education

Department:
Education
REPUBLIC OF SOUTH AFRICA

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NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N2

(8080602)

23 March (X-Paper)
09:00 – 12:00

This question paper consists of 5 pages, 1 diagram sheet and a 3-page formula sheet.

DEPARTMENT OF EDUCATION
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 correctly according to the numbering system used in this question paper.
4. Rule off on completion of each question.
5. Use only IEC symbols and units throughout.
6. ALL sketches must be neat, using a pencil and a ruler and NOT freehand.
7. NO red or green ink may be used.
8. Use π as 3,142 and NOT $\frac{22}{7}$.
9. 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 - 1.10) in the ANSWER BOOK.

1.1 Protons move about the nucleus of an atom in paths called shells.

1.2 When electrons are added to an atom, we get a cation.

1.3 Electrons move from the positive terminal through a load to the negative terminal of a power supply.

1.4 Ohm's law states that the voltage will increase when the current decreases and the resistance is kept constant.

1.5 The total resistance in a circuit increases when resistances are connected in parallel.

1.6 For a pure sine wave, the crest factor will be equal to a factor of 1,414.

1.7 At resonance, the impedance Z=R in the series RLC circuit.

1.8 The voltmeter has a very high internal resistance.

1.9 The photodiode's conductivity increases in the reverse bias region with an increase of light intensity.

1.10 In the PNP common emitter transistor amplifier, the positive of the supply is connected to the emitter. **[10]**

QUESTION 2

2.1 A conductor has a length of 1,5 m and resistivity of 0,001 5 μΩ.m. The conductor is a square and the one side measures 0,1 mm. Determine the resistance of the conductor. (3)

2.2 Refer to FIGURE 1 (DIAGRAM SHEET attached) and calculate the following:

2.2.1	The current I_2	(3)
2.2.2	The current I_1	(2)
2.2.3	The voltage V_3	(2)
2.2.4	The voltage V_4	(2)
2.2.5	The current I_3	(2)
2.2.6	The total current of the circuit I_t	(2)
2.2.7	The total resistance of the circuit R_t	(2)
		[18]

QUESTION 3

A series circuit consists of a resistance R= 20 Ω; the X_L = 30 Ω and the X_C = 60 Ω.
The current in the circuit is 2 A.

Calculate the following:

3.1	The voltage drop over R	(1)
3.2	The voltage drop over L	(2)
3.3	The voltage drop over C	(2)
3.4	The supply voltage	(4)
3.5	The phase angle	(2)
3.6	The crest factor	(4)
3.7	The form factor	(2)
		[17]

QUESTION 4

4.1 State the main difference in working principle of the analog and digital multimeters. (2)

4.2 Give THREE advantages of the digital multimeter in relation to the analog meter. (3)

4.3 The basic movement of a meter can read 10 volts and 1 mA.
Calculate the following:

4.3.1 The internal resistance of the meter (2)

4.3.2 The external resistance to increase the full scale to 1 000 volts (3)

4.3.3 Draw a labelled circuit diagram indicating the meter in QUESTION 4.3.2 above.
NOTE: You MUST show all the components and their values, as well as all relative voltage values. (3)
[13]

QUESTION 5

5.1 Draw a neat, labelled circuit diagram indicating a full wave, low voltage and power supply. The following must be indicated:

A centre-tap on the secondary side of the transformer, a couple of diodes, a resistor as a load and a component to filter most of the ripples. Indicate also the electron flow and the polarities over the load in the secondary part of the circuit. You must also show the relevant waveforms before and after the rectifier as well as the final output wave form. (10)

5.2 Choose the correct word(s) from those given in brackets. Write only the word(s) next to the question number (5.2.1 - 5.2.6) in the ANSWER BOOK.

5.2.1 The most widely used elements to make the N-type semiconductors are (gold/phosphorus) and (silicon/lead). (2)

5.2.2 The anode of a photo-diode must be connected to the (positive/negative) of the supply when it works as a light detector. (1)

5.2.3 The input-output-waveform in the common collector circuit are (90°/180°/360°) out of phase. (1)

5.2.4 A PNP germanium transistor has (three/two) junctions and three terminals. (1)

5.2.5 A transistor can act as an amplifier because the current in the (collector/base) can be controlled by a much smaller current in the (emitter/base). (2)

5.2.6 The base current in a common emitter amplifier is (0 mA/4 mA/5 mA) when the emitter current is 150 mA and the collector current is 146 mA. (1)
[18]

QUESTION 6

6.1 Describe briefly, by using labelled sketches, the difference between a bimetallic strip and a thermocouple transducer. (5)

6.2 Draw labelled circuit diagram symbols of the LDR and the photo diode. Briefly describe the main differences between them and the working principle of each. (5)
[10]

QUESTION 7

A transmission line has an impedance of 300 Ω. At the end of the line, a voltage of 25 V is measured. Calculate the input voltage if the gain of the line is 40 dB. **[5]**

QUESTION 8

8.1 Define Lenz's law. (3)

8.2 Define a synchro system. (3)

8.3 Give THREE advantages of a synchro system with reference to a mechanical system. (3)
[9]

TOTAL: 100

DIAGRAM SHEET

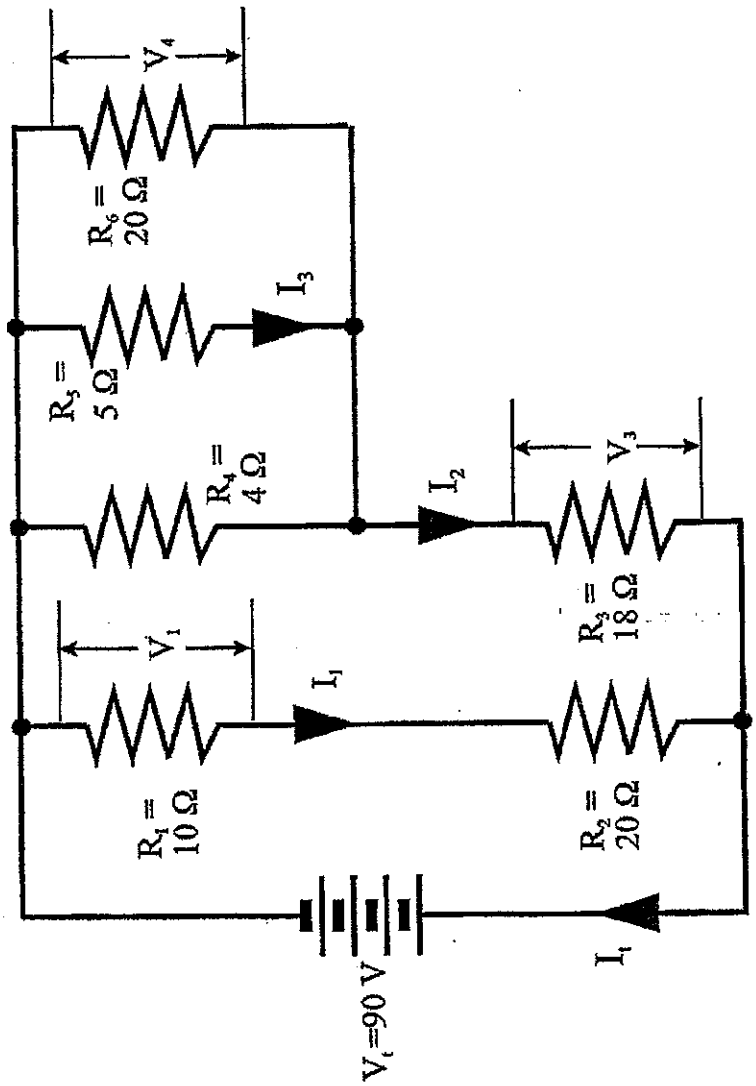

FIGURE 1

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 $= \frac{RMS \ value}{AVE \ value}$

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

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

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

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

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

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

(xi) Vormfaktor $= \frac{WGK - waarde}{GEM \ waarde}$

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

Kruinfaktor = $\frac{Maksimum\ waarde}{WGK - waarde}$

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

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

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

(xxiii) $V_C = I_T \times X_C$

(xxiv) $V_R = I_T \times R$

(xxv) $V_L = I_T \times X_L$

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

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

MEASURING INSTRUMENTS/MEETINSTRUMENTE

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

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

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

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

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