higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N2

(8080602)

14 November 2019 (X-Paper)
09:00–12:00

This question paper consists of 6 pages and a formula sheet of 3 pages.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
INDUSTRIAL ELECTRONICS N2
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Write neatly and legibly.

QUESTION 1

Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 The diode act as a ... when forward biased.

A semiconductor
B insulator
C rectifier
D conductor

1.2 A p-type semiconductor is formed by adding ...

A pentavalent atoms.
B trivalent atoms.
C silicon atoms.
D germanium atoms.

1.3 The inductive reactance is directly proportional to the ...

A current.
B voltage.
C resistance.
D frequency.

1.4 A transistor is a three-terminal device that consists of ... PN-junction/s.

A three
B two
C one
D four

1.5 The semiconductor diode is a ... PN-junction device.

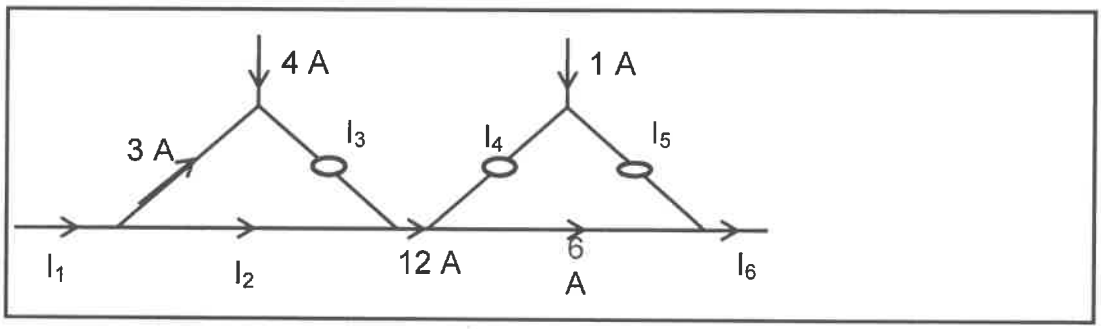
A three-terminal
B two-terminal
C four-terminal
D six-terminal

(5 × 2) **[10]**

QUESTION 2

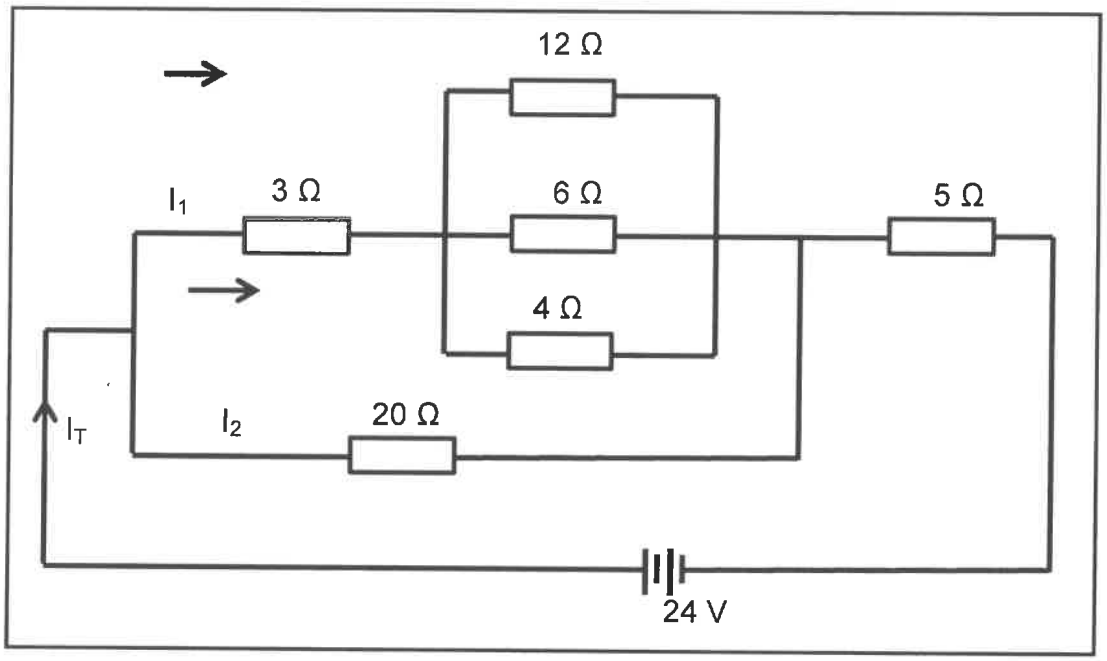
2.1 State Kirchhoff's current law. (2)

2.2 Use Kirchhoff's current law to calculate the unknown currents.



(6)

2.3 Refer to the figure below and calculate the following:



2.3.1 The total resistance of the circuit (5)

2.3.2 The total current in the circuit (3)

2.3.3 The current I_1 (4)

[20]

QUESTION 3

3.1 Define the *RMS value*. (2)

3.2 Given a peak value of 30A, use the following mid-ordinates to determine:

Current (A)	I_1 = 5A	I_2 = 14A	I_3 = 24A	I_4 =22A	I_5 = 10A	I_6 = 3A

3.2.1 The RMS value (3)

3.2.2 The average value (3)

3.2.3 The form factor (1)

3.2.4 The crest factor (1)

3.3 Draw a graphical representation to indicate the relationship between current and voltage in the following:

3.3.1 A pure resistive circuit

3.3.2 A pure capacitive circuit

3.3.3 An inductive circuit

(3 × 2) (6)

3.4 A 300 mH inductor is connected across a 220V/50Hz power supply.

Calculate the following:

3.4.1 The inductive reactance

3.4.2 The current flow through the circuit

(2 × 2) (4)
[20]

QUESTION 4

4.1 Matter is anything that occupies space.

List the FOUR main groups in which matter is divided. (4)

4.2 Name the TWO forces that act on an orbiting electron. (4)

4.3 Draw neat labeled sketches indicating the crystal lattice structure of a silicon or germanium atom for the following:

4.3.1 An N-type material (donor doping) (3)

4.3.2 A P-type material (acceptor doping) (3)

4.4 What is *ionisation*? (2)
[16]

QUESTION 5

5.1 Define a *diode*. (3)

5.2 Draw a neat labeled forward characteristic area of a diode to show the difference between a *germanium* and a *silicon diode*. (5)

5.3 Name and discuss the two ways in which damping can be obtained in measuring instruments. (6)

5.4 A moving-coil meter has a full-scare deflection of 10mA and an internal resistance of 100 Ω.

Calculate the value of a shunt resistor that would enable the meter to measure a current of 100mA. Also draw a circuit to show where this resistor should be connected. (4)
[18]

QUESTION 6

6.1 Calculate the emitter current in an NPN transistor if the collector current measures 96mA and the base current measures 4mA. (2)

6.2 Draw a neat labeled sketch of the common base amplifier using a PNP-transistor. Indicate clearly the input and the output waveform and name one use of the common base amplifier. (8)

6.3 A network has a gain of 100. Express this gain in decibels. (3)

6.4 State THREE important points one needs to consider when selecting a transducer. (3)
[16]

TOTAL: 100

INDUSTRIAL ELECTRONICS N2

FORMULA SHEET

DC THEORY/GS-TEORIE

(i) $V = I \times R$

(ii) $R_T = R_1 + R_2$

(iii) $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$

(iv) $P = V \times I$

(v) $P = I^2 \times \mathrm{R}$

(vi) $P = \frac{V^2}{R}$

AC THEORY/WS-TEORIE

(i) $t = \frac{1}{f}$

(ii) $e = E_m \ Sin\ 2\pi ft$

(iii) $i = I_m \ Sin\ 2\pi ft$

(iv) $\theta = 2\pi ft$

(v) $I_{AVE} = \frac{I_1 + I_2 + I_3}{n}$

(vi) $I_{RMS} = \sqrt{\frac{I_1^2 + I_2^2 + I_3^2}{n}}$

(vii) $V_{AVE} = \frac{V_1 + V_2 + V_3}{n}$

(viii) $V_{RMS} = \sqrt{\frac{V_1^2 + V_2^2 + V_3^2}{n}}$

(ix) $V_{AVE} = V_M \times 0{,}637$

(x) $V_{RMS} = V_M \times 0{,}707$

(xi) Form factor $= \frac{RMS\ value}{AVE\ value}$

(xii) $\text{Crest factor} = \dfrac{Maximum\ value}{RMS\ value}$

(xiii) $\omega = 2\pi f$

(xiv) $X_C = \dfrac{1}{2\pi fC}$

(xv) $X_L = 2\pi fL$

(xvi) $V_T = \sqrt{V_R^2 + V_L^2}$

(xvii) $V_T = \sqrt{V_R^2 + V_C^2}$

(xviii) $V_T = \sqrt{V_R^2 + (V_L \simeq V_C)^2}$

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

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

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

(xxii) $I_T = \dfrac{V_T}{Z}$

(xxiii) $V_C = I_T \times X_C$

(xxiv) $V_R = I_T \times R$

(xxv) $V_L = I_T \times X_L$

(xxvi) $\theta = Cos^{-1}\dfrac{R}{Z}$

(xxvii) $fo = \dfrac{1}{2\pi\sqrt{LC}}$

MEASURING INSTRUMENTS/MEETINSTRUMENTE

(i) $R_{SH} = \dfrac{I_M \times R_M}{I_{SH}}$

(ii) $R_S = \dfrac{V_T}{I_M} - R_M$

TRANSISTORS

(iii) $I_e = I_c + I_b$

DECIBEL RATIOS/DESIBELVERHOUDINGS

(iv) $N = 10 \log \frac{P_0}{P_1}$

(v) $N = 20 \log \frac{I_0}{I_1} + 10 \log \frac{R_0}{R_1}$

(vi) $N = 20 \log \frac{V_0}{V_1} + 10 \log \frac{R_1}{R_0}$

If/As $R_1 = R_0$

(vii) then/dan $N = 20 \log \frac{I_0}{I_1}$

(viii) $N = 20 \log \frac{V_0}{V_1}$

(ix) RESISTANCE/WEERSTAND

$$R = \frac{p\ell}{a}$$

(x) $a = \frac{\pi d^2}{4}$