



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

**T700(E)(M31)T
APRIL EXAMINATION**

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N2

(8080602)

**31 March 2016 (Y-Paper)
13:00–16:00**

This question paper consists of 7 pages and 1 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. ALL the sketches and diagrams must be in pencil, large, clear and neat.
 5. ALL answers with decimals must be rounded off to the third decimal place after the comma.
 6. Write neatly and legibly.
-

QUESTION 1

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (1.1–1.5) in the ANSWER BOOK.

- 1.1 Electrons that orbit the outermost shell of an atom are called valence electrons.
- 1.2 The hydrogen atom is an example of an atom that can exist on its own as a stable element.
- 1.3 Insulators are also called non-conductors or dielectrics.
- 1.4 Free electrons are those electrons that have left the outermost shell a parent atom.
- 1.5 The energy level of any electron is proportional to that electron's distance from the nucleus.

(5 x 1)

[5]**QUESTION 2**

Draw the IEC symbol of each of the following diodes:

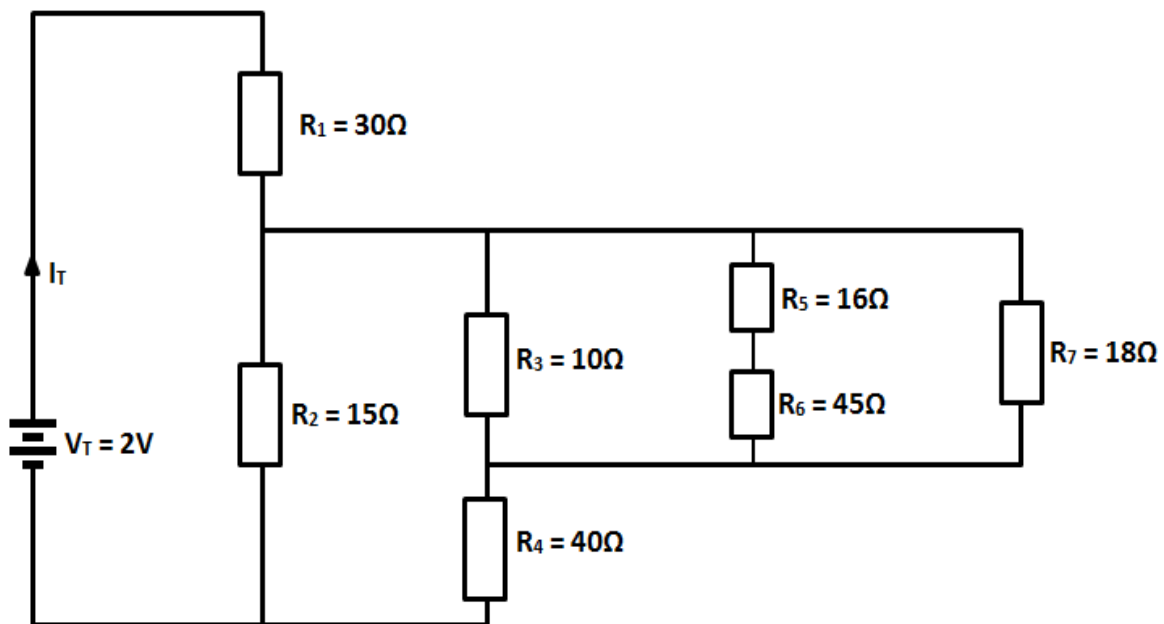
- 2.1 P-N junction semiconductor diode
- 2.2 Zener diode
- 2.3 Varactor diode
- 2.4 Light-emitting diode

(4 x 1)

[4]

QUESTION 3

3.1 Study FIGURE 1 below and answer the questions.

**FIGURE 1**

Calculate:

- | | | |
|-------|-------------------------------|------|
| 3.1.1 | Total resistance R_T | (11) |
| 3.1.2 | Total current I_T | (2) |
| 3.1.3 | The power dissipated in R_1 | (2) |

3.2 Study FIGURE 2 below and then use KCL to calculate the unknown current I_T .

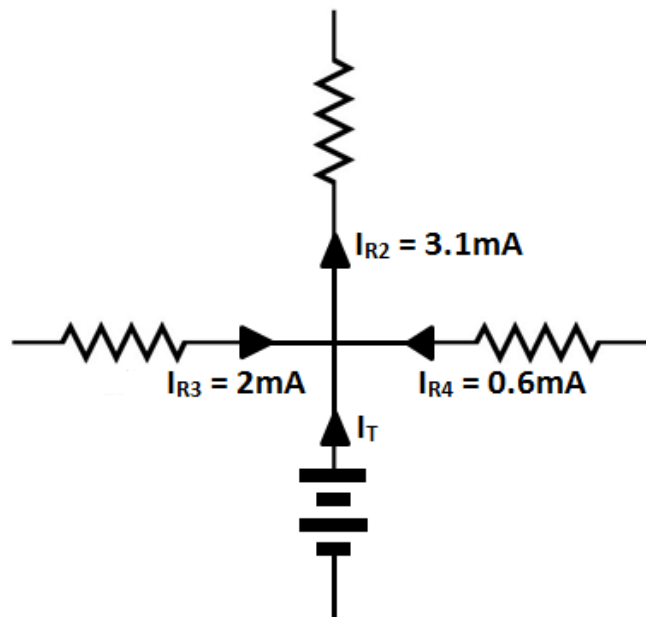


FIGURE 2

(5)
[20]

QUESTION 4

- 4.1 Give the value of the standard frequency supplied by power companies in South Africa as well as the standard voltage supplied for home use. (2)
- 4.2 Define the *form factor* and the *crest factor* of a waveform. (2)
- 4.3 Study FIGURE 3 below and answer the questions.

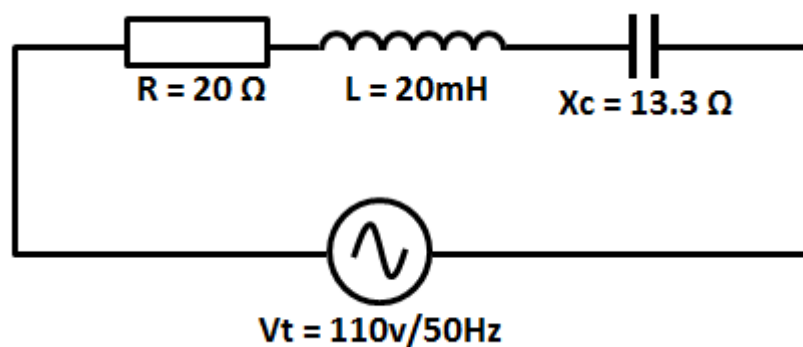


FIGURE 3

Calculate:

- 4.3.1 The value of the capacitor (3)
 - 4.3.2 The inductive reactance (X_L) (2)
 - 4.3.3 The total impedance (Z_T) (3)
 - 4.3.4 The total current (I_T) (2)
 - 4.3.5 The voltage drop across the resistor (V_R) (2)
 - 4.3.6 The voltage drop across the inductor (2)
 - 4.3.7 The phase angle (θ) (2)
- [20]**

QUESTION 5

- 5.1 A moving-coil measuring instrument with a resistance of $5\ \Omega$ gives a full scale deflection of 10 milliamperes.

Calculate:

- 5.1.1 The value of the shunt resistance (R_{SH}) required in order to use the instrument as an ammeter for a 2 A current flow (5)
- 5.1.2 The series resistance (R_S) required to use the instrument as a voltmeter of up to 12 V (3)

- 5.2 Name the TWO methods/means through which the damping process can be facilitated. (2)
- [10]**

QUESTION 6

- 6.1 In terms of the doping process, differentiate between the anode terminal and the cathode terminal of a semiconductor diode. (4)
 - 6.2 Make a neat, labelled circuit diagram of a full-wave bridge rectifier circuit. (6)
- [10]**

QUESTION 7

- 7.1 Make a neat, labelled circuit diagram of an NPN transistor amplifier that is connected in the common collector configuration mode. (5)
- 7.2 Name the output current of a common emitter transistor amplifier and then compare it to the base current of the same amplifier in terms of magnitude. (3)
- 7.3 Name the THREE classes of operation of transistor amplifiers. (3)
- [11]**

QUESTION 8

- 8.1 Describe the operating principle of a thermocouple, by drawing a neat, labelled circuit diagram. Insert a voltmeter in your sketch to indicate a voltage which depends upon the difference in the temperature of the two junctions of the thermocouple. (7)
- 8.2 Describe in detail the difference between negative temperature coefficient and positive temperature coefficient of materials in terms of the resistance of a material. (4)
- 8.3 State THREE advantages of a synchro system over a mechanical system. (3)
- [14]**

QUESTION 9

A 6,6 V input signal to a car audio system produces a current of 5,6 A in a subwoofer speaker system which has an impedance 7,6 Ω . The impedance on the input of the amplifier is 7,6 Ω .

Calculate:

- 9.1 The input power of the amplifier
- 9.2 The output power of the amplifier
- 9.3 The gain of the amplifier
- (3 x 2) **[6]**

TOTAL: 100

INDUSTRIAL ELECTRONICS N2

FORMULA SHEET

DC THEORY

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

AC THEORY

- (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 = $\frac{RMS \text{ value}}{AVE \text{ value}}$

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

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

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

$$(xv) \quad X_L = 2\pi fL$$

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

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

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

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

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

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

$$(xxii) \quad I_T = \frac{V_T}{Z}$$

$$(xxiii) \quad V_C = I_T \times X_C$$

$$(xxiv) \quad V_R = I_T \times R$$

$$(xxv) \quad V_L = I_T \times X_L$$

$$(xxvi) \quad \theta = \cos^{-1} \frac{R}{Z}$$

$$(xxvii) \quad f_0 = \frac{1}{2\pi\sqrt{LC}}$$

MEASURING INSTRUMENTS

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

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

TRANSISTORS

$$(iii) \quad I_e = I_c + I_b$$

DECIBEL RATIOS

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

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

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

If/As $R_1 = R_0$

$$(vii) \quad \text{then } N = 20 \log \frac{I_0}{I_1}$$

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

(ix) **RESISTANCE**

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

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