higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N3

1 April 2020

This marking guideline consists of 12 pages.

SECTION A

QUESTION 1

1.1	1.1.1	A		
	1.1.2	B		
	1.1.3	D		
	1.1.4	B		
	1.1.5	C		
			(5 × 1)	(5)
1.2	1.2.1	True		
	1.2.2	True		
	1.2.3	False		
	1.2.4	True		
	1.2.5	False		
			(5 × 1)	(5)
1.3	1.3.1	D		
	1.3.2	B		
	1.3.3	E		
	1.3.4	A		
	1.3.5	F		
			(5 × 1)	(5)
1.4	1.4.1	MOSFET		
	1.4.2	Differentiator		
	1.4.3	Negative temperature coefficient		
	1.4.4	Leads		
	1.4.5	Forward biased		
			(5 × 1)	(5)
				[20]

TOTAL SECTION A: 20

SECTION B

QUESTION 2

2.1 2.1.1 In Loop ABEFA:

$$V = I_1.R_1 + (I_1 - I_2)R_L + I_1.R_4$$
$$48 = 15I_1 + 5(I_1 - I_2) + 18I_1$$
$$48 = 15I_1 + 5I_1 - 5I_2 + 18I_1$$
$$48 = 38I_1 - 5I_2) \_\_\_\_\_ (1) \quad ✓✓$$

In Loop ABCDEFA:

$$V = I_1.R_1 + I_2.R_2 + I_2.R_3 + I_1.R_4$$
$$48 = 15I_1 + 10I_2 + 7I_2 + 18I_1$$
$$48 = 33I_1 + 17I_2 \_\_\_\_\_ (2) \quad ✓ \quad ✓$$

$$(1) \times 17$$
$$816 = 646I_1 - 85I_2 \_\_\_\_\_ (3) \quad ✓$$

$$(2) \times 5$$
$$240 = 165I_1 + 85I_2 \_\_\_\_\_ (4) \quad ✓$$

$$(3) + (4)$$
$$816 = 646I_1 - 85I_2$$
$$\underline{240 = 165I_1 + 85I_2}$$
$$1056 = 811I_1$$
$$I_1 = \frac{1056}{811}$$
$$\underline{I_1 = 1,302A} \quad ✓$$

$$48 = 38I_1 - 5I_2$$
$$48 = 38.(1,302) - 5I_2$$
$$-I_2 = \frac{48 - 49,476}{5}$$
$$\underline{I_2 = 0,295A} \quad ✓$$

$$I_1 - I_2 = 1,302 - 0,295$$
$$\underline{I_1 - I_2 = 1,007A} \quad ✓$$

(9)

2.1.2 $P = (I_1 - I_2)^2 \times R_L$

$P = 1,007^2 \times 5$ ✓

$\underline{P = 5,070W}$ ✓ (2)

2.2 2.2.1 $X_L = 2\pi.f.L$

$X_L = 2\pi \times 50 \times 25 \times 10^{-3}$ ✓

$\underline{\underline{X_L = 7,854\Omega}}$ ✓

$X_C = \frac{1}{2\pi.f.C}$

$X_C = \frac{1}{2\pi \times 50 \times 45 \times 10^{-6}}$ ✓

$\underline{\underline{X_C = 70,736\Omega}}$ ✓

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

$Z = \sqrt{35^2 + (70,736 - 7,854)^2}$ ✓

$\underline{\underline{Z = 71,966\Omega}}$ ✓ (6)

2.2.2 $I = \frac{V}{Z}$

$I = \frac{220}{71,966}$ ✓

$\underline{\underline{I = 3,057A}}$ ✓ (2)

2.2.3 $Z_{RL} = \sqrt{R^2 + X_L{}^2}$

$Z_{RL} = \sqrt{35^2 + 7,854^2}$ ✓

$\underline{\underline{Z_{RL} = 35,870\Omega}}$ ✓

$V_{RL} = I.Z_{RL}$

$V_{RL} = 3,057 \times 35,87$ ✓

$\underline{\underline{V_{RL} = 109,655V}}$ ✓ (4)

2.2.4 $V_C = I.X_C$

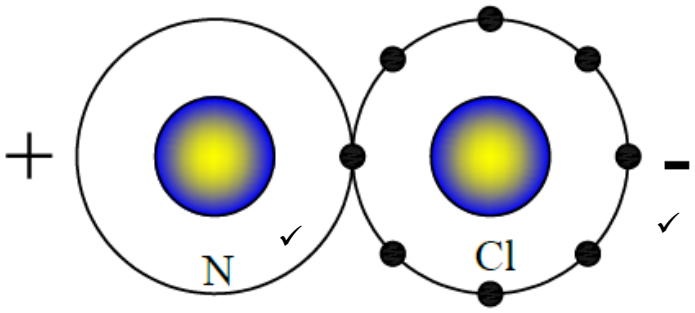
$V_C = 3,057 \times 70,736$ ✓

$\underline{\underline{V_C = 216,240V}}$ ✓ (2)

[25]

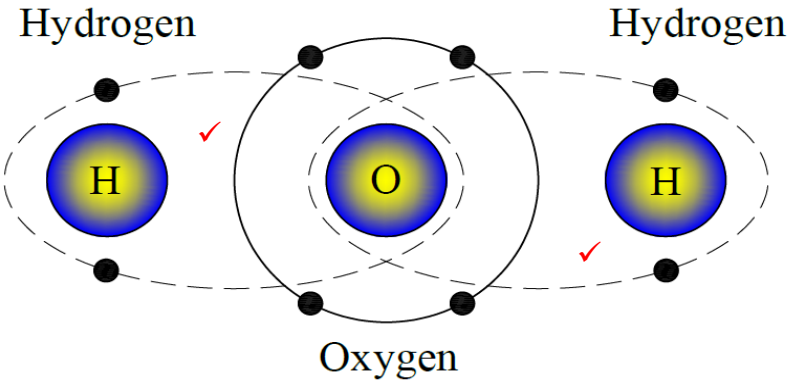
QUESTION 3

3.1 3.1.1



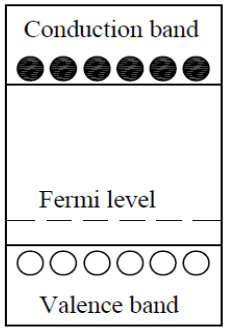
(2)

3.1.2



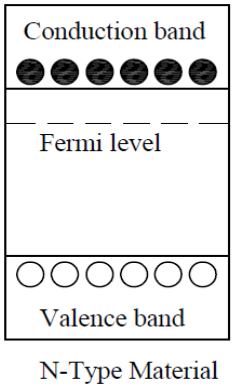
(2)

3.2 3.2.1



(2)

3.2.2



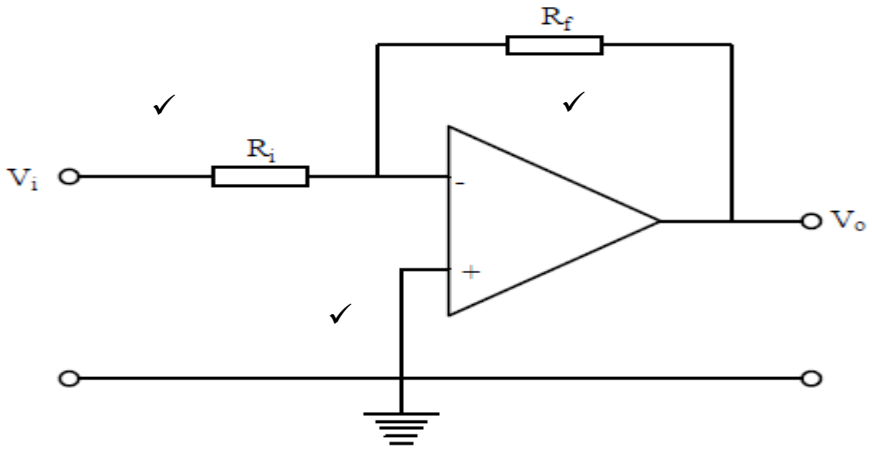
(2)

3.3 3.3.1 Reverse current✓ flowing at specified Zener test current to provide nominal Zener voltage✓ (2)

3.3.2 Specified voltage✓ at a specific test current✓ (2)

3.4 When light falls on the PN-junction electron-hole pairs are created which increase the availability of minority carriers. The minority carrier under reverse-biased conditions causes an increase in leakage current.✓ As the light intensity increases the leakage current increases and the diode becomes more conductive.✓ (2)

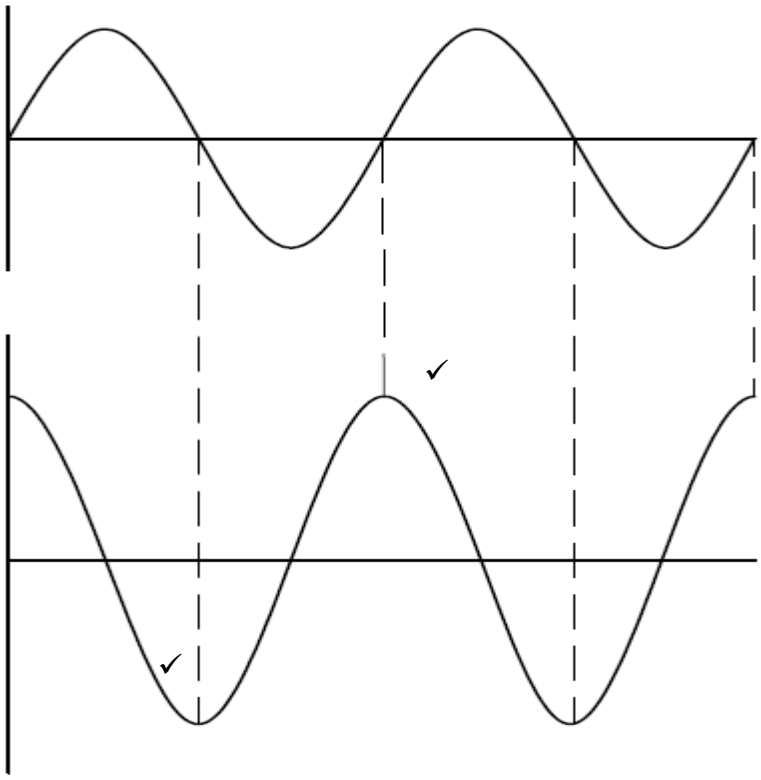
3.5



(3)

3.6 Used for matching high impedance output to low impedance input (1)

3.7



(2)
[20]

QUESTION 4

4.1 4.1.1

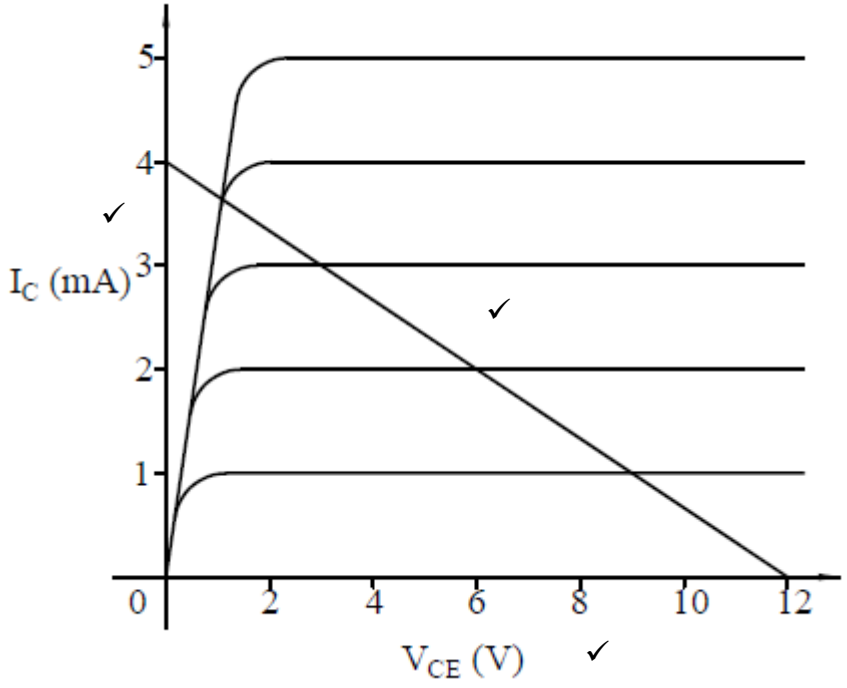
$$I_C = \frac{V_{CE}}{R_C}$$

$$I_C = \frac{12}{3\times10^3} \checkmark$$

$$\underline{\underline{I_C = 4mA}} \checkmark$$

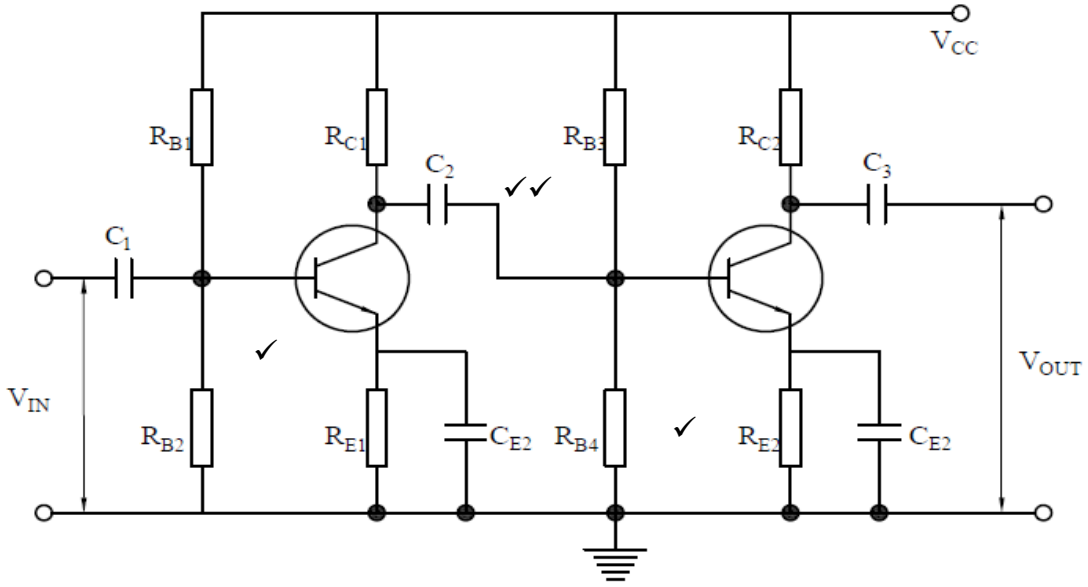
(2)

4.1.2



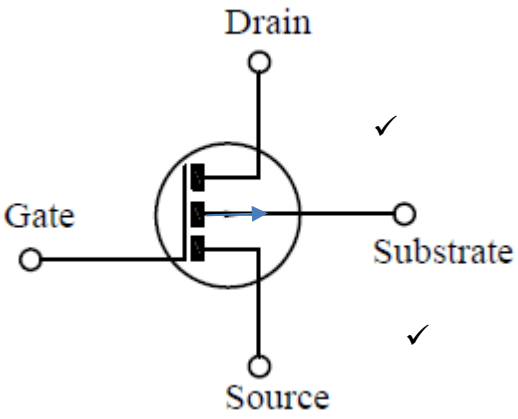
(2)

4.2



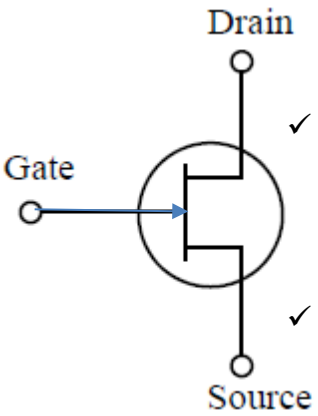
(4)

4.3 4.3.1



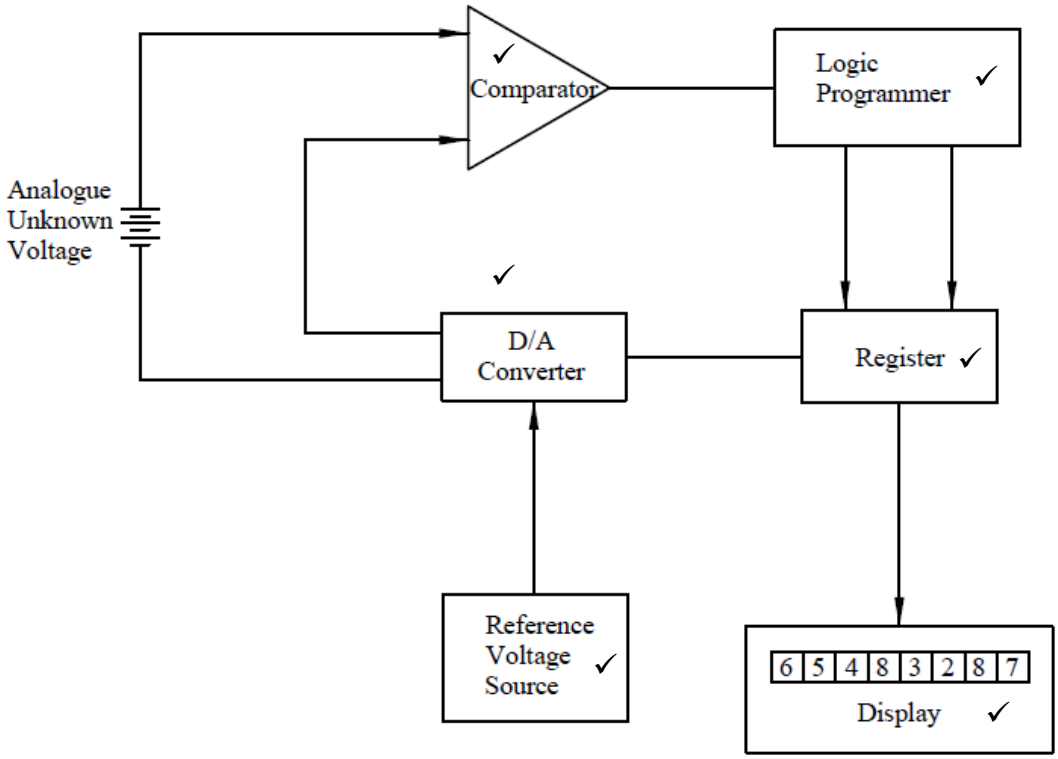
(2)

4.3.2

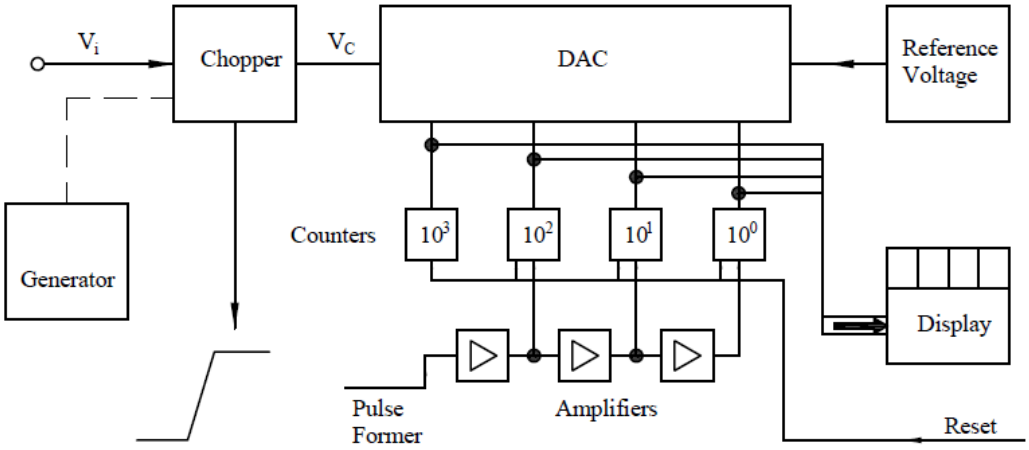


(2)

4.4



OR



(6)

4.5 Deflection plates position the CRT spot✓ anywhere on the screen by simultaneous application of appropriate vertical and horizontal voltage inputs✓ (2)

[20]

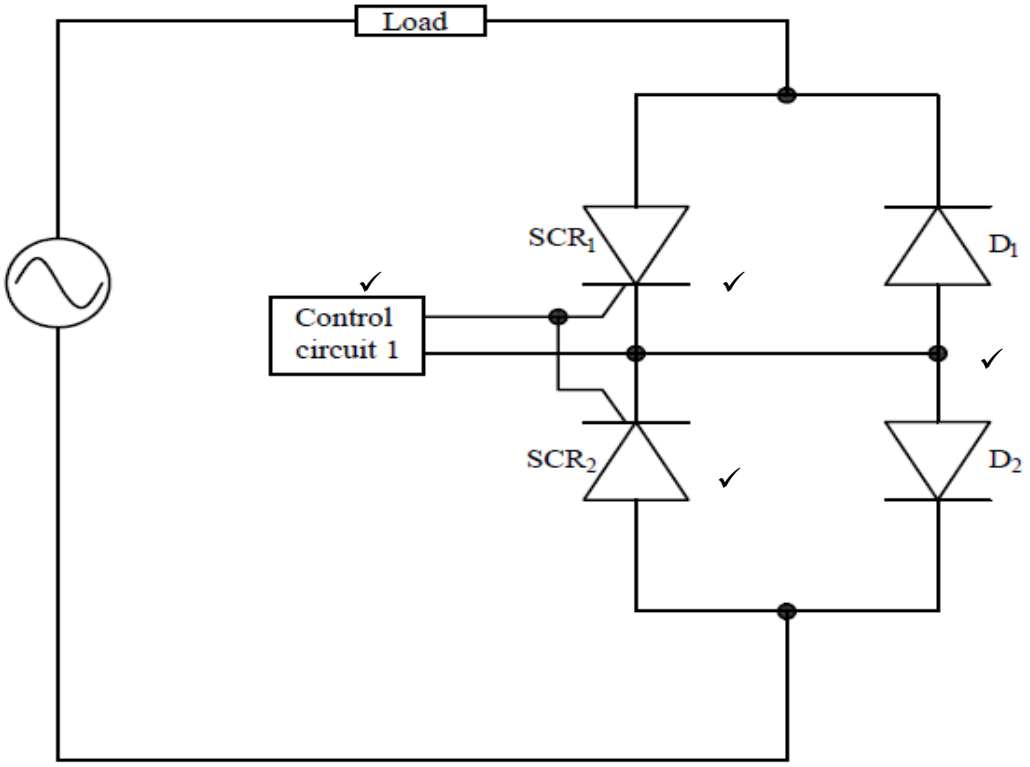
QUESTION 5

5.1 5.1.1 Moving the magnetic core by an externally applied force✓ varies the difference in voltage of the two secondary windings✓ of the transformer. The magnitude of this difference is an indication of the direction & magnitude of applied force.✓ (3)

5.1.2
- Pressure – force
- Displacement – linear movement
- Position – direction of movement (Any 2 × 1) (2)

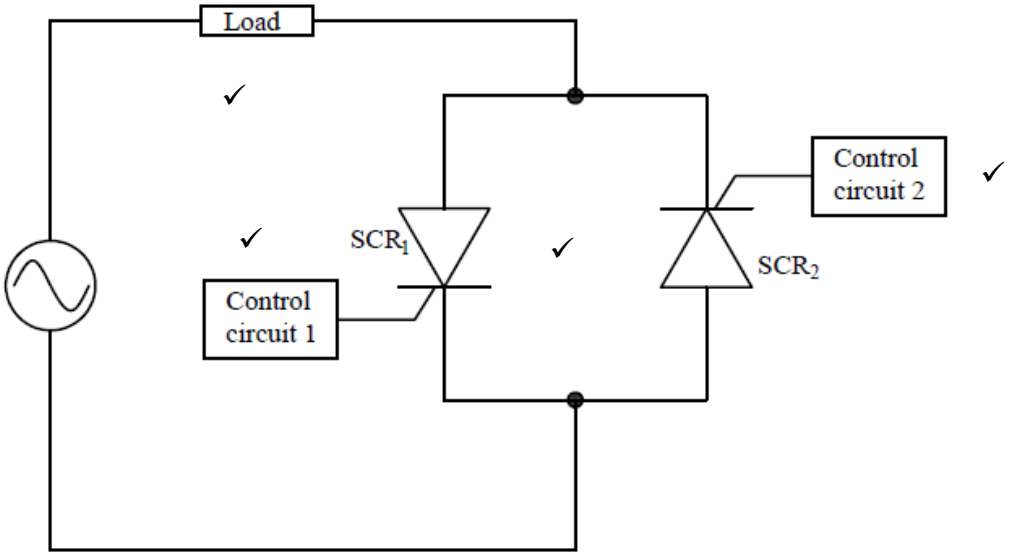
5.2
- Sound – microphones, speakers
- Acceleration – accelerometer
- Pressure changes – force measuring
- Vibration – ultrasonic cleaning (Any 2 × 1) (2)

5.3



OR

(4)



5.4 Voltage goes through zero and reduces the current below the holding current, ✓ forcing the SCR from conduction to OFF-state. ✓ (2)

5.5
- Line commutation
- Forced commutation (2)

[15]

TOTAL SECTION B: 80
GRAND TOTAL: 100