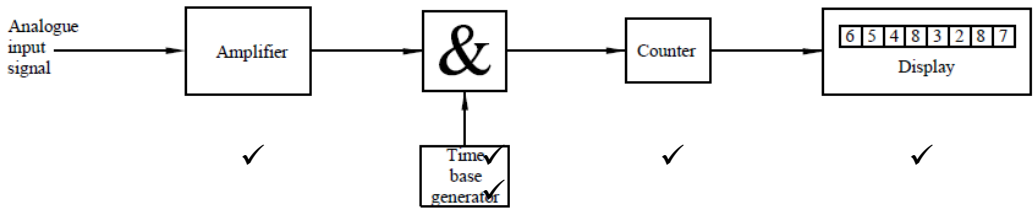
QUESTION 5

5.1



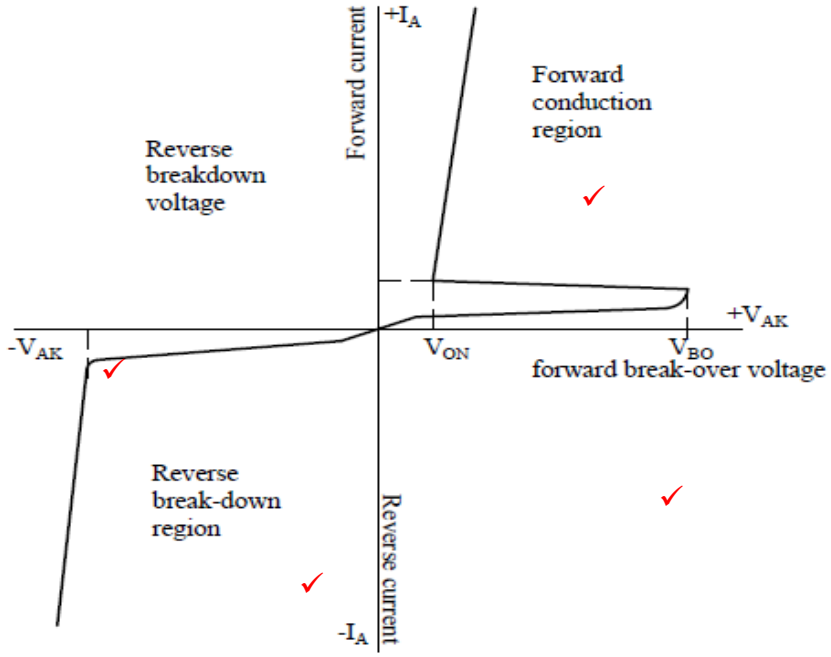
(5)

5.2



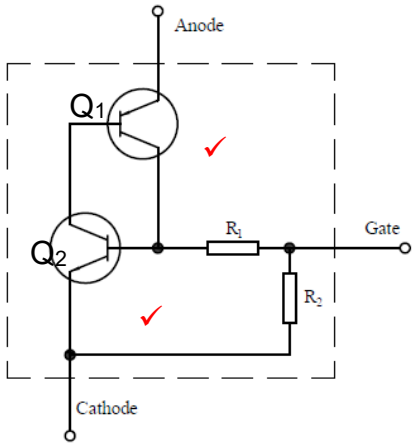
(5)

5.3



(4)

5.4



A positive pulse on the gate forward biases the base emitter junction of Q_2 – collector current of Q_2 begins to flow. ✓
Collector current of Q_2 will switch on Q_1. ✓

- Collectors of both transistors provide enough base voltage to keep both transistors on. (4)

5.5 By using commutation.
OR
Reducing the anode cathode voltage below the minimum holding current. (2)

[20]

TOTAL SECTION B: 80
GRAND TOTAL: 100

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