



Province of the
EASTERN CAPE
EDUCATION

**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

NOVEMBER 2018

**ELECTRICAL TECHNOLOGY: DIGITAL
ELECTRONICS
MARKING GUIDELINE**

MARKS: 200

This marking guideline consists of 13 pages.

INSTRUCTIONS TO MARKERS

- 1.1 All questions with multiple answers imply that any relevant, acceptable answer should be considered.
- 1.2 Calculations
 - 2.1 All calculations must show the formulae.
 - 2.2 Substitution of values must be done correctly
 - 2.3 All answers **MUST** contain the correct unit to be considered.
 - 2.4 Alternative methods must be considered, provided that the correct answer is obtained.
 - 2.5 Where an incorrect answer could be carried over to the next step, the first answer will be deemed incorrect. However, should the incorrect answer be carried over correctly, the marker has to recalculate the values, using the incorrect answer from the first calculation. If correctly used, the candidate should receive the full marks for subsequent calculations.
 - 2.6 Markers should consider that candidates' answers may deviate slightly from the marking guidelines, depending on how and where in the calculation rounding off was used.
3. This marking guideline is only a guide with model answers. Alternative interpretations must be considered and marked on merit. However, this principle should be applied consistently throughout the marking session.

QUESTION 1: OCCUPATIONAL HEALTH AND SAFETY

- 1.1 The purpose of the “Occupational Health and Safety Act is:
To provide for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery and equipment. ✓
To establish an advisory council for occupational health and safety. ✓ (2)
- 1.2
- Horseplay ✓
 - Running in the workshop
 - Throwing things
 - Leaving bags, chairs or material in a walkway
 - Spilling a liquid or oil without cleaning it up
 - Purposely leave a workplace untidy or cluttered with tools and junk. (1)
- 1.3
- Faulty tools or equipment ✓
 - Poor quality or missing guards on machinery
 - Congestion in the workshop
 - Poor housekeeping
 - Excessive noise
 - Poor ventilation
 - Lack of knowledge of emergency procedures. (1)
- 1.4 The person doing repairs or maintenance. ✓ (1)
- 1.5 Performing a task with the possibility of something bad happening. ✓ (1)
- [6]**

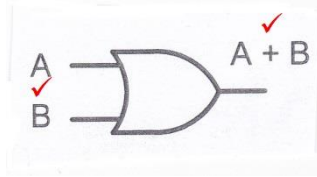
QUESTION 2: TOOLS AND MEASURING INSTRUMENTS

- 2.1 A crimping lug offers a quick and permanent solution of terminating a cable. ✓ (1)
- 2.2 A power tool is any tool that is driven by a power source other than by hand, ✓
in most cases this is by an electric motor. ✓ (2)
- 2.3 The time base generator generates the internal saw tooth waveform to control
the horizontal sweep of the trace. ✓ (1)
- 2.4 Avoid:
- Using tools for jobs they are not intended to do ✓
 - Using excessive force or pressure on tools ✓
 - Cutting towards yourself when using cutting tools
 - Wearing incorrect gloves when operating hand tools (2)
- [6]**

QUESTION 3: LOGICS

3.1 3.1.1 OR gate ✓ (1)

3.1.2



(2)

3.1.3

S ₁	S ₂	Output(Q)
0	0	0 ✓
0	1	1 ✓
1	0	1 ✓
1	1	1 ✓

(4)

3.1.4 $Q = A + B$ ✓✓ (2)

3.2

$$\begin{aligned}
 X &= \bar{A}B\bar{C} + A\bar{B}\bar{C} + A\bar{B}C + \bar{A}B\bar{C} \\
 &= (\bar{A}B\bar{C} + A\bar{B}\bar{C}) + (A\bar{B}C + \bar{A}B\bar{C}) \\
 &= B\bar{C}(\bar{A} + A) + \bar{B}C(A + \bar{A}) \\
 &= B\bar{C} + \bar{B}C \\
 &= \bar{C}(B + \bar{B}) \\
 &= \bar{C}
 \end{aligned}$$

(7)

3.3

C ✓	AB ✓			
	00	01	11	10
0	1 ✓	1 ✓	1 ✓	1 ✓
1 ✓				

(7)

3.4

Inputs		Outputs	
A	B	Sum ✓	Carry ✓
0	0	0	0 ✓
0	1	1	0 ✓
1	0	1	0 ✓
1	1	0	0 ✓

(6)

3.5 3.5.1 $Q_1 = A \cdot B$ ✓ (2)

3.5.2 $Q_2 = A \cdot C$ ✓ (2)

3.5.3 $Q = (A \cdot B) + (A \cdot C)$ ✓ (3)

3.6 Use a relatively high amount of current because transistors 'leak' current even when not in use ✓
Slow operating speed when changing states ✓ (2)

3.7 Benches must be earthed before handling these components ✓
They can be easily destroyed by static electricity ✓ (2)

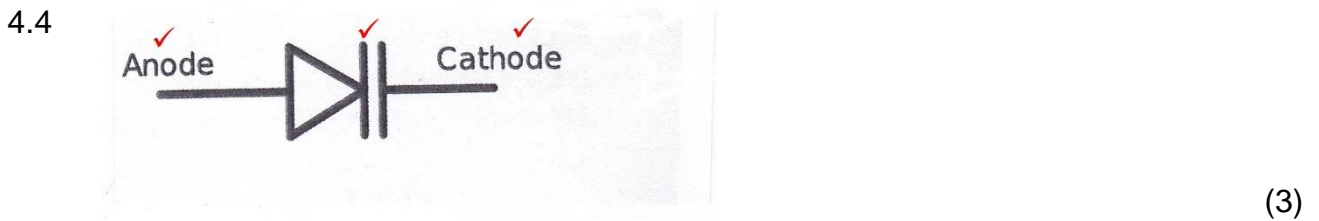
[40]

QUESTION 4: COMMUNICATION SYSTEMS

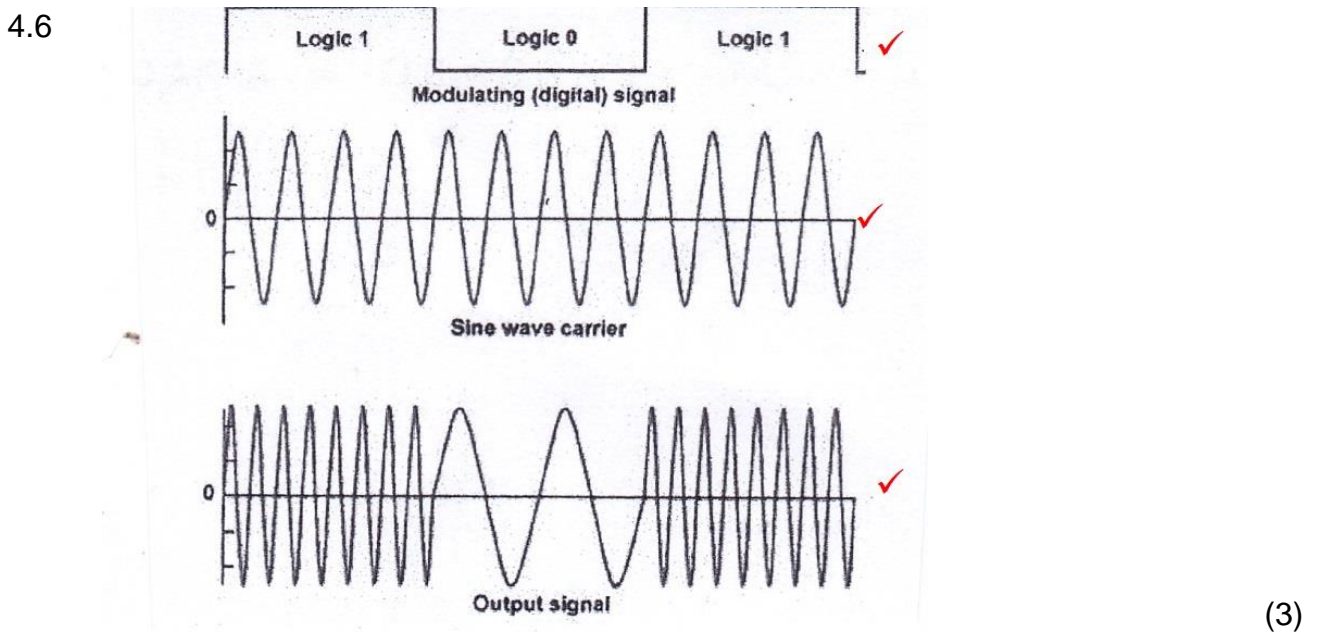
- 4.1
- RC Oscillator ✓
 - Colpitts Oscillator ✓
 - Hartley Oscillator
- (2)

4.2 Single Sideband Suppressed Carrier Modulation (SSB); ✓ SSB is a type of modulation where some of the parts of the ordinary AM are removed ✓ to improve its efficiency. ✓ (3)

4.3 Frequency modulation ✓
Amplitude modulation ✓ (2)

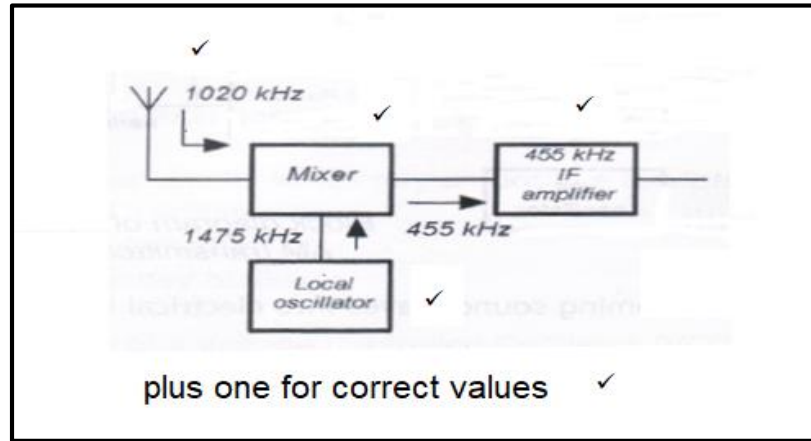


4.5 Phase Locked Loop is an electronic circuit with an oscillator ✓ that constantly adjusts its output frequency ✓ to match the frequency of an input voltage. ✓ (3)



4.7 Resonance occurs when the inductive reactance is equal in magnitude to the capacitive reactance. ✓ This causes the electrical energy to oscillate between the magnetic field of the inductor and the electrical field of the capacitor. ✓ (2)

4.8



(5)

4.9 The main role of a Voltage Controlled Oscillator is to generate ✓ an output frequency that is directly proportional to the input voltage. ✓

(2)

4.10 1 ✓

(1)

[26]

QUESTION 5: RLC

5.1 Impedance is the combined total resistance of all resistors (R) and reactances (X_L or X_C) ✓ in AC circuits ✓ (2)

$$\begin{aligned}
 5.2 \quad 5.2.1 \quad Z &= \sqrt{R^2 + (X_L - X_C)^2} \checkmark \\
 &= \sqrt{60^2 + (110 - 30)^2} \checkmark \\
 &= 100 \Omega \checkmark
 \end{aligned}
 \quad (3)$$

$$\begin{aligned}
 5.2.2 \quad I &= \frac{V}{Z} \checkmark \\
 &= \frac{400}{100} \checkmark \\
 &= 4A \checkmark
 \end{aligned}
 \quad (3)$$

$$\begin{aligned}
 5.2.3 \quad P &= I^2 R \checkmark \\
 &= 4^2 \times 60 \checkmark \\
 &= 960 W \checkmark
 \end{aligned}
 \quad (3)$$

$$\begin{aligned}
 5.2.4 \quad P_a &= I^2 Z \checkmark \\
 &= 4^2 \times 100 \checkmark \\
 &= 1600 VA \checkmark
 \end{aligned}
 \quad (3)$$

$$\begin{aligned}
 5.2.5 \quad PF &= \frac{P}{P_a} \checkmark \\
 &= \frac{960}{1600} \checkmark \\
 &= 0.6 \checkmark \quad \textit{lagging} \checkmark
 \end{aligned}
 \quad (4)$$

5.2.6 If frequency changes the inductive reactance will change ✓ because frequency and inductive reactance are directly proportional to one another ✓ (2)

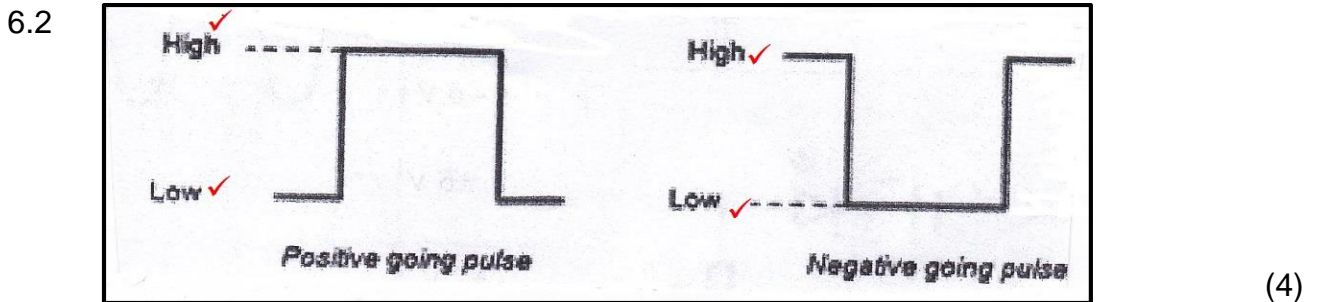
5.4 At the resonant frequency, the two reactances are identical in size but exactly opposite to each other in direction, making $X_L - X_C = 0$. ✓ At this point they cancel each other's effects and the only resistance left in the circuit is the resistance of the resistor. ✓ (2)

5.3 A and B=50 degrees. ✓
C and D=45 degrees. ✓ (2)

[24]

QUESTION 6: WAVEFORMS

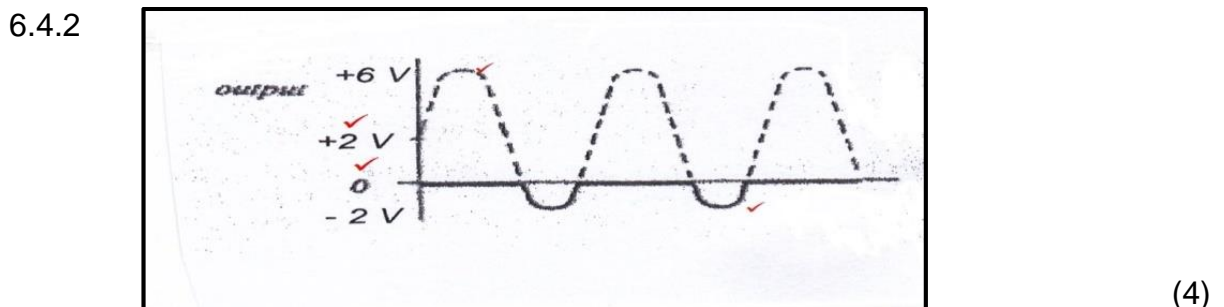
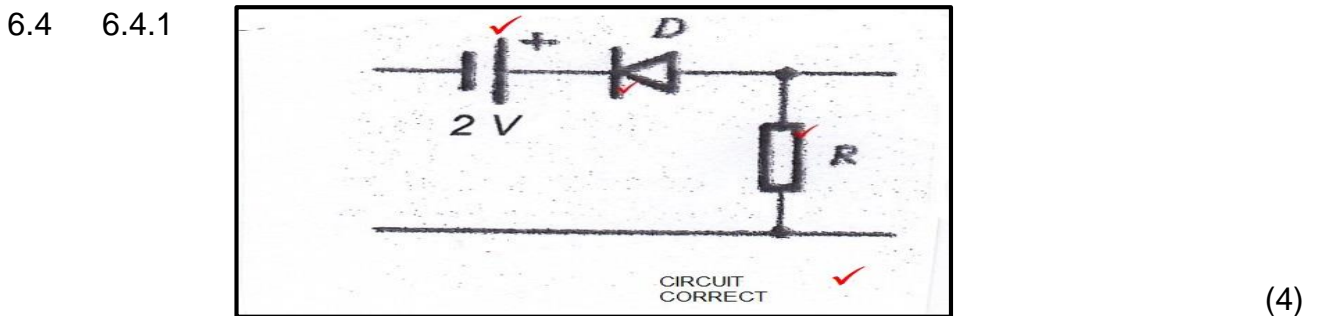
- 6.1 Electric field ✓
Magnetic field ✓ (2)



- 6.3 6.3.1 A cycle is the distance between the beginning and end of one complete sequence of a waveform ✓ including one peak and one trough, measured in seconds. ✓ (2)

- 6.3.2 Wavelength is the distance between one positive peak ✓ and the next. ✓ (2)

- 6.3.3 Peak to peak value is the measurement between the maximum ✓ and the minimum values of a waveform. ✓ (2)



6.5 $V_{rms} = 0,707V_{pk}$
 $V_{pk} = \frac{V_{rms}}{0,707}$ ✓
 $= \frac{9}{0,707}$ ✓
 $= 12,73V$ ✓ (3)

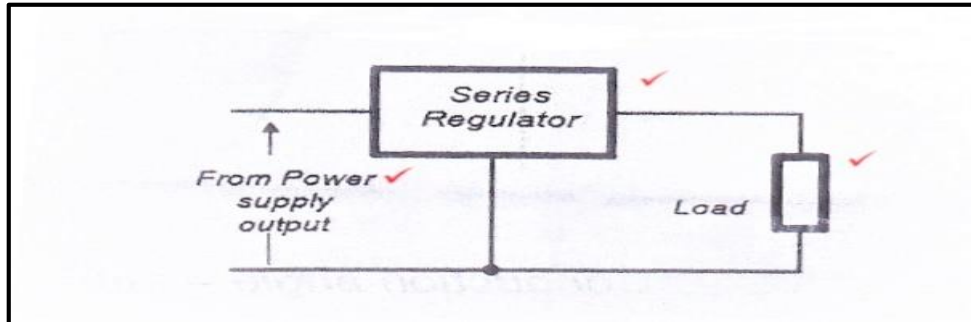
6.6 $T = \frac{1}{f}$ ✓
 $= \frac{1}{500}$ ✓
 $= 0.002sec$ or $2ms$ ✓ (3)

[26]

QUESTION 7: POWER SUPPLIES

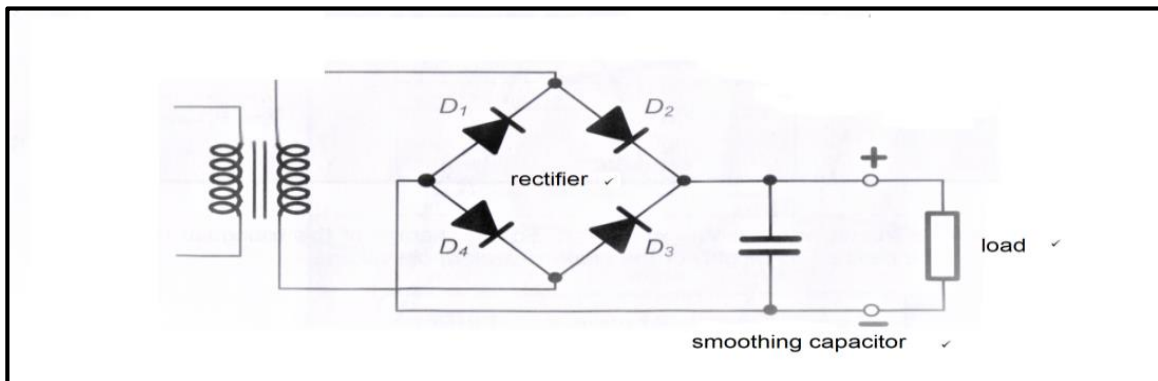
7.1 This circuit converts the lower AC voltage ✓ to a pulsating DC voltage. ✓ (2)

7.2



(3)

7.3



(3)

7.4 LC filter ✓

π filter ✓

Choke filter (L filter)

(2)

7.5 The inductor passes DC voltages ✓ while at the same time blocking AC voltages. ✓

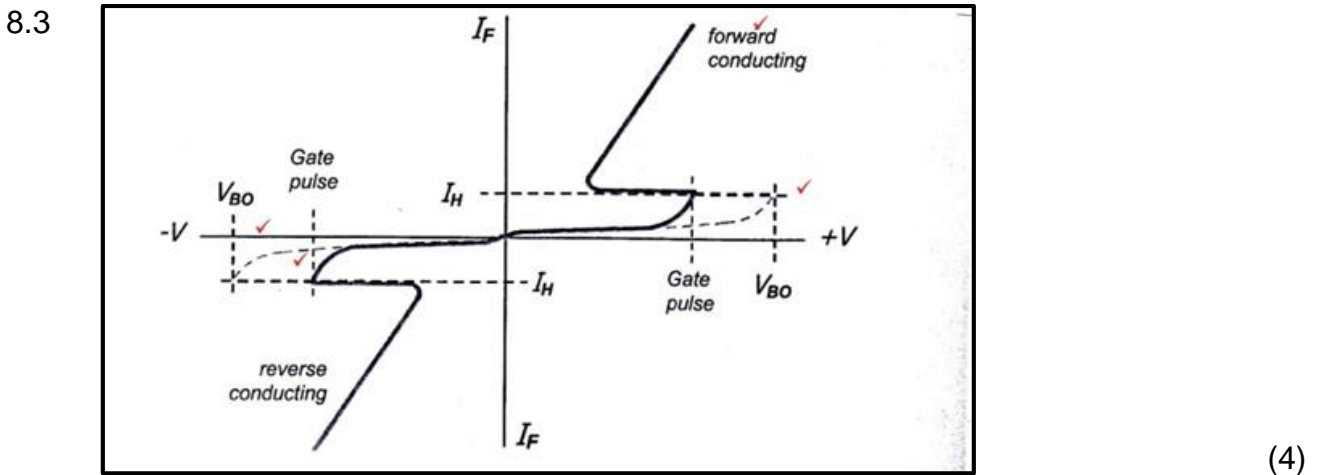
(2)

[12]

QUESTION 8: SEMI-CONDUCTORS

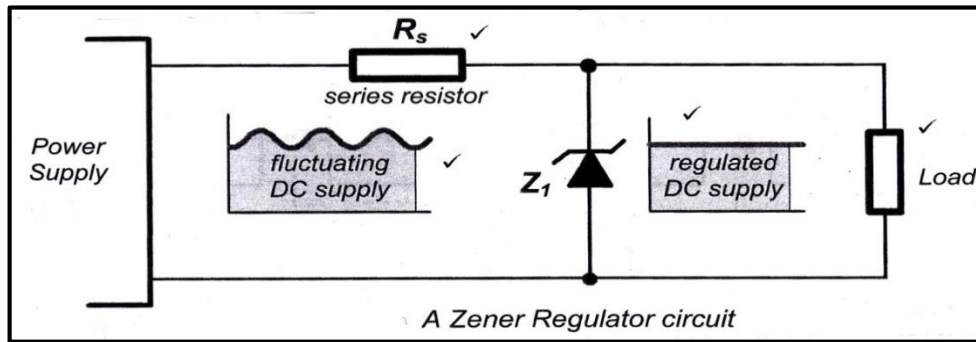
8.1 It is the point of intersection between the diode's characteristic and the circuit load line. ✓ (1)

8.2 The majority carriers in P-type silicon are holes formed when adding impurities. ✓ (1)



8.5 A zener diode has a unique reverse biased operating characteristic ✓ in that it blocks any flow of current when under low reverse voltage ✓ but as soon as the voltage rises to reach its 'zener breakdown', it breaks down and allows a current to flow in the reverse direction without any damage to itself. ✓ (3)

8.6



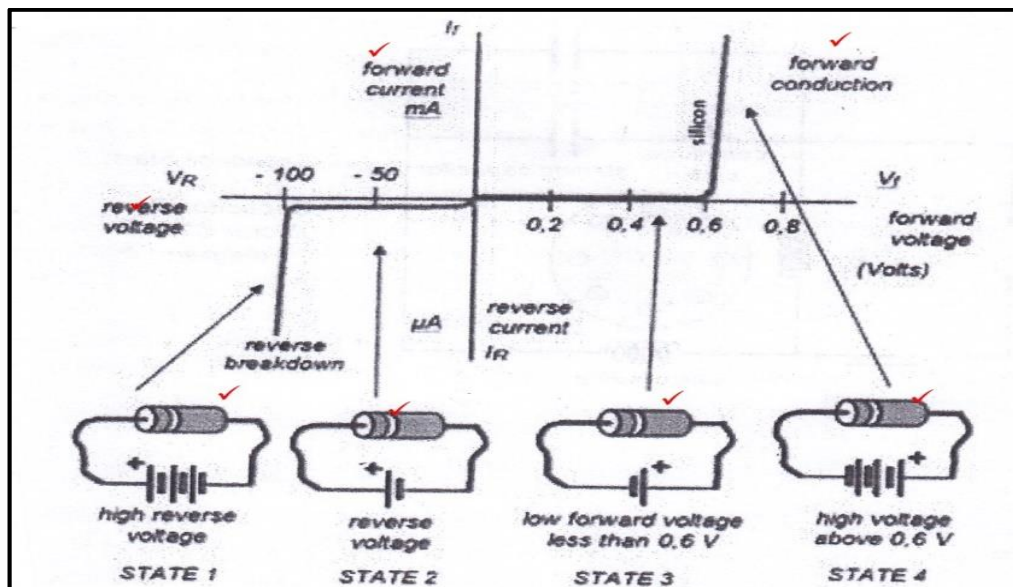
(4)

8.7 8.7.1 Emitter ✓–base ✓ junction needs to be forward biased. (2)

8.7.2 Collector ✓-base ✓ junction should be reverse biased. (2)

8.8 A DIAC (Diode–for-AC) is commonly used to trigger a TRIAC as it breaks down at a precise voltage ✓ so giving the TRIAC a precise triggering voltage in both half-cycles. ✓ (2)

8.9

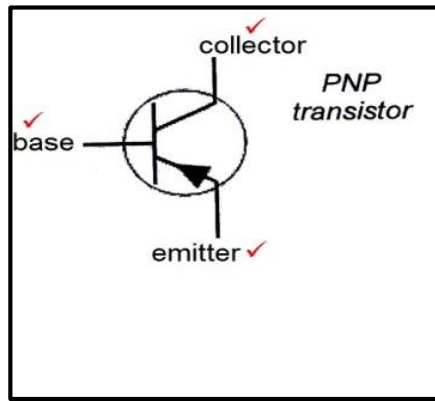


(7)

8.10 8.10.1 Forward bias is when a battery is connected across the PN-semiconductor with its positive lead on the P region and negative lead on the N region, ✓ its terminal voltage will oppose the internal junction voltage-allowing a large current to freely flow across the junction. ✓ (2)

8.10.2 Reverse bias is when a battery is connected across the PN semiconductor with its positive lead on the N region and negative lead on the P region. ✓ Its terminal voltage aids the junction voltage and this leads to the depletion region widening. ✓ (2)

8.11



(3)

8.12 Boron✓
Gallium✓
Indium

(2)

8.13 TRIAC is a bi-directional thyristor which is able to conduct in both directions. ✓
When powered by AC, it will conduct during both half cycles. ✓

(2)

8.14 The usual method of turning an SCR on is by forward biasing the anode-cathode terminals and applying a positive voltage to the gate terminal. ✓
By raising the anode-cathode forward biasing voltage to a large positive level which will force the one reverse biased pn junction to break down. ✓

(2)

[48]

QUESTION 9: SENSORS AND TRANSDUCERS

- 9.1 Electret microphones are widely used in most portable equipment as they are so versatile, examples are: cell phones, ✓ laptop computers, ✓ video cameras and in digital cameras. (2)
- 9.2 Capacitive humidity sensor ✓
Resistive humidity sensor ✓
Thermal conductivity sensor. (2)
- 9.3 9.3.1 A sensor is a device that detects or senses and reacts ✓ to and measures physical quantities. ✓ (2)
- 9.3.2 It is a device which detects objects ✓ without having any physical contact with them. ✓ (2)
- 9.4 9.4.1 It is the ability of certain crystal materials ✓ to generate an electric charge across their opposite faces ✓ when the material is subjected to mechanical stress. ✓ (3)
- 9.4.2 This effect is reversible, that is, if an electric charge is placed across the opposite faces of the material it will stress, bend and flex back and forth. ✓ (1)
- [12]**

TOTAL: 200